Challenges to Promote Science & Technology for Socio-Economic Development in OIC Countries

Conference Proceedings

Adnan Badran
Najwa Daghestani
Editors

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CHALLENGES TO PROMOTE SCIENCE & TECHNOLOGY FOR SOCIO-ECONOMIC DEVELOPMENT IN OIC COUNTRIES

Proceedings of the 24th IAS Science Conference on
Challenges to Promote Science & Technology for Socio-Economic Development in OIC Countries

Organized in Karachi - Pakistan
7-8 March 2023

Edited by

ADNAN BADRAN
NAJWA F. DAGHESTANI

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EDITORS

Prof. Adnan Badran is the Chancellor of the University of Petra and the Chairman of the Board of Trustees of the University of Jordan. He is a biologist with over 166 papers presented, and 46 books, 64 research papers published and 4 patents.
Badran was Prime Minister (2005), Minister of Agriculture (1989) and Minister of Education (1989) in Jordan. He was Senator and Chair of the Senate Committee on Science, Education and Culture (2006-2010). He also served as Deputy Director-General of UNESCO (1994-1998) and Assistant Director General for Science, Paris (1990-1994). Founding President of Yarmouk University and Jordan University of Science and Technology (1976-1986), President of Philadelphia University (1998-2005) and President of University of Petra (2007-2014), and Dean of the Faculty of Sciences at the University of Jordan (1971-1976). Secretary General (1986-1987) and Vice-president (2014-) of the Higher Council for Science and Technology, Jordan. President of the National Centre of Human Rights, Jordan (2008-2011) and President of the Asia-Pacific Forum on Human Rights, Sidney (2009-2011). Member of the Board of Trustees of the Arab Thought Forum (2012-). He is a Fellow and former Vice-president of the Academy of Sciences for the Developing World (TWAS), Fellow of the Islamic World Academy of Sciences (IAS) and President of the Arab Academy of Sciences. Chairman of the Board of the Arab Forum for Environment and Development in Beirut (2008-). President of the Higher Council of the National Centre for Curriculum development (2017-2019) and Chairman of Shoman Trust Fund for Research (2019-). Member of the Board of Trustees of the King Abdullah Ibn Al Hussein Award for Innovation (2020-). Member of the selection committee of Al-Hassan bin Talal Award for Scientific Excellence (2021-). Member of the Board of Trustees of the annual award in the name of Prince Muhammad Bin Fahd University for the best scientific production (Association of Arab Universities 2022-), President of Islamic World Academy of Sciences (2022-), and Vice President of Arab Peace Group (2022-).

Najwa F. Daghestani is currently the Programs Manager at the Islamic World Academy of Sciences (IAS). She earned her Master of Business Administration (MBA) from the German Jordanian University, Jordan, and her BSc in Computer Science from Princess Sumayya University, Jordan.

She works on organizing conferences and workshops, editing proceedings, newsletters and various papers and documents and acts as a liaison with international and national organizations and institutions.

She previously worked at the Royal Scientific Society as an Applications Programmer.

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Some of the participants in the 24th IAS Conference, 7 - 8 March 2023, Karachi, Pakistan.

PREFACE

The Organization of Islamic Cooperation (OIC) was founded in 1969 as an organization grouping Islamic countries. In 1981, the heads of state of the OIC decided to establish a number of specialized organs to enhance co-operation between the OIC-Member countries in the fields of culture, trade and science and technology. The science and technology role was assigned to the Islamabad-based COMSTECH; the Ministerial Standing Committee on Scientific and Technological Co-operation. In 1984, the heads of state of the OIC approved the launch of the Islamic World Academy of Sciences (IAS) as an independent autonomous S&T Think Tank of the OIC to be based in Amman, Jordan. Some of the issues that the IAS has been concerned with since its launch has been bridging the divide that has historically existed between the science community and the decision-making community in OIC-Member countries. Moreover, as an advocate for science, the IAS has always viewed science and technology – including the history of science – as an enterprise that can contribute to bridging divides between cultures and civilizations and has established itself as an active and vibrant player in the domain of science and technology promoting the values of science across the Islamic world. It executes its mission through programs emphasizing knowledge sharing, networking and capacity building, and sustaining stakeholder engagement. In this respect, the Academy advocates the scientific community's points of view in all facets of developmental processes. Its contribution is communicated to decision-making bodies at OIC, national or international levels. Among its many objectives, the IAS strives to fulfill its mission through many activities and initiatives such as conferences, webinars and workshops.

Scientific advances and technological change are important drivers of economic performance. The ability to create, distribute and exploit knowledge has become a major source of competitive advantage, wealth creation and improvements in the quality of life. Often, access to science and technology and its benefits are unevenly distributed resulting in broad inequities and social and economic gaps. Therefore, it is imperative that science and technology is directed towards meeting the basic needs of society, and contribute to having better access to the outcomes of science and technology which in turn will help reduce inequities and elevate the socio-economic status of the people and the country.

Science is universal and it's the cornerstone of creating knowledge to be turned into technology and innovation. IAS provides a platform for exchanging scientific information and sharing it for development and self-reliance.
The main purpose of socio-economic development is to maintain the social and material well-being of a nation and its people with the aim of achieving the highest

possible level of human development and dignity. It is a progressive support of a country's qualitative and quantitative dimension, to achieve a high level of efficiency, well-being and justice at all levels and to increase the economic standards of living and human capital through improved education, income, skills development and employment.

To achieve socio-economic development, a solid science and technology infrastructure is needed. In addition, the involvement of the public in science, technology and innovation policies would help improve regulatory science and technology assessment.

Under the high patronage of His Excellency President of Pakistan, the Islamic World Academy of Sciences (IAS) convened its 24th international scientific conference in Karachi, Pakistan during 7-8 March 2023 in collaboration with the Organization of Islamic Cooperation Ministerial Standing Committee on Scientific and Technological Cooperation (COMSTECH), and the International Center for Chemical and Biological Sciences (ICCBS). The theme of the conference was **Challenges to Promote Science & Technology for Socio-Economic Development in OIC Countries.**

The conference was held at the International Center for Chemical and Biological Sciences (ICCBS) (H.E.J. Research Institute of Chemistry and Dr. Panjwani Center for Molecular Medicine and Drug Research), University of Karachi, Pakistan.

The major focus of the conference was to discuss the challenges for the establishment of Socio-Economic Development in OIC Countries and to come up with policy documents on different subjects. The aim was to introduce new global trends and technologies in science and educational policies for the OIC member countries.

Linkages were also established at the intra-OIC as well as regional and international levels to strengthen institutional capacity and human resource development in the Member States through targeted capacity-building and financial assistance.

This publication includes the majority of the speeches, keynote addresses and presentations that were delivered during the 24th IAS Conference

Adnan Badran
Najwa Daghestani

ACKNOWLEDGMENTS

The Islamic World Academy of Sciences (IAS) is grateful to His Excellency President of Pakistan Dr. Arif Alvi for his high patronage and support of the conference.

We extend our gratitude to the International Center for Chemical and Biological Sciences (ICCBS) in Karachi, Pakistan for hosting the IAS 24th conference and for their generous hospitality and organization, and to the staff of the ICCBS for their cooperation and effort that paved the way to make this conference a successful event.

We would also like to thank all the organizations that have sponsored the conference including the OIC Standing Ministerial Committee on Scientific and Technological Co-operation (COMSTECH), Islamabad, Pakistan and the Higher Council for Science and Technology (HCST), Amman, Jordan.

We are very grateful to Prof. Dr. M. Iqbal Choudhary, Coordinator General, COMSTECH and Director, ICCBS for all his relentless efforts during the conference and attention to all details and for making all the participants feel welcome.

The dedicated staff of the IAS in Amman including Ms. Taghreed Saqer, all deserve our thanks and appreciation.

Adnan Badran
Najwa F. Daghestani

SPONSORS OF THE IAS 2023 CONFERENCE

Islamic World Academy of Sciences (IAS)
Amman - Jordan
www.iasworld.org

The nascent idea of establishing the Islamic World Academy of Sciences (IAS) first appeared in the plan of action developed by the OIC Standing Committee for Scientific and Technological Cooperation (COMSTECH). Upon the invitation of Jordan, the Founding Conference of the Academy was held in Amman (Jordan) in October 1986. IAS came into being as an independent, non-political, non-governmental and non-profit organization of distinguished scientists dedicated to the promotion of all aspects of science and technology in the Islamic world.

The IAS seeks to act as functional platform for improving, facilitating and nurturing interaction, collaboration, networking and enhancing knowledge sharing in a bet to address pressing challenges facing socio-economic development in OIC member states.

The IAS aspires to avail its capacity and capability to serve as Islamic Brain Think Tank and to respond effectively and timely to current and futuristic needs for advancing and promoting developmental goals and objectives to realize aspirations of the Ummah.

Main objectives of the Academy are:
1. Enabling inter-Islamic world connections among scientists and academies to advance STI.
2. Acting as legitimate, scientifically-based voice for the cause of STI on behalf of scientists in the Islamic World.
3. Promoting the development of ecosystem that nurtures science and values education and research as a vehicle for socioeconomic transformation in the Islamic World.
4. Providing science-informed advice and recommendations through its various activities to local, regional and international levels.

International Center for Chemical and Biological Sciences (ICCBS)
Karachi – Pakistan
www.iccs.edu

The International Center for Chemical and Biological Sciences (ICCBS), among the developing world's finest centers of excellence, is located in Pakistan's financial center and largest city, Karachi. Its reputation for scientific research and graduate training extends far beyond the country's borders. The Center is comprised of H.E.J. Research Institute of Chemistry, and Dr. Panjwani Center for Molecular Medicine & Drug Research.

The large complex of ICCBS is comprised of 17 research buildings that house some of the region's most sophisticated laboratory facilities. The ICCBS scientists carry out research, training, product development, and service delivery in the chemical, biological, and biomedical sciences. The degree-granting programs have served as the focal points of ICCBS efforts to provide world-class training to young researchers, coming primarily from developing countries, including those belonging to the Organization of Islamic Cooperation (OIC), an international network comprised of 57 Muslim countries.

In 2004 and 2010, the ICCBS received the prestigious IsDB (Islamic Development Bank) prize for the best science institution in the entire Islamic world, which is an unprecedented honor to any science institution in OIC region. Additionally, the institute has also been selected as one of the three library centers of the World Academy of Sciences (TWAS). The center has been designated as the W.H.O. Center for Pesticide Analysis for the Eastern Mediterranean Region. The center is also a UNESCO Category II Center, IUCN-International, WAITRO, and COMSATS Center of Excellence. More recently the center is designated as the OIC Center of Excellence in Chemical Sciences. Through these international recognitions, the center is playing a key role in global capacity building.

OIC Standing Ministerial Committee on Scientific and Technological Co-operation (COMSTECH)
Islamabad - Pakistan
www.comstech.org.pk

COMSTECH the Ministerial Standing Committee on Scientific and Technological Cooperation of the OIC (Organization of Islamic Cooperation) was established by the Third Islamic Summit of OIC held at Makkah, Saudi Arabia in January 1981. The President of Pakistan is Chairman of COMSTECH. The core mandate of COMSTECH is to strengthen cooperation among OIC Member States in science and technology (S&T), and enhance their capabilities through training in emerging areas, undertake follow-up-actions and implementation of the resolutions of the OIC, and to draw up programs and submit proposals designed to increase the capability of the Muslim countries in science and technology (S&T). The ultimate aim is to build and nourish a scientific culture in addition to using S&T as a major contributor to socio-economic development and rapid industrialization.

The objectives of COMSTECH include

1. Assessment of human and material resources of Member States and identification of scientific and technological needs and requirements of the Ummah,
2. Building indigenous capabilities of Member States in the fields of science and technology through cooperation and mutual assistance,
3. Enhancement of cooperation and coordination in scientific and technological fields amongst the OIC member states with a view to achieving collective competence in science and technology for solution of the problems of the OIC member states,
4. Creation of an effective institutional structure for planning, research, development and monitoring of scientific and technological activities at national, regional, and international levels.

COMSTECH works in close collaboration with various Standing Committees and other organs of the OIC, Member States of the OIC and their major Scientific and Technological Institutions, in addition to some international organizations. The latter include The World Academy of Sciences (TWAS), Islamic Scientific, Educational and Cultural Organization (ISESCO), Islamic World Academy of Sciences (IAS), Islamic Development Bank (IDB), Global Environment Facility (GEF), United Nations Environment Program (UNEP), United Nations Development Program (UNDP), International Foundation for Science, Stockholm (IFS), Eastern Mediterranean Regional Office of the World Health Organization (WHO–EMRO). In addition, protocols are being prepared for collaboration with the Lindau Council and IIASA in the EU.

The Higher Council for Science and Technology (HCST)
Amman – Jordan
www.hcst.gov.jo

The Higher Council for Science and Technology was established in 1987 as a public independent institution and acts as a national umbrella for all science & technology (S&T) activities in Jordan.

The objective of the Higher Council is to build a national science and technology base to contribute to the achievement of development goals, through increasing awareness of the significance of scientific research and development, granting the necessary funding and directing scientific and research activities, within national priorities, in line with development orientations.

The Higher Council was also entrusted with the establishment of specialized centers for R&D activities, the support of innovation and entrepreneurship to contribute to commercialize scientific and technological ideas into products and businesses, the conclusion of agreements relating to cooperation with Arab, regional and international parties, the representation of the Kingdom in scientific and technological activities, at the Arab, regional and international levels.

The Higher Council is chaired by HRH Prince El Hassan Bin Talal, who has been instrumental to the progress of science and technology in Jordan from the beginning.

The 24th Islamic World Academy of Sciences Conference
on
"Challenges to Promote Science & Technology for Socio-Economic Development in OIC Countries."

Conference Declaration

Adopted at Karachi, Pakistan
on
Sha'ban 16, 1444 Hijri
Wednesday, 8 March 2023

The Islamic World Academy of Sciences (IAS), the International Center for Chemical and Biological Sciences (ICCBS), the Ministerial Standing Committee on Scientific and Technological Cooperation of the OIC (COMSTECH), and the Higher Council for Science and Technology (HCST) extend their appreciation and gratitude to His Excellency the President of Pakistan for his high patronage of the conference and to His Royal Highness Prince El Hassan bin Talal, the Founding patron of IAS.

1. Whereas, seeking knowledge is upheld in Islam.

2. Whereas, knowledge is derived from research observation and development on our planet sphere, geosphere, biosphere and ecosphere and cybersphere.

3. Whereas, the delivery of R&D in science, technology and innovation (STI) ecosystem is used for promotion of socio-economic development.

4. Whereas, OIC member states recognized education, science and technology as a vehicle for socio–economic transformation in 2020, reconfirmed in 2021 OIC summit conference.

5. Whereas, OIC countries and humanity in general are facing global, natural and man-made disasters; *i. e.*, earthquakes, floods, hurricanes, droughts, climate change, pollution of (drinking water, oceans, land and biosphere) resulting in loss of biodiversity, disrupting food chain supply, energy deficiency, poor health and hence increase in poverty.

We the Fellows of the IAS and participants in the IAS 24th conference entitled *"Challenges to Promote Science & Technology for Socio-Economic Development in OIC Countries."* Held in Karachi on 7-8 March 2023 in partnership with ICCBS;

1. Call on OIC member states for the inclusion of enquiry-based education to enhance creativity, curiosity and problem solving for building-capacity in STI and enriching human resources.

2. Call on OIC member states to formulate and implement National Innovation Policies in order to promote entrepreneurship targeted at manufacture and export of high technology goods.

3. Call on OIC member states to identify centers of excellence for the IAS network STIs leading to regional R&D delivery or **commons** scientific application, innovation and leading to socio-economic development and digital transformation.

4. Bridge the academia and industry for joint R&D leading to socio-economic development.

5. Create social and technology parks and incubators to commercialize the delivery of research and innovations into start-up SMEs and enhance diversification of new materials and quality control.

6. Create a consortium for a sustainable **triangle of energy-water-food security** linked to IAS platform to network reputable research centers in OIC countries for self-reliance and meeting the SDGs, and call on COMSTECH to increase their mobility grants to scientists from LDCs to centers of excellence for training and research in combating poverty and hunger.

7. Strengthen world class research institutions, such as the International Center for Chemical and Biological Sciences, at Karachi University, and use them for human resource development in frontier fields of science and technology in the OIC region.

8. Align cooperation and collaboration with private sector on achieving a sustainable triangle of food, water and energy security, for future generations.

9. Promote cooperation and collaboration of the private sectors for health security of vaccines and drugs to embark across borders, a joint enterprise of manufacturing vaccines and needed drugs for emerging pandemics in the OIC member states.

10. Academia and research centers of OIC member states should encourage interdisciplinary research to deal with **“common”** problems of the Islamic

world, including fields of humanity and social sciences such as climate change, the triangle for sustainability, population, poverty, Medicare etc.

11. Urge the OIC member states to invest at least 1% of their GDP in research in science, technology and innovation (STI) for socio-economic development.

12. Encourage the OIC member states to provide sustained support to the OIC S&T institutions, such as COMSTECH and IAS so that they can fulfil their assigned mandate.

13. Encourage the OIC member states to venture into getting benefits of game changing technologies like nanotechnology. Artificial Intelligence (AI), and other emerging technologies, including radionuclide medical technology leading to the 4^{th} Industrial Revolution.

24th Islamic World Academy of Sciences Conference
on

Challenges to Promote Science & Technology for Socio-Economic Development in OIC Countries

CONFERENCE REPORT

7 - 8 March 2023

Under the high patronage of His Excellency President of Pakistan, the Islamic World Academy of Sciences (IAS), which is patronized by H.R.H. Prince El-Hassan bin Talal, convened its 24th international scientific conference in Karachi, Pakistan during 7-8 March 2023 in collaboration with the Organization of Islamic Cooperation Ministerial Standing Committee on Scientific and Technological Cooperation (COMSTECH), and the International Center for Chemical and Biological Sciences (ICCBS). The theme of the conference was **Challenges to Promote Science & Technology for Socio-Economic Development in OIC Countries.**

The conference was held at the International Center for Chemical and Biological Sciences (ICCBS) (H.E.J. Research Institute of Chemistry and Dr. Panjwani Center for Molecular Medicine and Drug Research), University of Karachi, Pakistan. It was an open activity in which around 150 local and international participants attended from 20 countries. Among the participants were Fellows of the IAS and local scientists from various universities and institutions. The conference was a hybrid event where some speakers and participants joined via zoom. After the conference, the 25th meeting of the General Assembly of the IAS as well as the 45th meeting of the IAS Council were convened.

The conference was co-sponsored by; OIC Standing Ministerial Committee on Scientific and Technological Co-operation (COMSTECH), Islamabad, Pakistan, International Center for Chemical and Biological Sciences (ICCBS), Karachi, Pakistan and the Higher Council for Science and Technology (HCST), Amman, Jordan. Conference partner institutions from Pakistan were the Pakistan Academy of Sciences (PAS), Dr. Panjwani Memorial Trust, the Husein Ebrahim Jamal Foundation and the Government of Sindh.

The inaugural ceremony started with the National Anthem of Pakistan and a recitation from the Holy Qur'an followed by a welcome address by **H.E. Prof. Muhammad Iqbal Choudhary**, Coordinator General, COMSTECH/ Director ICCBS, University of Karachi, Pakistan.

The ceremony included a message from **H.E. President of the Islamic Republic of Pakistan** and Patron of the Islamic World Academy of Sciences (IAS) that was delivered by H.E. Prof. Iqbal Choudhary, **His Royal Highness Prince El-Hassan bin Talal**, Founding Patron of the IAS sent a message to address the conference participants and was delivered by H.E. Prof. Adnan Badran and address of the Chief Guest **H.E. Syed Murad Ali Shah**, Chief Minister, Government of Sindh, Pakistan and an address of **H.E. Prof. Adnan Badran**, President, Islamic World Academy of Sciences (IAS), Jordan.

The ceremony also included addresses from **H.E. Prof. Atta-ur-Rahman**, Patron-in Chief, UNESCO Science Laureate, International Centre for Chemical and Biological Sciences, University of Karachi, Pakistan, remarks from **Mr. Aziz Latif Jamal**, Chairman, Husein Ebrahim Jamal Foundation, Pakistan followed by Remarks of **Ms. Nadira Panjwani**, Chairperson, Dr. Panjwani Memorial Trust, Pakistan and Remarks from **Prof. Khalid Mahmood Iraqi**, Vice Chancellor, University of Karachi. **Prof. Mukhtar Ahmad**, Chairman, Higher Education Commission of Pakistan addressed the conference virtually on Zoom.

The first academic session of the conference included keynote presentations starting with a presentation by **Prof. Atta-Ur-Rahman** FIAS, UNESCO Science Laureate and Professor Emeritus, International Centre for Chemical and Biological Sciences, University of Karachi, Pakistan entitled **Higher Education, Science and Technology - Imperatives for Socio-Economic Development**; a presentation by **Mr. Michael Wadleigh**, Founder, The Homo Sapiens Foundation (UNESCO), Science Activist, Oscar-winning Director, USA entitled **UNESCO Open Data to Stop Trends to Global Socio-economic Collapse**; a presentation by **Prof. Zakri Abdul Hamid** FIAS, Founding Fellow, International Science Council, Science Advisor to the Sixth Prime Minister of Malaysia, Chairman, Atri Advisory, Malaysia on **The Role of Science, Technology and Innovation in Achieving the SDGs in OIC Countries**. **Prof. Syed Qaim** FIAS, Institute of Neuroscience and Medicine, Nuclear Chemistry, Forschungszentrum Jülich, Germany, presented on the **Standardisation of Production Data of Medical Radionuclides under German-Pakistan Cooperation**. Next, **Prof. Ahmed Azad** FIAS, Former Chief Research Scientist, CSIRO Division of Biomolecular Engineering, Melbourne Australia, presented on **Producing Affordable Biotech Medicines for the Islamic World: Opportunities and Requirements**. Last keynote speaker of the session was **Prof. Zulfiqar Bhutta**, Professor and Founding Director of the Institute for Global Health and Development and the Centre of Excellence in Women and Child Health, Aga Khan University and Co-Director, Centre for Global Child Health, Hospital for Sick Children, Toronto, Canada who presented virtually through Zoom on **Status and Progress in Health and Health-related Sustainable Development Goals in the Islamic World; Challenges and Opportunities.**

The second day of the conference started with the second session of the conference with a presentation by Prof. Adnan Badran, President, IAS and Chancellor, University of Petra and Chairman of the Board of Trustees of the University of Jordan, Jordan, on **Digital Transformation: Technology and Innovation for Socio-Economic Development** followed by **Prof. M. Iqbal Choudhary FIAS,** Coordinator General COMSTECH/Director ICCBS, Pakistan, with a presentation on **Combating the Drug Development Challenges with Sustainable and Inclusive Drug Discovery and Development - An Emerging Paradigm.** Next was a presentation entitled **Halal Products Biomolecular Science and Healthy Life** by **Prof. Ali Moosavi-Movahedi FIAS**, Professor of Biophysics, University of Tehran, Inst of Biochem Biophys, Iran. Last in the session was a presentation by **Prof. Ilkay Erdogan Orhan** FIAS, Dean, Faculty of Pharmacy, Gazi University, Türkiye, on **Drug Research Through Nature - From Lab to Patent.**

Session 3 started with a presentation by **Prof. Mohammed Besri**, Emeritus Professor, Hassan II Institute of Agronomy and Veterinary Medicine, Morocco, entitled **The Montreal Protocol and the Ozone Depleting Substances Phase-Out: Impact on Human, Plants and Environment**; then a presentation on **Plant Sciences: A Tool to Achieve Targets of SDGs** by **Prof. Zabta Shinwari** FIAS, Vice President, IAS and National Professor and Professor Emeritus, Quaid-i-Azam University, Pakistan. Next was a presentation on **Health as an Ethical Issue: Lessons from the COVID-19 Pandemic** by **Prof. Liaquat Ali** FIAS, Honorary Chief Scientist & Advisor, Pothikrit Institute of Health Studies (PIHS), Bangladesh. Last presentation in this session was by **Prof. Abdullah Al Musa,** Secretary General, Higher Council for Science and Technology (HCST), Jordan, who presented on the topic of **Biodiversity Economics**.

Session 4 started off with a presentation entitled **Metamaterials and their Applications** by **Prof. Hala El-Khozondar** FIAS, Professor, Islamic University of Gaza, Palestine followed by a presentation on **Research and Innovation for Economic Development** by **Prof. Irfan Ahmad,** Assistant Dean for Research, Carle Illinois College of Medicine, University of Illinois at Urbana-Champaign, USA. **Prof. Irshad Hussain**, Professor, Department of Chemistry & Chemical Engineering, SBA School of Science & Engineering (SSE), Lahore University of Management Sciences (LUMS), Pakistan delivered a presentation on **Functional Nanomaterials for Biomedical Applications. Prof. Jackie Ying** FIAS, Founding Executive Director, NanoBio Lab, Institute of Materials Research and Engineering, USA joined the conference from Singapore through Zoom and presented on the topic of **Design and Synthesis of Nanomaterials for Biomedical and Energy Applications.** The last presentation of the session was by **Prof. Noor M. Butt** FIAS, Professor & Chairman, Preston Institute of Nano Science & Technology (PINSAT), Preston University Kohat, Pakistan on **The Multidisciplinary BS Degree in Nanoscience and Nanotechnology: Its growing Academic and Socio-Economic Importance.**

Lastly, the conference included a Panel Discussion Session on **How STI can meet the Challenges of Socio-economic Development in OIC Countries**, chaired by Prof. Adnan Badran FIAS (Jordan) with panelists Prof. Atta-Ur-Rahman (Pakistan), Prof. M. Iqbal Choudhary FIAS (Pakistan), Prof. Hasan Mandal (Turkey) joining on Zoom & Mr. Michael Wadleigh (USA).

At the conclusion of the Conference, Prof. Atta-ur-Rahman made some closing remarks and read the adopted IAS 2023 Karachi Declaration on **Challenges to Promote Science & Technology for Socio-Economic Development in OIC Countries.**

The declaration of the conference (approved by the Fellows of the IAS and participants in the IAS 24^{th} Conference):

Called on OIC member states for the inclusion of enquiry-based education to enhance creativity, curiosity and problem solving for building-capacity in STI and enriching human resources.

Called on OIC member states to formulate and implement National Innovation Policies in order to promote entrepreneurship targeted at manufacture and export of high technology goods.

Called on OIC member states to identify centers of excellence for the IAS network STIs leading to regional R&D delivery or **commons** scientific application, innovation and leading to socio-economic development and digital transformation.

Bridge the academia and industry for joint R&D leading to socio-economic development.

Create social and technology parks and incubators to commercialize the delivery of research and innovations into start-up SMEs and enhance diversification of new materials and quality control.

Create a consortium for a sustainable **triangle of energy-water-food security** linked to IAS platform to network reputable research centers in OIC countries for self-reliance and meeting the SDGs, and call on COMSTECH to increase their mobility grants to scientists from LDCs to centers of excellence for training and research in combating poverty and hunger.

Strengthen world class research institutions, such as the International Center for Chemical and Biological Sciences, at Karachi University, and use them for human resource development in frontier fields of science and technology in the OIC region.

Align cooperation and collaboration with private sector on achieving a sustainable triangle of food, water and energy security, for future generations.
Promote cooperation and collaboration of the private sectors for health security of vaccines and drugs to embark across borders, a joint enterprise of manufacturing vaccines and needed drugs for emerging pandemics in the OIC member states.

Academia and research centers of OIC member states should encourage interdisciplinary research to deal with **"common"** problems of the Islamic world, including fields of humanity and social sciences such as climate change, the triangle for sustainability, population, poverty, Medicare etc.

Urge the OIC member states to invest at least 1% of their GDP in research in science, technology and innovation (STI) for socio-economic development.

Encourage the OIC member states to provide sustained support to the OIC S&T institutions, such as COMSTECH and IAS so that they can fulfil their assigned mandate.

Encourage the OIC member states to venture into getting benefits of game changing technologies like nanotechnology. Artificial Intelligence (AI), and other emerging technologies, including radionuclide medical technology leading to the 4th Industrial Revolution.

Lastly, the IAS through its declaration extended its appreciation and gratitude to His Excellency President of Pakistan for his patronage of the 24th IAS scientific conference and to all organizations and institutions that extended sponsorship for this conference, these are; OIC Standing Committee on Scientific and Technological Cooperation (COMSTECH), Pakistan, International Center for Chemical and Biological Sciences (ICCBS) and Higher Council for Sciences and Technology (HCST), Jordan.

As part of the follow-up action to the conference, the Academy will circulate the IAS 2023 Karachi Declaration to concerned individuals and relevant agencies throughout OIC and developing countries, so that measures are taken to put into action the ideas proposed at the conference.

The presentations delivered at this conference are published on YouTube; https://www.youtube.com/@iccbs.pakistan5655/streams

The IAS will also publish the complete proceedings of the conference online and will be distributed internationally.

ADDRESS OF
HIS EXCELLENCY PROF. MUHAMMAD IQBAL CHOUDHARY, COORDINATOR GENERAL, COMSTECH AND DIRECTOR, ICCBS, PAKISTAN

Honorable Syed Murad Ali Shah, The Chief Minister
Prof. Atta-ur-Rahman FRS Patron in Chief
Prof. Adnan Badran, President of the Islamic World Academy of Sciences
Prof. Khalid Mahmood Iraqi, The Vice Chancellor
Mr. Aziz Latif Jamal Chairman Husein Ebrahim Jamal Foundation
Ms. Nadira Panjwani, Chairperson Dr. Panjwani Memorial Trust
Mohtaram Mureed Rahimon sahib
Dignitaries, Diplomats, Distinguished Fellows
Ladies and Gentlemen

Assalam o alaikum

1. I am very pleased to welcome the Honorable Chief Minister, distinguished fellows of the Islamic World Academy of Sciences, and other valued guests on behalf of the ICCBS and OIC-COMSTECH.

2. The theme of the event “sciences for sustainable development” is timely and important. The foundational tenant of scientific enterprise is to benefit the human society, while protecting the ecosystem we live in. It is now globally recognized that only science and technology can help the world to meet the enduring challenges of climate change, poverty, and hunger.

3. We are fortunate to have with us outstanding scholars to speak on various aspects of the topic (Dr. Michael Wadliegh Oscar winning film maker and climate activist as the representative of UNESCO).

4. Science and technology has played a central role in global transformation. On the brighter side scientific breakthroughs, such as Green revolution and biotechnology has protected us against widespread famine, and antibiotics and antivirals have saved millions of lives. According to McKincy’s report on “Next Big Things”, post-industrial economies of the world will be driven by 12 emerging technologies, including big data, block chain, robotics, IOT, advanced energy storage devises, autonomous vehicle, third generation genomics, etc. These disruptive technologies will drive massive economic transformation and collectively generate wealth of 14 to 33 trillion USD by 2028.

5. On the other hand, in many cases the fruits of human ingenuity have not reached to the people who needed them the most. This has led to unprecedented inequality, and social

distortion. Dissymmetry in scientific development and their applications has created an inherent conflict between the haves and have-nots.

6. Therefore, development in science and technology is important but more important is to develop a science which is socially responsible, economically inclusive, and environmentally sustainable. Science with values of benefiting humanity, bringing ease in the lives of masses, and ensuring lasting peace and prosperity, while in complete harmony with the nature.

7. Unfortunately, the OIC region, home to over 1.9 billion people, is faced with daunting challenges of conflicts, poverty, and environmental degradation. Despite these challenges, it is the youthful population that would provide unprecedented opportunities and hope if their creative potential is fully unleashed.

8. The International Center for Chemical and Biological Sciences, established in 1966, is an excellent example of private-public partnership where leading philanthropic organizations have generously contributed in the development of world's finest research infrastructure. The ICCBS, since its inception, has contributed in global human resource development in frontier fields of science. Its thousands of alumni in five continents of the world are the permanent ambassadors of Pakistan. Currently over 600 Ph. D. students from home and abroad are benefiting from the excellence of the ICCBS. The center is also serving the industrial sector and federal and provincial governments in critical areas of national needs.

9. Ladies and Gentlemen

I also serve as the Coordinator General of the OIC Standing Committee COMSTECH. The COMSTECH, comprise of 57 Ministers. In my tenure, COMSTECH has initiated major programs including:

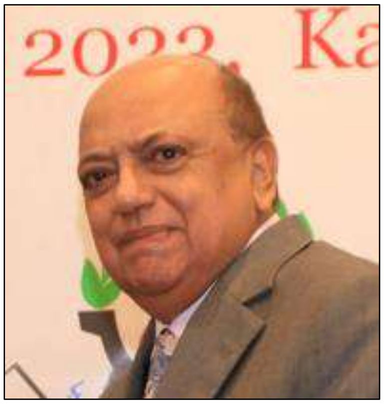
1. OIC's largest research fellowship programs
2. Health Africa initiatives
3. Capacity building in food security
4. 500 Fellowships for Palestinians
5. Program for refugee scientists
6. OIC Technology Portal
7. Research grant programs with IFS and ICGEB
8. Yemen, Sudan, Somalia, Kirghizstan, and Somalia programs

COMSTECH has established various institutions, including the Islamic World Academy of Sciences and 13 inter-Islamic networks for the S&T development in different fields.

At the end I would like to express my gratitude to our Chief Minister for the sustained support he has provided to the ICCBS for all these years, and our distinguished and valued guests for their presence here this morning.

Assalam o alaikum Wa rahmatullah

REMARKS OF
MR. AZIZ LATIF JAMAL S I.
CHAIRMAN, HUSEIN EBRAHIM JAMAL FOUNDATION
PAKISTAN



Honorable Chief Minister Syed Murad Ali Shah
Vice Chancellor Prof. Dr. Khalid Mahmood Iraqi
Prof. Dr. Atta-ur-Rahman FRS, Patron in Chief ICCBS
Prof. Dr. Adnan Badran, President of the Islamic World Academy of Sciences
Prof. Dr. Muhammad Iqbal Choudhary, Director ICCBS and Coordinator General COMSTECH
Mohtarma Nadira Panjwani sahiba, Chairperson Dr. Panjwani Memorial Trust
Distinguished Delegates
Excellencies
Ladies and Gentlemen

Assalam o alaikum

1. It is with greatest pleasure that I welcome the Honorable Chief Minister, and all of you to the inauguration ceremony of the 24th **International Conference on Science and Technology for Sustainable Socio-economic Development of the OIC Region.**

2. This major event is jointly organized by the OIC Standing Committee on Science and Technology (COMSTECH) and International Center for Chemical and Biological Sciences. Over 50 participants, including over 30 fellows of the IAS from some 19 countries, are here to attend this important event.

3. The IAS is one of the key organizations established by COMSTECH General Assembly. I am pleased to learn that IAS is working closely with the COMSTECH and ICCBS for the capacity building of the young scholars from OIC countries for the science and technology based socio-economic development of the OIC region.

4. *Ladies and Gentlemen*

   National capacity in science and technology has strategic importance, and thus establishing, nurturing, and strengthening worked class research institutions are imperative for sustainable science based socioeconomic development. With this vision, my late father Mr. Latif Ebrahim

Jamal, has decided to invest in the establishment of Husein Ebrahim Jamal Research Institute of Chemistry, an institution which is now a global center of excellence in frontier research in the field of chemical and biochemical sciences. The HEJ Foundation since then has continued the traditions of legendary Latif Ebrahim Jamal sahib, and has established another two large centers at the International Center for Chemical and Biological Sciences. Our commitment remains firm and strong, as we fully appreciate that magnificent institution, led by three generations of most committed eminent scientists, is helping our beloved country Pakistan at every time of need. This institute has laid a strong skill base for the nation and produced much needed Ph. D. level manpower. In the future too, I and next generation of Jamal family will continue to support this magnificent institution for the greater good of the country.

5. There are three major contours of this S&T capacity building initiatives. First and foremost is the human capacity building for which the Husein Ebrahim Jamal Foundation has established a myriad of institutions, from schools to colleges, vocational training centers, as well to university campuses. The second important contour is the establishment of high quality research and development institutions in frontier technologies. We are glad that along with the world famous H. E. J. Research Institute, we have also contributed a research building for the nanotechnology center, the only one of its kind in the country. The third is the linkages between the academic research with industrial sector. For this purpose, our foundation is working very hard to bring top industrialists of the country to the ICCBS and providing them platform to benefit from the excellence of this premier research establishment.

6. At the end I would like to express my gratitude to the leadership of the ICCBS Prof. Dr. Atta-ur-Rahman FRS and Prof. Dr. M. Iqbal Choudhary, for their life long struggle to strengthen, nurture and protect this world class institution. We are committed to stand by them at all turbulent times as this institution is both a national asset and national pride.

7. I would like to thank once again Excellency the Chief Minister for gracing the occasion and for his sustained support and patronage to the ICCBS.

8. *Ladies and Gentlemen*
   I am indebted to your presence here this morning as well.

   Assalam o alaikum

REMARKS OF
MS. NADIRA PANJWANI
CHAIRPERSON, DR. PANJWANI MEMORIAL TRUST, PAKISTAN

Excellency Syed Murad Ali Shah Sahib,
Dr Azra Fazal Pecheou Sahiba,
Distinguished Panel
Ladies & Gentlemen,

Assalamun Alaikum & Good Morning

On behalf of myself and all members of the Panjwani Trust which is the founding body of the Dr Panjwani Center for Molecular Medicine & Drug Research at ICCBS, it is my pleasure, it is my privilege to welcome all of you to today's inaugural session for the 24th Scientific Conference of the Islamic Academy of Sciences.

As you know, and this is also for the information of our foreign guests here, this center is one of the premier scientific establishments of Pakistan and a hub for frequent scientific gatherings.

The opportunity of hosting this prestigious international event of the Muslim World of science is indeed a unique honour for all of us.

Ladies & Gentlemen,

On the subject of Muslims and Science, it is customary to take great pride in our past and to talk about the grandeur of the Golden age of Islamic science which roughly speaking was at its peak from the 8th to the 13th century AD.

This was a period of unprecedented discovery and learning in all major capital cities of Islam like Baghdad, Cairo and Cordoba, which became citadels of science, philosophy, medicine and education.

However, the intellectual decline that set in after the Mongolian invasions, the splintering of the Abbasi dynasty, the misplaced religious intolerance towards the spirit of scientific inquiry, the shifting of focus from science to religious dogma and the consequent surge in the political power of religious leaders, gradually converted the blossoming garden of Islamic science into a dry desert which has remained parched and barren to this day.

There may be the occasional examples of personal or organizational excellence here and there, but this does not address the larger problem of our failure in the fields of technology, innovation, R & D and the production of ideas.

57 Muslim countries of the world since 1901 have received only 3 Nobel awards in the fields of science and all three did their award-winning research outside their home countries.

Muslim countries on average spend far less than 1% of their GDP on research and development and their contribution to global scientific literature is a meagre 1.2%.

Today we are in a state of permanent dependence on the West which thrives on the dynamism of its scientific and technological advancements.

It is evident that lack of political will, lack of a futuristic vision and the failure to keep up with the rapid pace of change are responsible for this disappointing situation.
Whenever a speech is censored, whenever a thought is forbidden and whenever a freedom is denied, the chains of intellectual captivity are cast. To break these chains, we need to awaken our minds, our hearts and our collective conscious.

To those of you, who are thought leaders and decision makers, I submit that the time for a ruthless introspection is upon us.

Today, a nation of 230 million and more, like Pakistan, is pleading for handouts from international lenders.

Looking further afield, with a few notable exceptions, majority of the Muslim states are in a state of neo-colonial and indirect subjugation. Even the economically affluent Muslim countries are client states of the major foreign powers for their protection and survival. This disgrace is a testimony of our collective failure.

The theme of this conference is Socio-Economic Development in OIC Countries therefore Assemblies such as this must be used to cut through the chase and confront our existential challenges.

We need to rethink the reason and the purpose for our existence.

In closing let us draw inspiration from the words of our Holy prophet, may peace be upon him, “Whoever walks in the pursuit of knowledge, Allah facilitates for him the way to heaven”.

Ladies and Gentlemen, I wish you a great conference with meaningful and productive outcomes for the greater good of the Ummah.

Thank you very much.

STI FOR SOCIO-ECONOMIC DEVELOPMENT IN OIC MEMBER STATES
OPENING ADDRESS[1]
HIS EXCELLENCY ADNAN BADRAN
PRESIDENT, IAS

Dear Fellows of the Academy,
Ladies and Gentlemen,

Since our 23rd IAS conference which was held in Rabat under the Patronage of His Majesty King Mohammad VI of Morocco, two fellows of our academy Prof. Abdul Salam Majali of Jordan and Prof. Abdul Latif Ibrahim of Malaysia, have passed away, our condolences and God bless their souls. May I ask for a moment of silence.

Our academy is back with vigour after its interruption by the pandemic. Our world is passing through crisis of fragmentation. Wisdom is so badly needed to meet the interconnected challenges. We are encountering a global economic crisis, climate change, income inequality, tension between East and West, loss of trust and lack of resilience.

As stated in Davos 2023 declaration, that the world more than ever needs, smart thinking, wise leaders, honest decision makers, academia responsible citizens to forge the pathways to cooperation, dialogue, building bridges of peace and stability, rather than destroying bridges of our fragmented world.

With the power of collaboration, innovation and ingenuity, we have the capacity to turn challenges into opportunities particularly in the Islamic world.

UNESCO after world war II in 1945 was created to end all wars, with preamble of its constitution stating: “If wars start in the minds of men and women, then we can build the defences of peace in the minds of men and women through the pillars of **education, science, culture** and **communication**.

One great pillar of education is “**Learning to live with others**”, respect other cultures, other traditions and other values, and respect differences among human beings. Diversity is the virtue of

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[1] The 24th Conference of the Islamic World Academy of Sciences (IAS) on “Challenges to Promote Science & Technology For Socio-Economic Development In OIC Countries”

life diversity of fauna and flora of our planet, diversity of minds and thought and expression, not to discriminate against others' beliefs, color, gender, ethnicity or who differs in his thought accept differences.

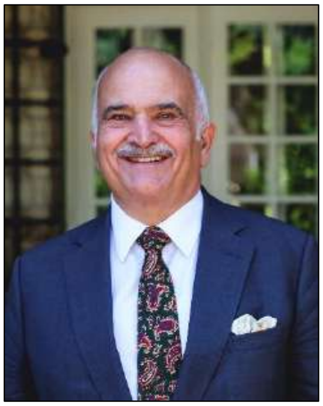
So, science is the **common ground,** is the **meeting place** for us in the Islamic world as pathway to socio-economic development. Cooperation and collaboration among scientists and scientific centers are essential to achieve progress and to migrate OIC countries from developing into a developed world.
Such cooperation to become effective requires governance and management of STI to speed up the catalysis to its climax for socio- economic development.

A consortium of centers of excellence in OIC countries is required to work on a **common problem** shared and cared by all countries as for example, **energy-water-food security** for a sustainable triangle, and this is for one and cooperation and collaboration in **frontier area of sciences,** and this is for two.

In the Islamic world we should bridge the delivery of R&D into socio-economic development. The linkage between academia and industry is absent and there is a gap in most member states. Partnership with the private sector is essential for commercialization.

Finally, with those remarks, I wish you a successful conference of deliberations and declaration.

BUILDING BRIDGES IN THE OIC COUNTRIES
STATEMENT BY
HIS ROYAL HIGHNESS PRINCE EL HASSAN BIN TALAL
FOUNDING PATRON OF THE
ISLAMIC WORLD ACADEMY OF SCIENCES



Dear Fellows of the Academy,

Dear Guests,

Disasters, whether elemental, foreseeable, deliberate, or accidental, carry incalculable harm to individuals, families, towns, cities, regions, and entire countries on a physical, social, emotional, and economic level that numbers and statistics cannot convey, as exemplified by the devastating floods in Pakistan and the earthquakes that have hit Syria and Turkey.

In memory of those who have passed away, let us observe a moment of silence. God almighty bless them all.

Man-made and natural disasters are transboundary and complex, and therefore require us to develop a critical mass of interdisciplinary and multidisciplinary science.

Even if emissions meet the 2015 Paris Agreement reduction pledges, children born after 2020 will, on average, face seven times more scorching heatwaves, almost three times more droughts, three times as many crop failures and river floods, and twice as many wildfires during their lives than their grandparents.

Choosing solidarity, interdisciplinary cooperation, and multilateralism is vital for the betterment of all. There is, therefore, a collective and intergenerational responsibility to advocate for the advancement of *regional commons* through evidence-based *policy*, rather than *politics*.

As a consequence, I encourage policy makers and members of the scientific community of OIC countries to recognise that science transcends political boundaries, making it an effective tool for collaboration.

As such, it is essential to encourage collaboration between centres of excellence in OIC member states.

Whether in the context of climate change, food security, biodiversity, or poverty reduction, all things falling under the umbrella of the water-energy-food security nexus, human welfare and dignity must be the guiding principles for collaboration.

Partnerships and cooperation within this nexus may contribute to self-reliance and quality of life, particularly for the most vulnerable and marginalized.

It may be tempting to view the pandemic or natural disasters as one-off events, but both shocks to the global system demonstrate that in the absence of intra-independence, interdependence and interconnectedness are just a recipe for fragility and insecurity.

For decades I have called for the development of a Zakat Foundation to coordinate the collection of zakat and direct it across borders to individuals and communities in urgent need. By institutionalizing Zakat, a transboundary cultural and religious duty, we can strengthen the resilience of vulnerable groups while creating a sense of cultural affinity.

The concept of human dignity, or karama insaniya (in Arabic), does not discriminate; it embraces the richness of diversity. Zakat, too, does not discriminate and would equally help anyone in need, regardless of their race, religion, social status, or anything else.

There is no doubt that science, technology and innovation all play a key role in socio-economic development of OIC countries, but policies must always be made with reference to human dignity and cultural affinity in order to improve people’s lives in the long-term.

It is also essential that the "commons" for socio-economic development are created through an inquiry-based learning environment that encourages cooperation, critical thinking, and innovation.

My best wishes go out to you in this crucial endeavour, to which we are all dedicated.

10

Message from Dr Arif Alvi
President of the Islamic Republic of Pakistan

Message on the occasion of the 24th International Scientific Conference of the Islamic World Academy of Sciences (IAS) on "Challenges to Promote Science and Technology for Scio-Economic Development in OIC Countries"

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I would like to warmly welcome all of you to the 24th International Scientific Conference of the Islamic World Academy of Sciences on "Challenges to Promote Science and Technology for Socio-Economic Development in OIC Countries" which is being jointly organized by the Islamic World Academy of Sciences (IAS), Organization of Islamic Cooperation Ministerial Standing Committee on Scientific and Technological Cooperation (COMSTECH) and the International Centre for Chemical and Biological Sciences (ICCBS).

I would like to express our deep gratitude and thanks to His Royal Highness Prince El-Hassan bin Talal for his gracious patronage of the Islamic World Academy of Sciences. I also wish to convey our appreciation to COMSTECH and ICCBS for hosting the Conference of the Islamic World Academy of Sciences on a subject of increasing importance for the Muslim Ummah.

As you are aware, Muslim Ummah is facing major challenges in promoting sustainable and inclusive socio-economic development. These challenges relate to poverty alleviation, food security, low literacy, youth employment, health and well-being and the impacts of climate change. These challenges could be overcome successfully by making joint and coordinated efforts by the Muslim countries by harnessing the potential of science, technology and innovation for the benefit of the entire OIC region. The growing severity of these challenges demands efficient and effective actions based on strengthening capacity in the fields of science, technology and innovation.

For this purpose, we need to increase linkages and active collaborations among academia, industry, governments and organizations like COMSTECH, IAS, and ICCBS. Business communities, IT professionals, scientists, and youth of OIC countries must be given more opportunities to interact, share their experiences, and learn from each other. Furthermore, they must undertake joint initiatives and projects in the field of Science and Technology, particularly in emerging fields of IT, like Artificial Intelligence, Cyber Security, Data Analysis, and Cloud Computing.

It is a matter of great satisfaction that COMSTECH has initiated a large number of programs for the development of science, technology and innovation in the Islamic countries. In this endeavour, COMSTECH has made valuable contribution in establishing the Islamic World Academy of Sciences. Another noteworthy action by COMSTECH is to align its programs with the Sustainable Development Goals (SDGs) of the 2030 Development Agenda.

In the end, I would like to call on distinguished fellows of the Islamic World Academy of Sciences to support COMSTECH in this noble mission to speed up scientific and technological progress in the Islamic countries as per COMSTECH's mandate of enhancing cooperation in science and technology and creating institutional structures for research, and development.

The challenges of promoting socio-economic development in the Muslim Ummah are significant. But I am confident that you will succeed in your objectives. I wish you a productive and successful meeting.

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REMARKS OF
PROF. DR. KHALID MAHMOOD IRAQI
VICE CHANCELLOR, UNIVERSITY OF KARACHI
PAKISTAN

Honorable Chief Minister Syed Murad Shah, Chief Minister Sindh
Prof. Dr. Atta-ur-Rahman FRS, Patron in Chief ICCBS
Prof. Dr. Adnan Badran Former Prime Minister of Jordan, and President of The Islamic World Academy of Sciences
Prof. Dr. M. Iqbal Choudhary, Coordinator General OIC-COMSTECH and Director ICCBS
Mr. Aziz Latif Jamal, Chairman Husein Ebrahim Jamal Foundation
Ms. Nadira Panjwani, Chairperson Dr. Panjwani Memorial Trust
Diplomats
Distinguished Delegates
Ladies and Gentlemen,

Assalam o alaikum

1. On behalf of the University of Karachi, I am pleased to welcome the Honorable Chief Guest Syed Murad Ali Shah, distinguished fellows of the World Academy of Sciences, and valued guests at the inauguration of this prestigious pan Islamic event.

2. Science and technology are important aspects of our lives as the play a central role in socioeconomic development of any nation.

3. I am happy to note the IAS is organizing its 24th international conference on the application of science and technology for sustainable socioeconomic development in the OIC region.
4. The Muslim world faces numerous challenges, including food, energy and water scarcity, overwhelming disease burden, and huge negative impact of climate extremities. As a result, poverty, conflicts, deprivation and unemployment are effecting the lives of millions of people all across the Muslim lands.

5. In such a gloomy situation, science and technology and modern day innovation are the only way towards a sustainable and inclusive socioeconomic development.

6. In this context the event like this with brightest minds of the Muslim world, present at one platform, can guide the policy makers, politicians, production sector and universities towards coherent, bipartisan, and long term policies and plans of action.

7. *Ladies and gentlemen,*
The International Center for Chemical and Biological Sciences of University of Karachi is committed to not only build human capacity but also to provide necessary technological basis for science based development of Pakistan. The ICCBS is premier institution of

excellence with global recognition. We at the University of Karachi are proud to host this world class institution which is also playing key role in global capacity building.

8. The excellence of the ICCBS is internationally recognized, and impact of its services for the nation is far beyond the scope of these short remarks. This legendary institution owes its phenomenal success to tireless, and sincere leadership of Prof. Salim uz zaman Siddiqui to Prof. Atta-ur-Rahman, and now my dear brother Prof. Muhammad Iqbal Choudhary and their outstanding teams.

9. *Ladies and Gentlemen,*
   Allow me at this moment to recognize The Islamic World Academy of Sciences, COMSTECH and ICCBS for jointly organizing this major international event at the University of Karachi. The largest public sector and second oldest university of Pakistan.

10. As I conclude I wish this event an immense success and looking forward to the outcome which I promise to highlight at all the major fora.

11. Thank you very much Honorable Chief Minister and Ladies and Gentlemen for you presence here this morning.

    Pakistan Zindabad.

ADDRESS OF HIS EXCELLENCY. SYED MURAD ALI SHAH
CHIEF MINISTER OF SINDH
PAKISTAN

Prof. Dr. Adnan Badran, President of the World Academy of Sciences
Prof. Dr. Atta-ur-Rahman, Patron in Chief
Prof. Dr. Muhammad Iqbal Choudhary, Coordinator General COMSTECH
Prof. Dr. Khalid Mahmood Iraqi, Vice Chancellor, University of Karachi
Mr. Aziz Latif Jamal, Chairman Husein Ebrahim Jamal Foundation
Ms. Nadira Panjwani, Chairperson Dr. Panjwani Memorial Trust
Distinguished Fellows of the IAS
Foreign and Local Delegates

Diplomats

Ladies and Gentlemen

Assalam o alaikum

It is indeed a great pleasure for me to inaugurate the 24th Conference of the IAS on, "Challenges to Promote Science and Technology for Socio-economic Development in OIC Countries" at the International Center for Chemical and Biological Sciences. I am pleased to see a large number of distinguished fellows participating in this international event. This major science event is an important step forward towards a better understanding how science and technology can be effectively deployed to solve enduring problems of poverty, food insecurity, climate change, in the Muslim world. This gathering represents the growing interest and commitment of Muslim Ummah towards the science and technology for human wellbeing. Personally, for me, participation in the events of this type is always a reassuring and gratifying experience.

I am pleased to learn that this 24th Scientific Conference of the IAS is organized under the patronage of the HE President of Pakistan and HRH Prince Hasan bin Talal. I have been told that IAS, established by the COMSTECH, is rendering excellent services to science in several years through promoting understanding and appreciation of the role of science and technology in sustainable development of the Muslim world. The IAS is a world renowned science Academy based in Amman Jordan, established by the COMSTECH the OIC's Ministerial Standing Committee for Sciences and Technology Cooperation. It comprises 57 Ministers of Science & Technology of the 57 OIC member states, chaired by the President of Pakistan. I congratulate the IAS, COMSTECH, and the host institution ICCBS for their collective efforts in moving towards creating a renaissance of science and technology in the Muslim world.

Being a professional Engineer, I am very much aware of the importance of the need of research in science and technology. It is only through the applications of science and technology that we can handle the enduring challenges of poverty, climate change, food insecurity, increasing disease burdens, that world faces today. We need to not only solve many local issues, but also partner with other nations in handling global challenges. The theme of the event is therefore timely and significant.

Ladies and Gentlemen

In the enterprise of science and technology, strong research and development institutions play a key role. I am pleased to see that our premier research institution, the International Center for Chemical and Biological Sciences constantly is striving to upgrade its capacity and human resources for frontier research and graduate training in chemical, biomedical and biochemical sciences. This center is an excellent example of the strong commitment of our private sector, Federal and Provincial Governments, International donors and our scientists and researchers towards the science and technology based development in Pakistan.

It is heartening to learn that the International Center for Chemical and Biological Sciences has been recognized as the UNESCO and OIC Center of Excellence, as well as the WHO collaborating center. The ICCBS has received Best Science Institution in Muslim World Prize from the Islamic Development Bank twice in 2004 and 2010. The ICCBS is also the only center where over 200 scientists from all over the world, including western countries, are annually visiting for research training and joint projects. These are indeed unique honors on which our nation take pride. I understand that it was only possible through the internationally recognized academic status and excellent leaderships of Prof. Atta-ur-Rahman and Prof. Iqbal Choudhary. I must acknowledge here the vision and patriotism of Nadira Panjwani Sahiba, Chairperson Dr. Panjwani Trust, and Mr. Aziz Latif Jamal, Chairman Husein Ebrahim Jamal Foundation, which led to the establishment of the world research centers at the ICCBS. Their role in the promotion of higher education and scientific research in Pakistan will always be cherished. Personally, for me, visiting a center of excellence of this stature is always a reassuring and gratifying experience.

We at the Sindh Government have placed the ICCBS in the center of our science and technology based initiatives. Various Ministries of my government are working closely with the ICCBS management to establish research centers, upgrade existing laboratory infrastructure of the province, as well to conduct some of the enduring issues in health and agriculture which province is facing today. This includes the establishment of Sindh Serology and DNA Forensic lab., upgradation of Chemico-bacterial lab in Karachi, and establishment of Traditional Medicine Research Center. I am also delighted to learn that my idea of the establishment of seamless learning platform for the universities has been implemented as the SIREN (Sindh Innovation, Research, and Education Network) by the ICCBS which connects leading universities of Sindh. My Government has also decided to declare five centers of the ICCBS as Sindh Health Care Research facilities in fields such as regenerative medicine, disease genomics and pharmaceutical research.

At the end I must thank the COMSTECH, with Prof. Iqbal Choudhary as its Coordinator General, for organizing this major international event at the ICCBS in collaboration of the Islamic World Academy of Sciences and the ICCBS, University of Karachi, for having me invited to this prestigious occasion. I also assure you of the firm commitment of my Government towards protecting and strengthening Universities and research centers in the province and linking them to production sector for the benefit of common people.

Ladies and Gentlemen

Thank you very much for your presence here this morning.

Pakistan Pa'indabad
Allah Hafiz

HIGHER EDUCATION, SCIENCE AND TECHNOLOGY-IMPERATIVES FOR SOCIO-ECONOMIC DEVELOPMENT

ATTA-UR-RAHMAN FRS
UNESCO Science Laureate and Professor Emeritus,
International Centre for Chemical and Biological Sciences,
University of Karachi, Pakistan

ABSTRACT

The remarkable developments in the higher education sector, triggered by the higher education reforms introduced by us during 2002-2008, have led to an unprecedented growth in high quality research publications in Pakistan. The focus of the HEC reforms was to improve the quality of higher education and research, provide greater access to higher education, and provide education relevant to national needs and international demands. The establishment of the Pakistan Education and Research Network (PERN) in 2004 brought a revolution by providing free access of 65,000 textbooks and 25,000 international journals to students, teachers and researchers (1). The single biggest contribution to the improvement of the higher education research environment was the emphasis of the HEC programmes on the development and absorption of high-quality faculty. About 11,000 of our brightest students were selected and sent abroad for training at PhD and post-doctoral levels to leading universities of the world in USA, UK, Germany, France, Sweden, Australia and Austria. The world's largest Fulbright program was initiated with 50% of the funds being invested by Pakistan. Pakistan was about 400% behind India in research output on a per capita basis but overtook India in 2017 and was about 20% ahead of India by 2018---- no mean achievement. A satellite (Paksat 1) was placed in space with some of its capacity directed to education. These remarkable transformations in the higher education, science and technology sections were applauded by neutral international experts and agencies (2-8) leading to many international awards (9-14).

The role of higher education, science and technology has now become central to socio-economic development. The stunning developments in artificial intelligence, new materials, energy storage systems, gene editing, regenerative medicine, and other disruptive innovations are changing the landscape of businesses of today and tomorrow. Some of these developments will be described

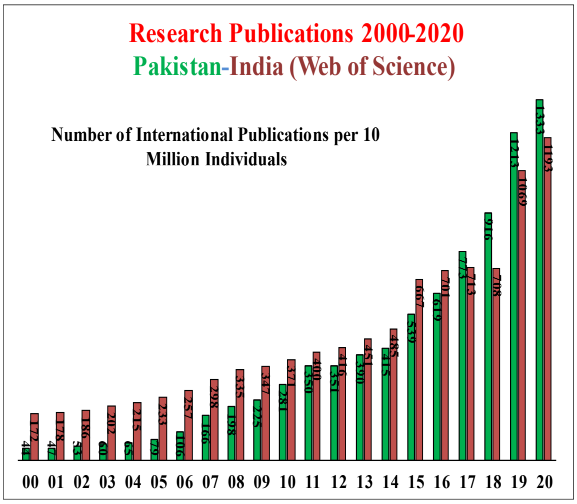

Fig.1: Research publications per capita in international journals, Pakistan versus India. Green bars indicate the number of international publications from Pakistan per 10 million population during the year 2000 (extreme left) to the year 2020 (extreme right). The red bars show the same data for India. As can be seen, Pakistan overtook India in the year 2018. The data is taken from the Web of Science and was kindly supplied by Prof. Raheel Qamar, former Rector COMSATS.

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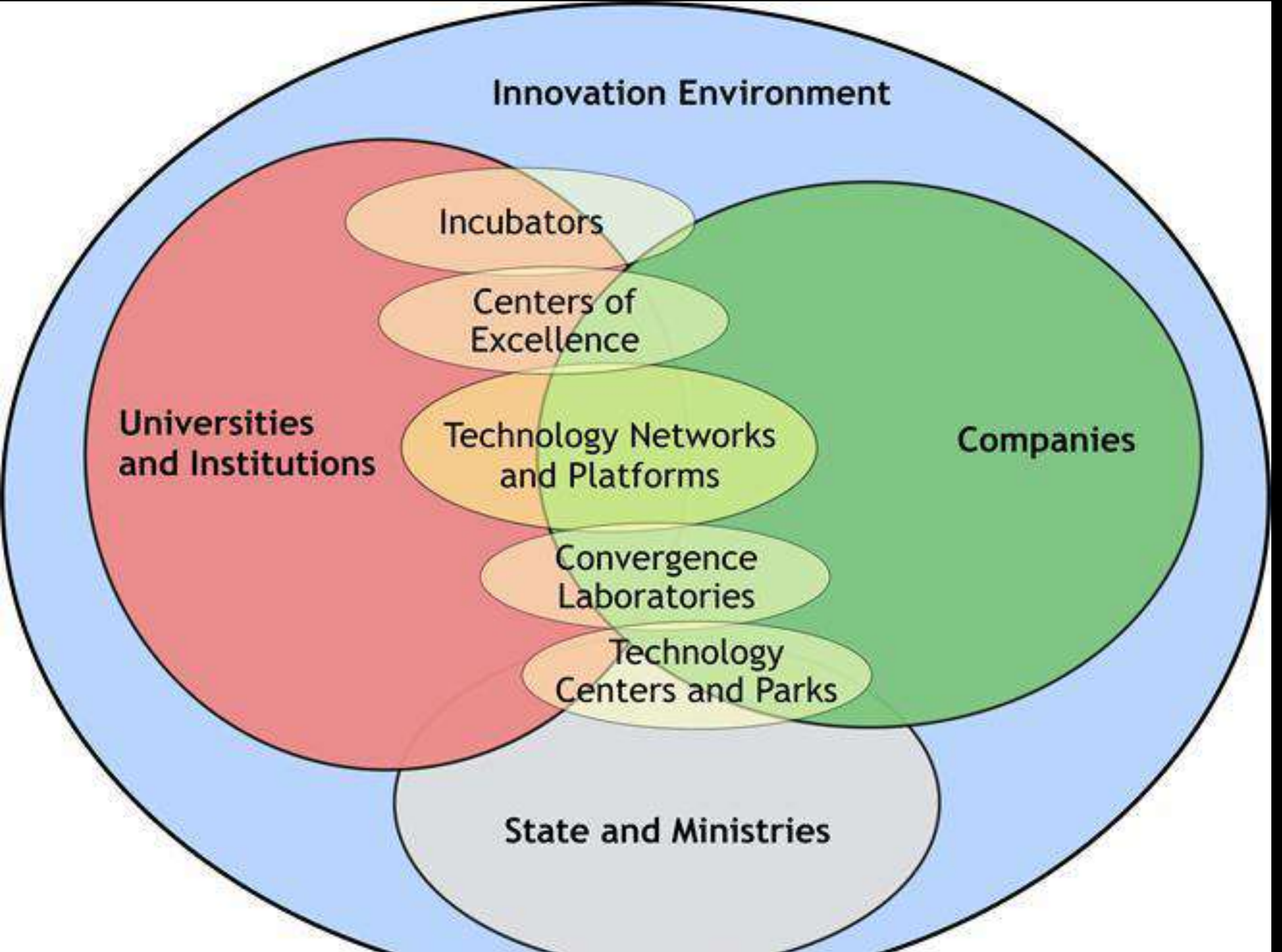
7) *Anita Makri, (December 21, 2018). "Pakistan and Egypt had highest rises in research output in 2018". Nature. doi:10.1038/d41586-018-07841-9. S2CID 158229390,* *https://www.nature.com/articles/d41586-018-07841-9*
8) *Iulian Herciu, Thomson Reuters,* *http://images.info.science.thomsonreuters.biz/Web/ThomsonReutersScience/%7Bdab71dc1-d7d8-48af-88a6-fa7efa61ae22%7D_Pakistan_Citation_Report_FINAL.pdf (2017).*
9) *https://aurins.uitm.edu.my/ ,March 17, 2021.*
10) *"Chinese research center to be named after Dr Attaur Rahman". Tribune.com.pk. May 28, 2019.*
11) *http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/Flyer-Lecture_Pakistan_WSD14.pdf*[bare URL PDF]
12) *"Foreign Members-Academic Divisions of the Chinese Academy of Sciences". English.casad.cas.cn.*
13) *"The News International: Latest News Breaking, Pakistan News".* *https://web.archive.org/web/20140919224413/http:/www.thenews.com.pk/Todays-News-6-273635-Chinese-award-for-Dr-Atta-ur-Rahman (September 19, 2014).*
14) *https://global-geography.org/af/Geography/Asia/Pakistan/Special_Information/Report_on_some_top_Pakistani_scientists*

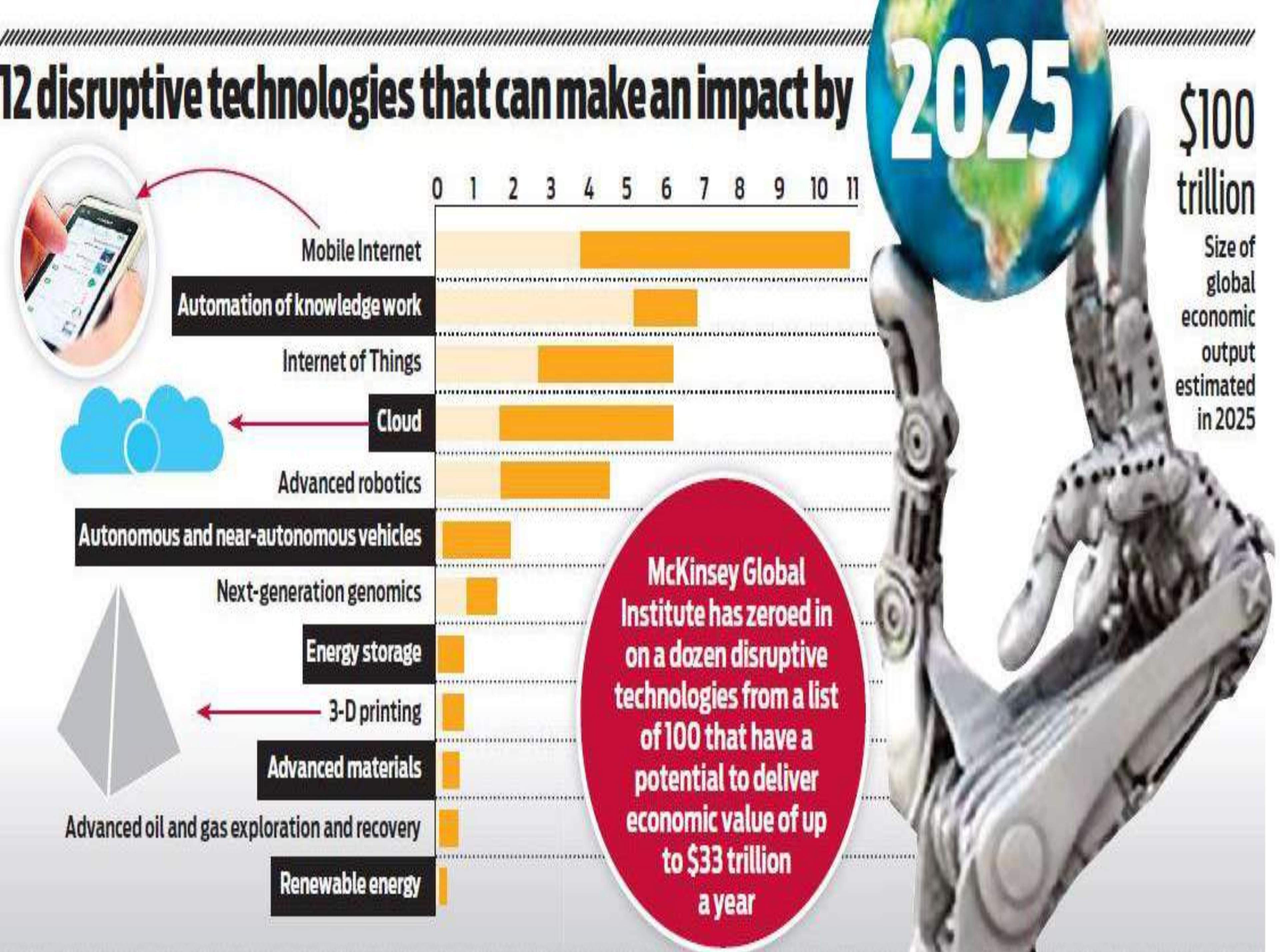
Higher Education, Science & Technology : Imperatives for Socio-economic Development

Atta-ur-Rahman *FRS*

N.I., H.I., S.I., T.I.

UNESCO SCIENCE LAUREATE


Innovation Environment
Incubators
Centers of Excellence
Universities and Institutions
Technology Networks and Platforms
Companies
Convergence Laboratories
Technology Centers and Parks
State and Ministries


12 disruptive technologies that can make an impact by 2025
$100 trillion
Size of global economic output estimated in 2025
0 1 2 3 4 5 6 7 8 9 10 11
Mobile Internet
Automation of knowledge work
Internet of Things
Cloud
Advanced robotics
Autonomous and near-autonomous vehicles
Next-generation genomics
Energy storage
3-D printing
Advanced materials
Advanced oil and gas exploration and recovery
Renewable energy
McKinsey Global Institute has zeroed in on a dozen disruptive technologies from a list of 100 that have a potential to deliver economic value of up to $33 trillion a year

Innovation Determines Progress

Socio-economic development is no longer dependent on natural resources (eg.Japan, European countries)

KNOWLEDGE is now the main driving force of world economies

China

Singapore

Korea

Taiwan

The Triple Helix : Knowledge Economy: Singapore

- Small country ---865 sq km (population 5 million)

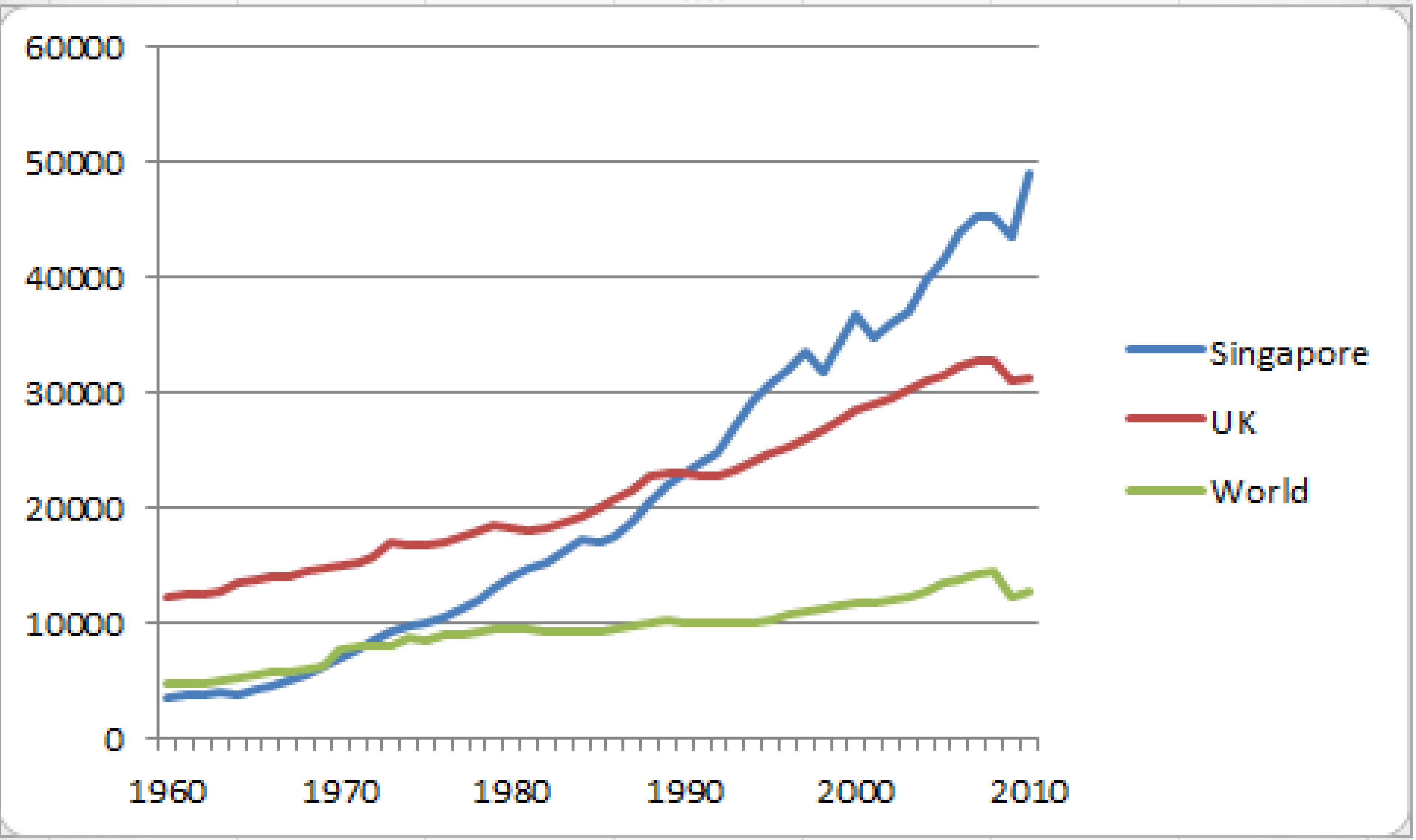
- No natural resources: focus ONLY on human resources and high tech manufacturing/exports

  Lee Kwan Yew: Leadership !!!!!!

Mobilization of its human capital

- Exports: $ 400 Bln
- GDP : $ 467 Billion ***Through extensive growth in its high technology manufacturing industries***

GDP per capita (adjusting to inflation) - 1960 to 2010
Singapore vs fomer colonial ruling power UK



Korean & Austrian Strategies

- ***Korean Minister of Education/Science is Deputy Prime Minister of Korea***
- ***Austrian Minister of Science is also Minister for Economic Affairs as well as Deputy Prime Minister of Austria***

Pakistan---An Exciting Beginning !!

- My appointment as Federal Minister of Science & Technology/Information Technology& Telecom (2000) and later Chairman Higher Education Commission (2002-2008)

- 6000% Increase in Development Budget of Science & Technology/IT Telecom Ministry and later 3500% increase in Dev. Budget of Higher Education

- ***HEC an autonomous body reporting to PM***

- ***Challenges: Quality, Access, Relevance***

- *Excite young minds* about the wonders of science !
- *Select and train the Brightest in top universities abroad*
- *Attract them back*--- by creating an enabling environment :
- *Salaries*
- *Research Funding*
- *Access to Literature*
- *Free Access to Sophisticated Instrumentation*
- *Jobs on Arrival*

Comparative analysis of TTS/BPS faculty . 4 KPIs

Total faculty BPS 28106 (PhD 8377, Non PhD 19729)

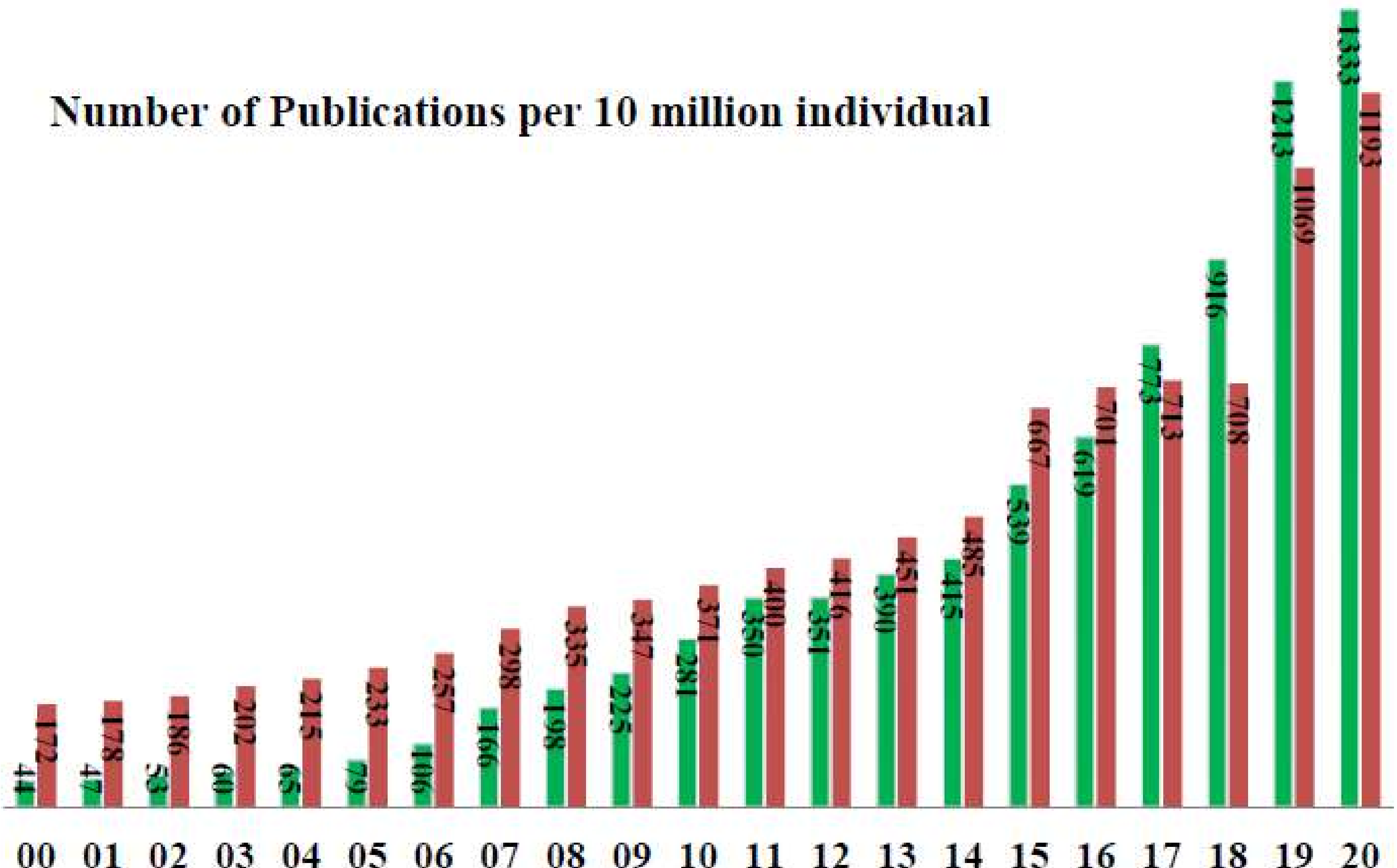
TTS faculty 3599 (All PhDs)

+ **TTS-BPS Analysis for Years 2014-2018**

Key Performance Indicators	TTS (3599 PhDs)	BPS (8377 PhDs)
Intl. Publications	6171	2086
Intl. Citations	84280	23822
MPhil/PhDs Supervised	4164	2180
Research Grant Projects Secured	3032	681

Research Publications 2000-2020

Pakistan-India (Web of Science)



Prof. Michael Rode, Chairman UN CSTD: "In no other country has the higher education sector seen such spectacular positive developments as that in Pakistan during the last six years."

Thomson Reuters (2016): "Pakistan has emerged as the country with the highest percentage of Highly Cited Papers compared with the BRIC countries (Brazil, Russia, India and China)."

ip-science.interest.**thomsonreuters**.com/incites-**pakistan**/

Presentation to Indian PM

"Pak threat to Indian science" --- Hindustan Times

Neha Mehta

New Delhi, July 23, 2006

"*Pakistan may soon join China in giving India serious competition in science. Science is a lucrative profession in Pakistan".*

Book Published 2022 (Chapter 5 on Pakistan Transformation)

Defying Gravity !

- National IT Policy formulated within 3 months of my appointment as Federal Minister (year 2000)
- E Governance Programs Initiated
- 15 Year Tax holiday given for IT industry
- Engineering Sciences given priority --- NUST, UET Lahore and COMSATS Inst Inf Tech among top universities in Pakistan

Using Technology to Leap-Frog!

- Pakistan Educational Research Network
- Digital Library Program
- PAKSAT 1 (Pakistan's Educational Satellite)
- Pakistan's International Video-conferencing Network

New Kind of *Hybrid* Engineering/Technology University

- Fchhochscule ! (BS and MS in Applied Industrial Engineering)—combined with:
- Postgraduate Engineering University with Centers of Excellence in Selected Fields
- Technology Park with Industrial R and D Centers
- Split in 8 Portions (3 Austrian 5 Chinese Universities) each being developed in Partnership with *different* Foreign University
- Students must spend 500 hours in industry

Engineering/Technology Hybrid University

- Cherry Picking : Benefitting with the strengths of different specialised universities
- Responsibilities of Foreign Partners:

a) Train Faculty and Technicians

b) Ensure Quality Assurance (quality of lectures, research exams etc)

c) Provide Foreign Faculty for Lectures and Research

d) Ensure Linkages with Foreign Industry

Pak Austrian Fachhochschule at Haripur, Hazara

Disciplines & Partners of PAF-IAST

No.	Disciplines (Fachhochschule)	Austrian Partners
1	Electrical and Computer Engineering	University of Applied Sciences, Joanneum, Graz
2	Computer Science Software Engineering	University of Applied Sciences, Joanneum, Graz
3	Chemical Engineering (Environment, Process and Energy Engineering)	University of Applied Sciences (MCI), Innsbruck
4	Biomedical Sciences	University of Applied Sciences, Joanneum, Graz
5	Information Design	University of Applied Sciences, Joanneum, Graz

No.	Disciplines (Research Centers)	Chinese Partners
1	Artificial Intelligence	Shenzhen Institute of Advanced Technology Guangdong University of Technology Johannes Kepler University (Linz, Austria)
2	Railway Engineering	Beijing Jiao Tong University, Beijing
3	Mineral Resource Engineering	China University of Mining and Technology, Xuzhou
4	Agriculture Food Technologies	Jiangsu University, Jiangsu

The University in Sialkot will be a hybrid model with two portions.

One portion will be the Fachhochschule (BS and MS) in collaboration with Austria.

The other portion will be a postgraduate research portion (Mphil and PhD/postdoctoral) in collaboration with China, Austria and other countries.

THE GOLDEN INDUSTRIAL TRIANGLE ---- SIALKOT---- GUJRANWALA---- GUJRAT !!!!!!

Knowledge Economy Task Force

- **There has been a 600% increase in Development Budget of MoST as a result of our Knowledge Economy Task Force Projects**
- Significant increases in budgets of HEC (Projects worth about Rs. 42 bln added), and MoITT
- After 4 years of stagnant recurring budgets of universities/HEC ((65bln) due to poor advocacy, PM has agreed to increase recurring budget this year by Rs.15 Bln
- NRPU being revived with over 1200 grants being given this year as compared to only 100 grants/year

Knowledge Economy Task Force

- 26 Major National Projects Under Way:

Artificial Intelligence
Internet of Things
Advanced Agriculture
High Speed Railways Engineering
Energy Storage Systems
National Scholarships
Distance Education etc

Knowledge Economy Task Force

- **Tenure track system was allowed to decay over the last decade--- now 35% and 100% increases agreed to after my THREE presentations to PM and Finance Minister**

- Faculty Development program is the heart of quality higher education. It had been severely curtailed, with only about 200-300 scholarships been given annually. Now plan to award 1200 scholarships this year
- MatricTech Program initiated

Blended Education:

- A 6 billion rupee project begun at Virtual University, Lahore is for introducing a system of blended learning in our universities.
- This will result in students in our universities learning not just from their teachers but using Massive Open Online Courses (MOOCs) they will be able to benefit from lectures available at MIT, Stanford, Harvard and other top universities.
- This should result in a major improvement in educational standards.

Foreign Scholarships:

- A 13 billion rupee scholarship project of the Knowledge Economy Task Force has been approved. The project is aimed at strengthening the faculty in our universities by sending large number of our brightest students to top universities abroad.

- 400% Increase in Budget of MoST

MatricTech Programme:

- To produce citizens with specialized skills, a special Matric Tech programme has been launched as a pilot in about 500 schools so that in the last 3 years of their education, the matric students are trained in certain specialized skill sets.

Artificial Intelligence and Other Emerging Technologies:

- Selected key areas that are being given a high national priority in order for Pakistan include Industrial Biotechnology, Regenerative Medicine, Information Technology, Artificial Intelligence, Machine Learning, Robotics, Big Data, Internet of Things, Block Chain Technologies.

NADRA's TAX PROFILING BROADENING AND ESTIMATION SYSTEM

- Using NADRA 's (limited) transaction records with innovative Artificial Intelligence (AI) Protocols, our model identified 3.8 million non filers - each with a tax liability of more than Rs 100,000 who should have paid an estimated Rs 1.6 trillion in Income Tax in the fiscal year ended 30 June 2017.

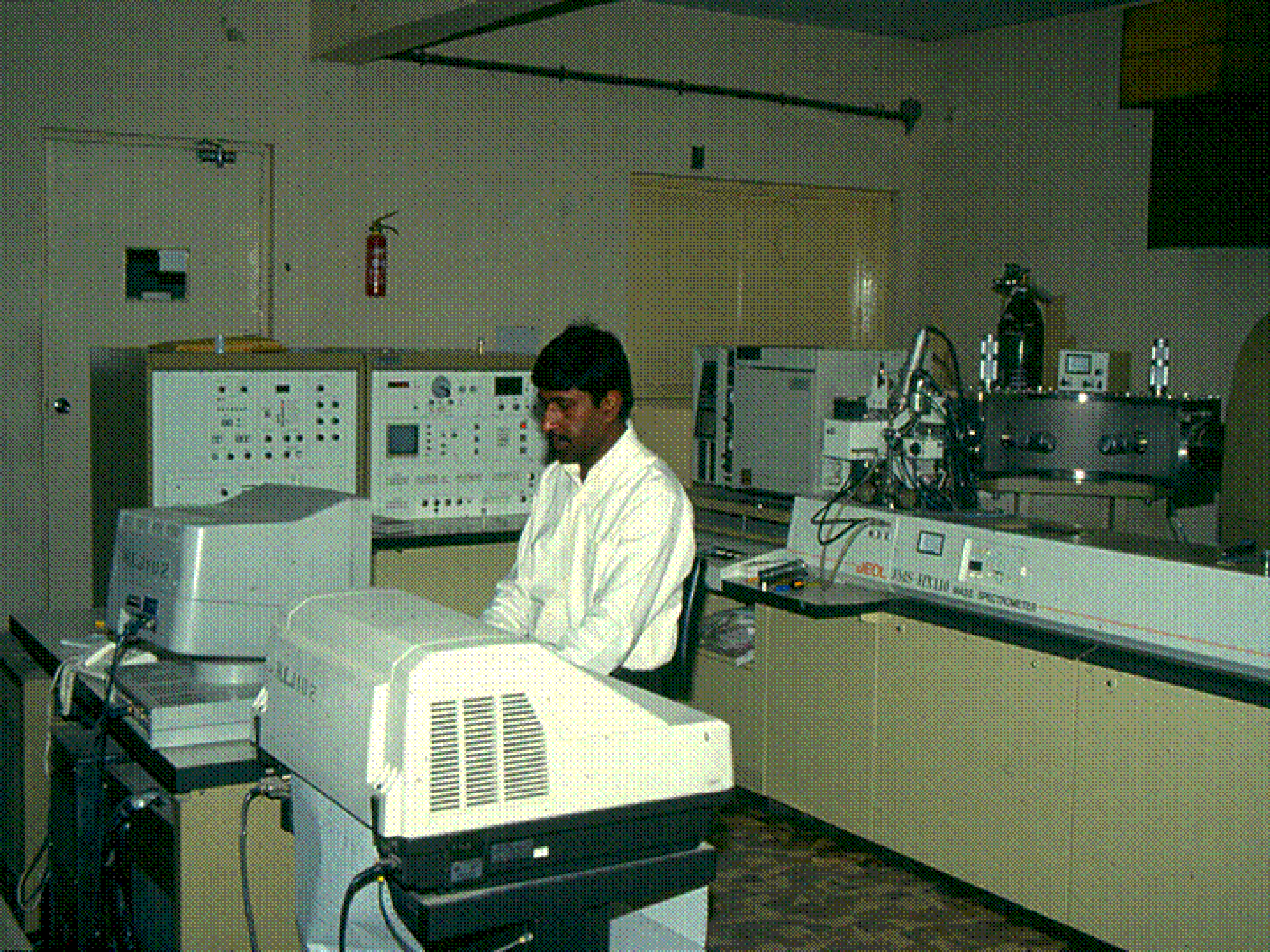
TEST RESULTS AND EXPERIENCES

- After 21 June the number of declarations went above 141,000 in the following 6 weeks
-
- Resultantly, total declared Assets moved sharply up to Rs 3 Trillion and actual taxes paid to Rs 65 Billion.
- More than 90,000 non filers became filers and Total tax returns for the year ending 30 June 2018 crossed 2 million persons--- far the highest number ever in the history of FBR.

i-MOOCs

- Integrated Approach to MOOCs
- All courses integrated and arranged according to levels (school, college, university) and disciplines
- www.lej4learning.com.pk

NUCLEAR MAGNETIC RESONANCE SPECTROMETERS



ICCBS – *Awards and Honors*

• Fellow of Royal Society (*FRS*)	2
• Mustafa (PBUH) Prize 2021	1
• UNESCO Science Prize	1
32 CIVIL AWARDS :	
• Nishan-e-Imtiaz	1
• Hilal-e-Imtiaz	5
• Sitara-e-Imtiaz	13
• Tamgha-e-Imtiaz/Pride of Performance	13
• D. Sc.	10
• Khwarizmi International Award	5
• ECO Award and Prize	3
• IDB Prizes for Best Science Institution	2

INTERNATIONAL GRANTS

1. International grants worth over $ 37 million were won:

(a)	Germany	DM 5.7 million
(b)	USA	$ 8.0 million
(c)	UK	£ 1.0 million
(d)	Japan	$ 23.0 million
(e)	Others	$ 3.0 million

2. Research projects worth another $ 12.5 million from WHO, OPCW, USAID, ONR, NSF (USA) and British Council have been completed.

Academician Atta-ur-Rahman Belt and Road Traditional Medicine Research Center,

Changsha, Hunan, China

Atta-ur-Rahman Institute of Natural Product Discovery, Malaysia

Thanks

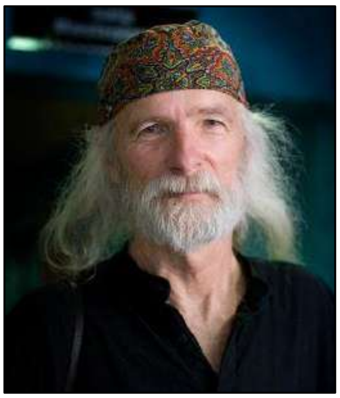
UNESCO OPEN DATA TO STOP TRENDS TO GLOBAL SOCIO-ECONOMIC COLLAPSE

MICHAEL WADLEIGH

Founder, The Homo Sapiens Foundation (UNESCO)

Science Activist, Oscar-winning Director, USA

ABSTRACT



CLOSED MASS. All humans, all life, all products are exclusively made from ever more rapidly degraded, depleted natural resources. Earth is closed mass, sunlight enters but there are NO meaningful material imports, exports or emigrations to other celestial bodies likely in any millennium soon, probably never. Earth was supplied once with finite material resources including the atmosphere - we've got what we got - and for socio-economic development anywhere in our globalized world we must make the best of them, but we are NOT.

CONSUMPTION. The cause of nature destruction including 90% of biodiversity loss is humanity's relentlessly accelerating natural resource consumption (IRP), the greatest human activity, 103 billion tonnes of biomass, metals, minerals and fossil fuels extracted annually. On IRP trends just the next 35 years of natural resource consumption will equal the last 300,000 years, by 2100 annual consumption will be six times IRP's sustainable limit.

CLIMATE. The cause of climate change / global warming is humanity's ever increasing greenhouse gas emissions. At IPCC's best 83% likelihood, on current policies and pledges in just 4 years the carbon budget for dangerous 1.5ºC global warming will be emitted, in only 17 years for disastrous 2ºC, and by 2100 - when today's children should be alive -the budget for catastrophic 4ºC will be emitted.

COLLAPSE. Combined with 6 times the sustainable natural resource consumption limit, 4ºC global warming will cause massive global changes including shortages of every essential for human life - food, water, medicines, shelter - social-economic collapse with potentially hundreds of millions dead, billions forced from lands rendered uninhabitable.

RESPONSIBILITY. UN Ultra High developed nations (red in maps) the most educated, healthiest and wealthiest set the standards for all countries. Just 12% of humanity have 64% of global wealth, cause 50% of emissions and 37% of consumption cumulatively - and both are increasing, not decreasing. Ultra High lead humanity in "NOWISM, everything for the present nothing for the future, maintain and increase living standards for us now".

ULTRA HIGH CITIZENS must be accurately, impartially, effectively informed now - "if electorates don't demand it governments won't do it" - so they can demand responsible government action to set the global standard, stop collapse and secure the future.

اقرأ

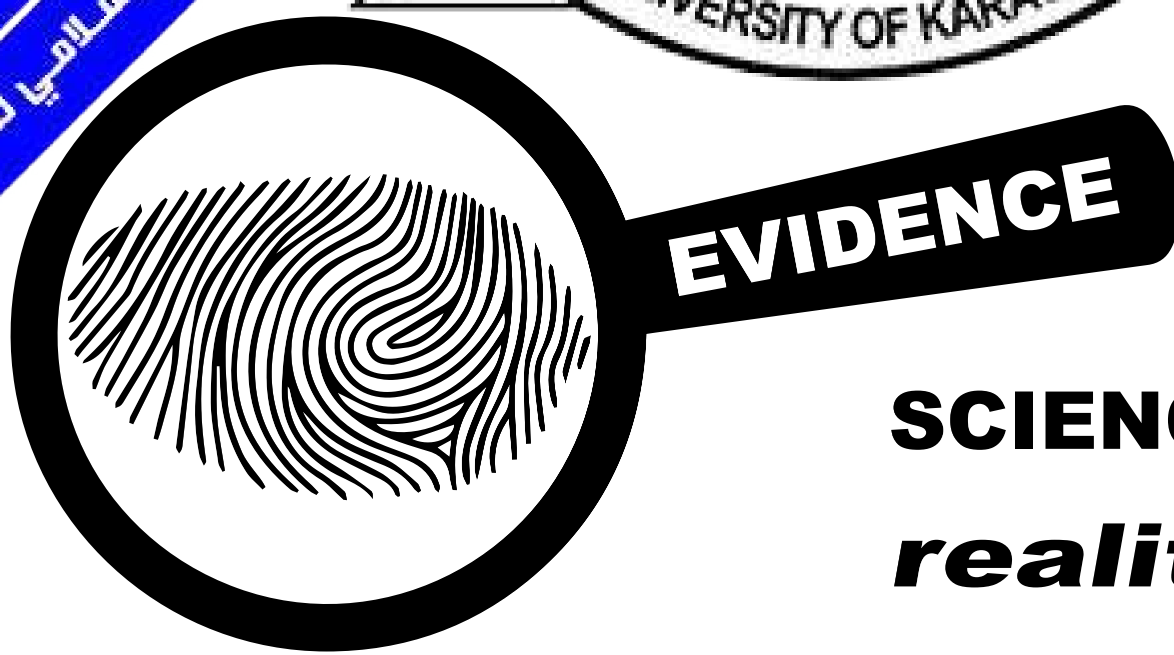
ISLAMIC WORLD ACADEMY OF SCIENCES

اكاديمية العالم الإسلامي للعلوم

INTERNATIONAL CENTER FOR CHEMICAL AND BIOLOGICAL SCIENCES

HEJ and PCMD

UNIVERSITY OF KARACHI



SCIENCE

reality

unesco

Open Data

~~The laws of humans must obey the laws of nature or humanity will not survive.~~

The laws of nature must obey the laws of humans or we won't be reelected.

POLITICAL REALITY. "a state of things as they don't actually exist" - is part of democracy, to be <u>popular</u> and stay elected governments tend to convey "good news, positive stories" NOT reality, accurate, unbiased scientific <u>evidence</u>.

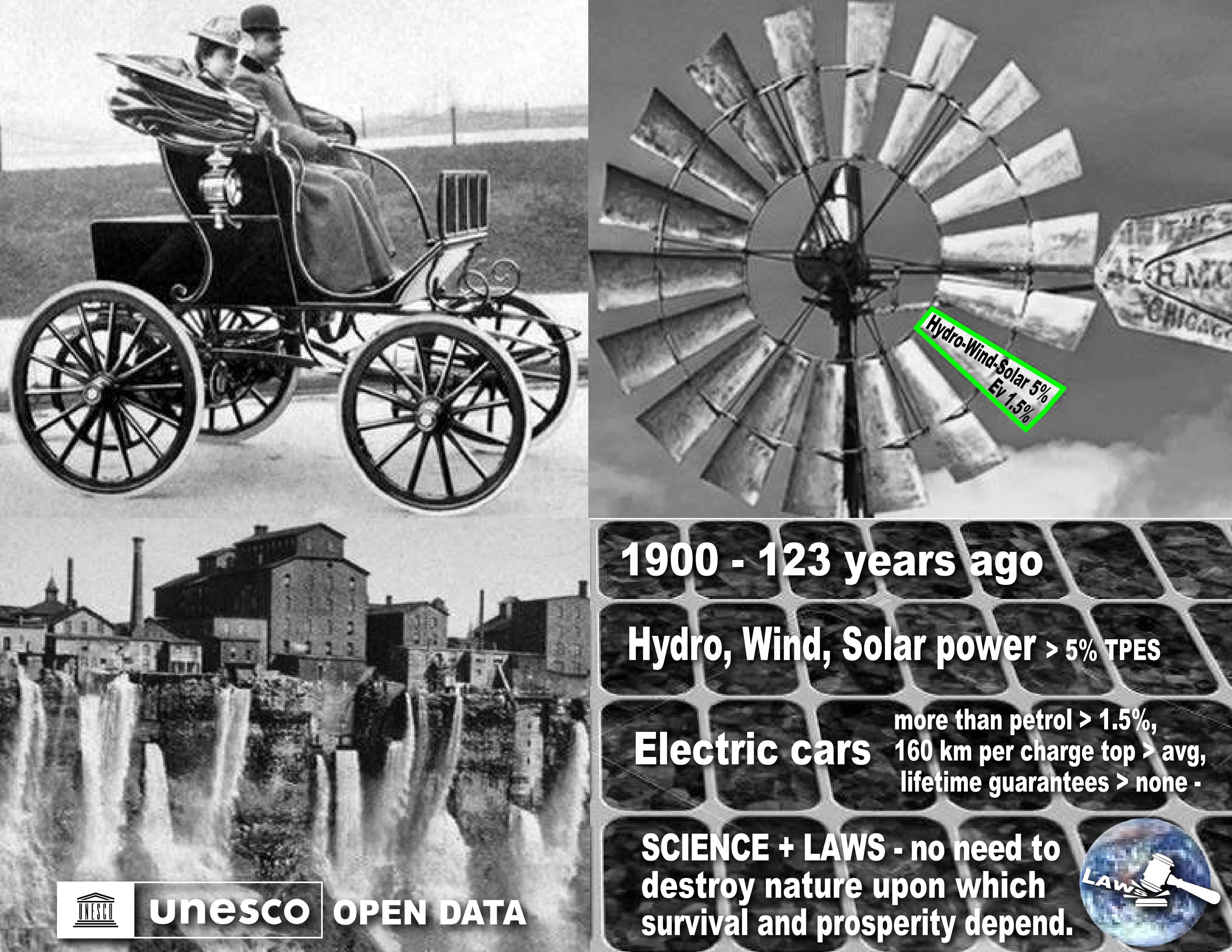
unesco Open Data

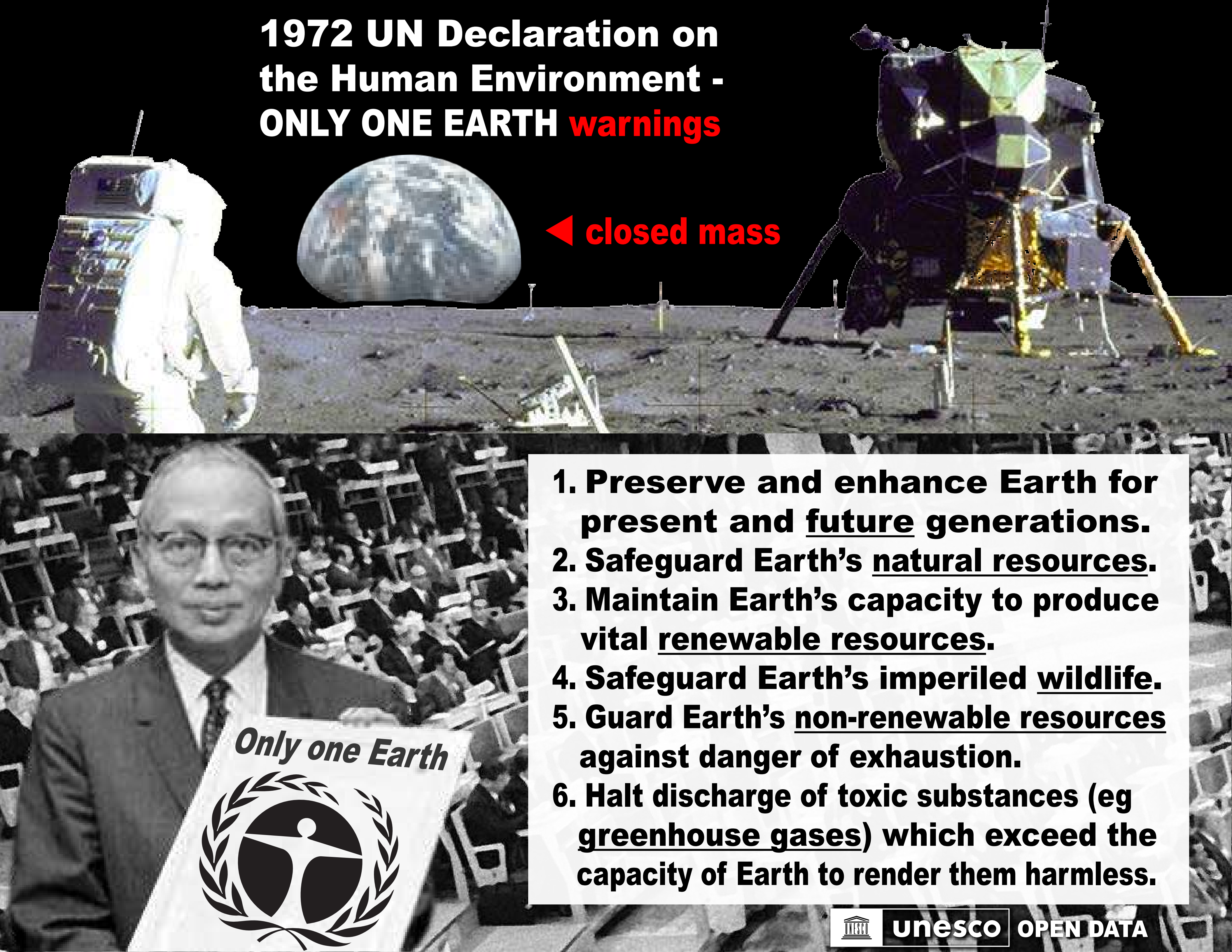
unesco

~~Closed Data~~
Open Data

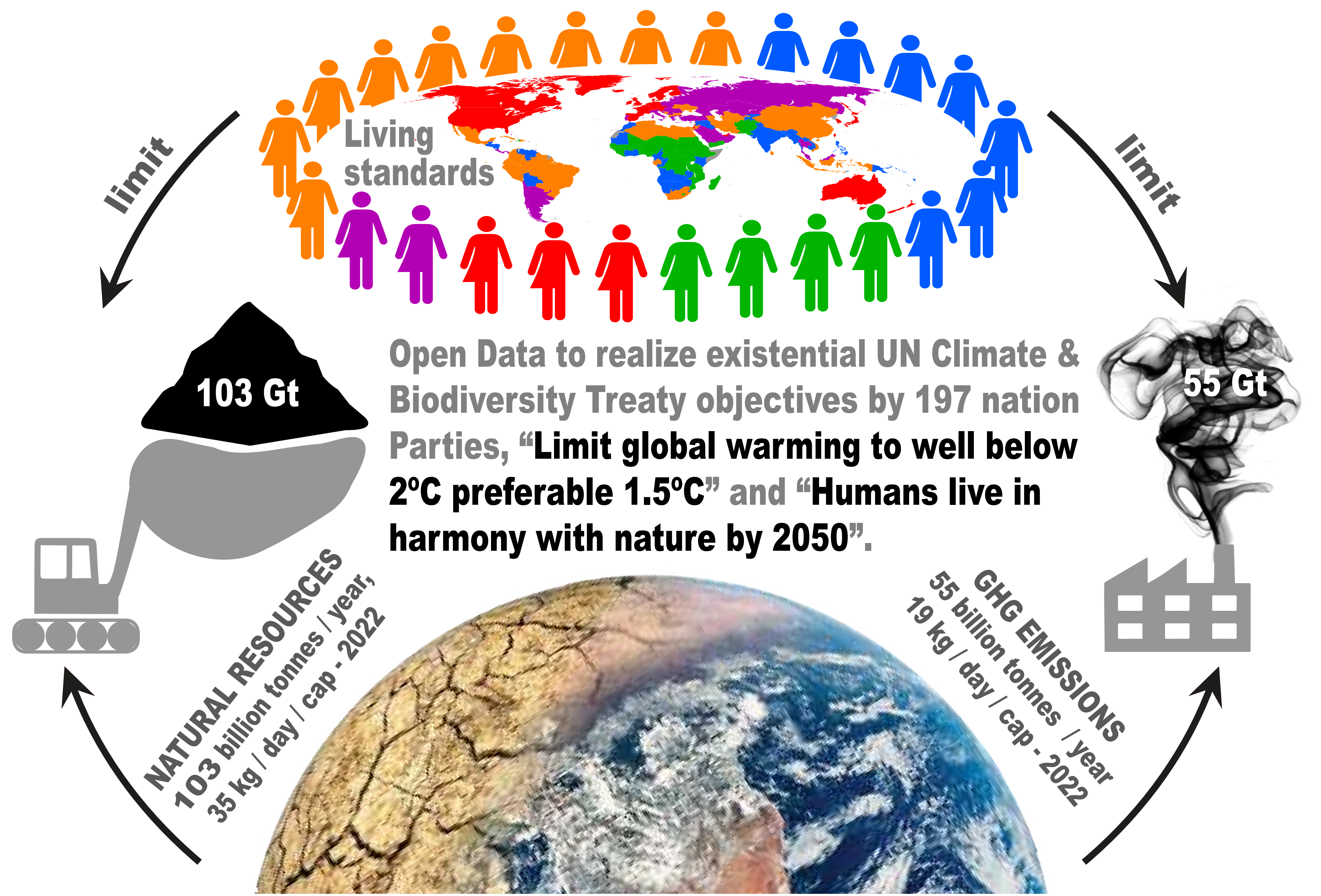
REALITY. "the state of things as they actually exist", accurate, unbiased scientific evidence, not popularity -

reviewed with public communication supported by IPCC Co-Chairs Dr Valérie Masson Delmotte, Dr Panmao Zhai, Dr Hans Pörtner, Dr Debra Roberts, Dr Jim Skea; UNEP Emissions Gap Reports' "intellectual leaders" Dr Bert Metz, Dr John Christensen; IRP Co-Chairs Dr Janez Potocnik, Dr Izabella Teixeira, founding Co-Chairs Dr Ashok Khosla, Dr Ernst Weizsaecker... this UN Only One Earth Science is considered "an important contribution to the UN 75th Anniversary Initiative"*, public communication supported by Dr Jian Liu, Chief Scientist UNEP, Dr Pavel Kabat, Chief Scientist WMO, Dr Soumya Swaminathan, Chief Scientist WHO, Dr Youba Sokona, Vice Chair IPCC, Dr Shamila Nair-Bedouelle, Director General Science UNESCO, Dr Guido Schmidt-Traub, Executive Director UNSDSN, Dr Elizabeth Mrema, Executive Secretary CBD, Dr Stefan Swartling Peterson, Director Health UNICEF.
*** Fabrizio Hochschild, UN Technology Envoy, UN 75th Anniversary Special Advisor.... PLUS ????**


Hydro-Wind-Solar 5%
Ev 1.5%
1900 - 123 years ago
Hydro, Wind, Solar power > 5% TPES
Electric cars
more than petrol > 1.5%,
160 km per charge top > avg,
lifetime guarantees > none -
SCIENCE + LAWS - no need to destroy nature upon which survival and prosperity depend.
LAWS
UNESCO
unesco OPEN DATA

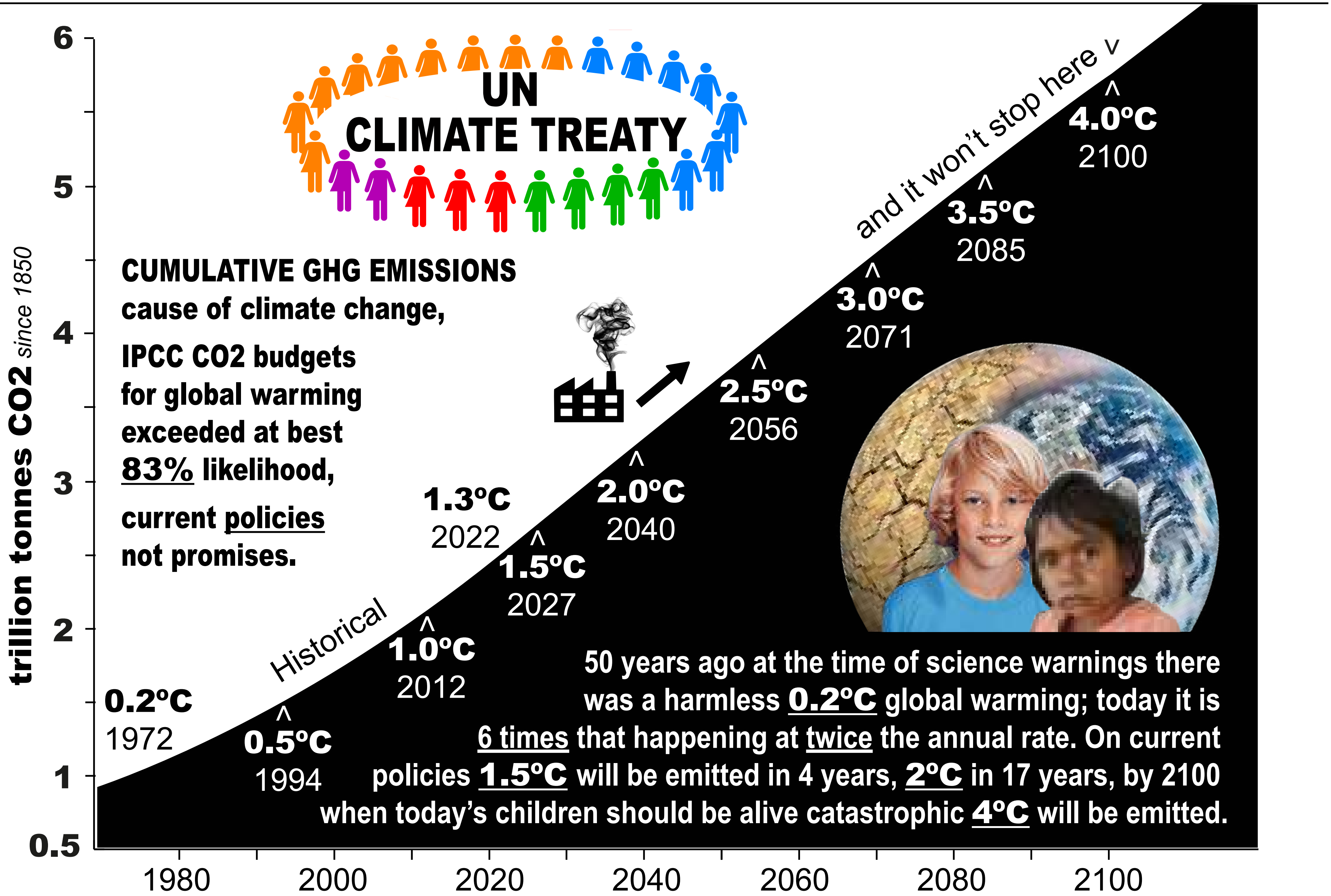

1972 UN Declaration on
the Human Environment -
ONLY ONE EARTH warnings
closed mass
Only one Earth
1. Preserve and enhance Earth for present and future generations.
2. Safeguard Earth's natural resources.
3. Maintain Earth's capacity to produce vital renewable resources.
4. Safeguard Earth's imperiled wildlife.
5. Guard Earth's non-renewable resources against danger of exhaustion.
6. Halt discharge of toxic substances (eg greenhouse gases) which exceed the capacity of Earth to render them harmless.
unesco OPEN DATA

unesco OPEN DATA to stop social-economic collapse



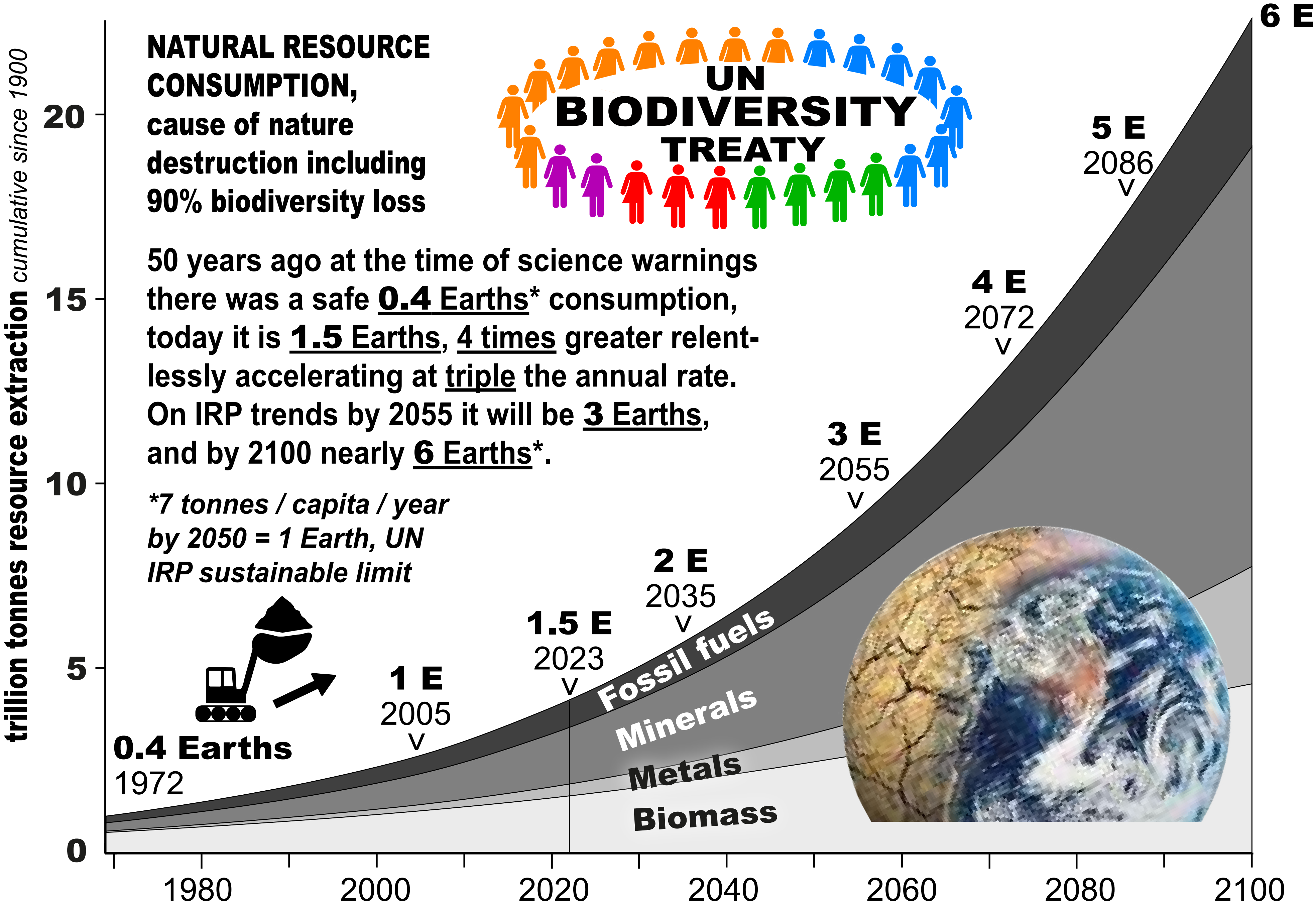
Contact: Dr Bhanu Neupane b.neupane@unesco.org, Only one Earth science coordinators Michael Wadleigh, Birgit van Munster OnlyOneEarthScience@gmail.com +44 7538 416407

unesco OPEN DATA to stop social-economic collapse

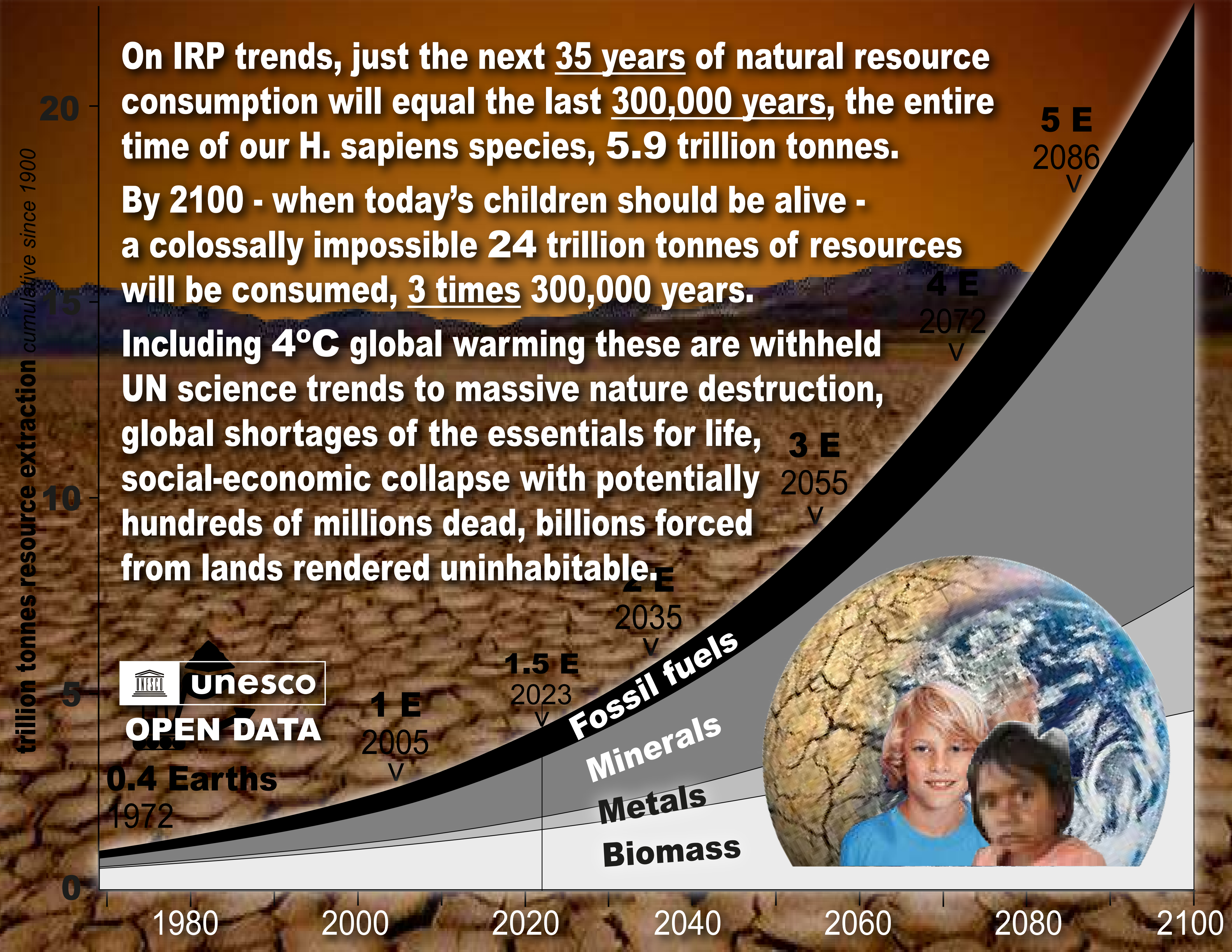


REALITY, evidence, not popularity

unesco OPEN DATA to stop social-economic collapse

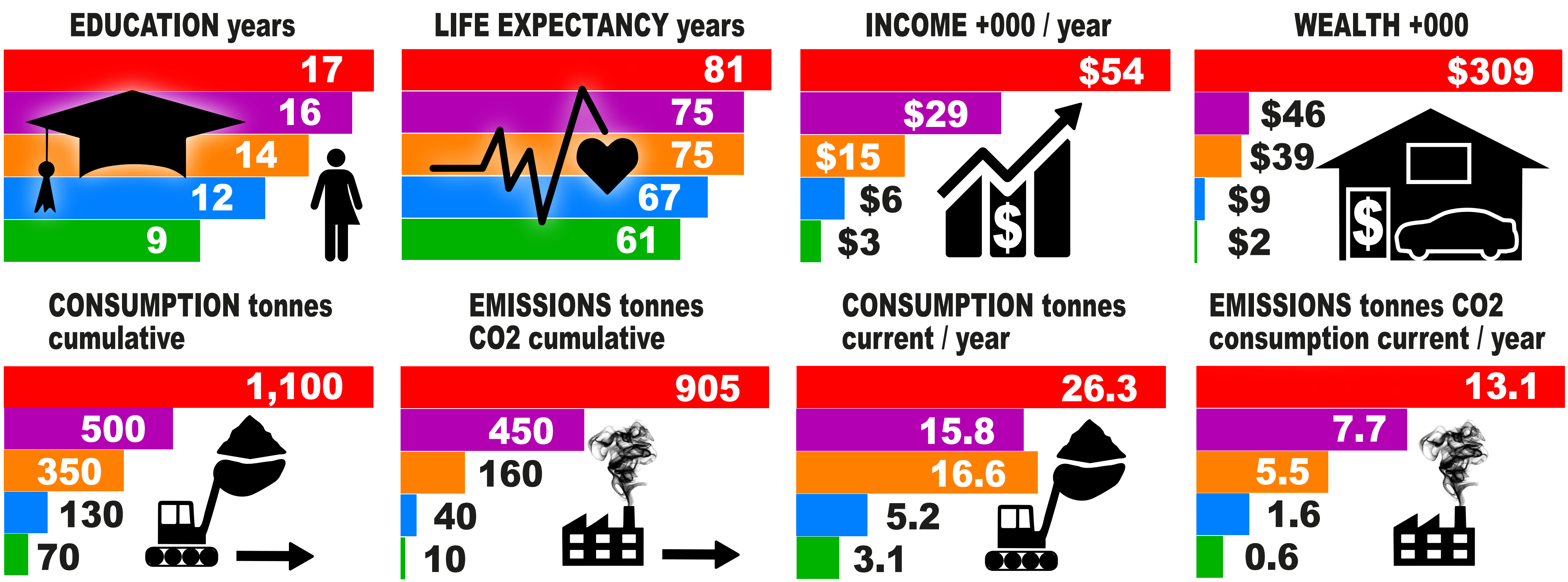


REALITY, evidence, not popularity


On IRP trends, just the next 35 years of natural resource consumption will equal the last 300,000 years, the entire time of our H. sapiens species, 5.9 trillion tonnes.
By 2100 - when today's children should be alive - a colossally impossible 24 trillion tonnes of resources will be consumed, 3 times 300,000 years.
Including 4°C global warming these are withheld UN science trends to massive nature destruction, global shortages of the essentials for life, social-economic collapse with potentially hundreds of millions dead, billions forced from lands rendered uninhabitable.
trillion tonnes resource extraction cumulative since 1900
0
5
10
15
20
1980
2000
2020
2040
2060
2080
2100
unesco
OPEN DATA
0.4 Earths
1972
1 E
2005
1.5 E
2023
2 E
2035
3 E
2055
4 E
2072
5 E
2086
Fossil fuels
Minerals
Metals
Biomass

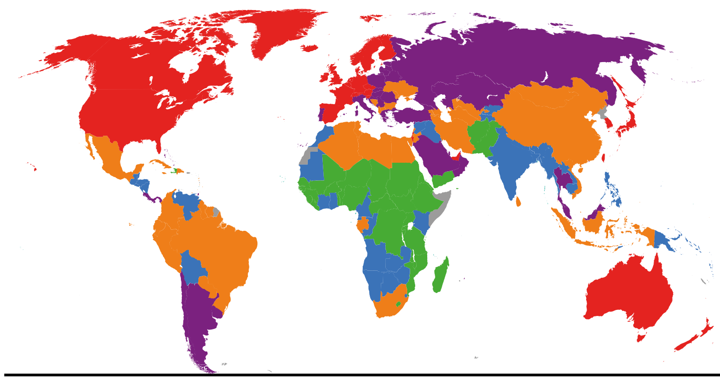
OPEN DATA to stop trends to social-economic collapse - 197 nation Parties' data UN Climate & Biodiversity Treaties

UN living standard per capita *(% pop)*
ULTRA HIGH *(12%)*
VERY HIGH *(9%)*
HIGH *(35%)*
MEDIUM *(28%)*
LOW *(15%)*



• **The 8 UN widely varying LIVING STANDARD PER CAPITA indicators for UN Biodiversity & Climate Treaty agreements by 197 nation Parties - which ELECTORATES must know to demand RESPONSIBLE action by GOVERNMENTS NOW.** *All 197 nations' living standards are attached.*

OPEN DATA to stop trends to social-economic collapse



WEALTH	total trillions	% population
$309,300	$297,000,000,000,000 = 64%	12%
$45,600	$31,000,000,000,000 = 7%	9%
$39,300	$106,000,000,000,000 = 23%	35%
$8,600	$19,000,000,000,000 = 4%	28%
$2,200 per capita	$2,000,000,000,000 = 0.5%	15%

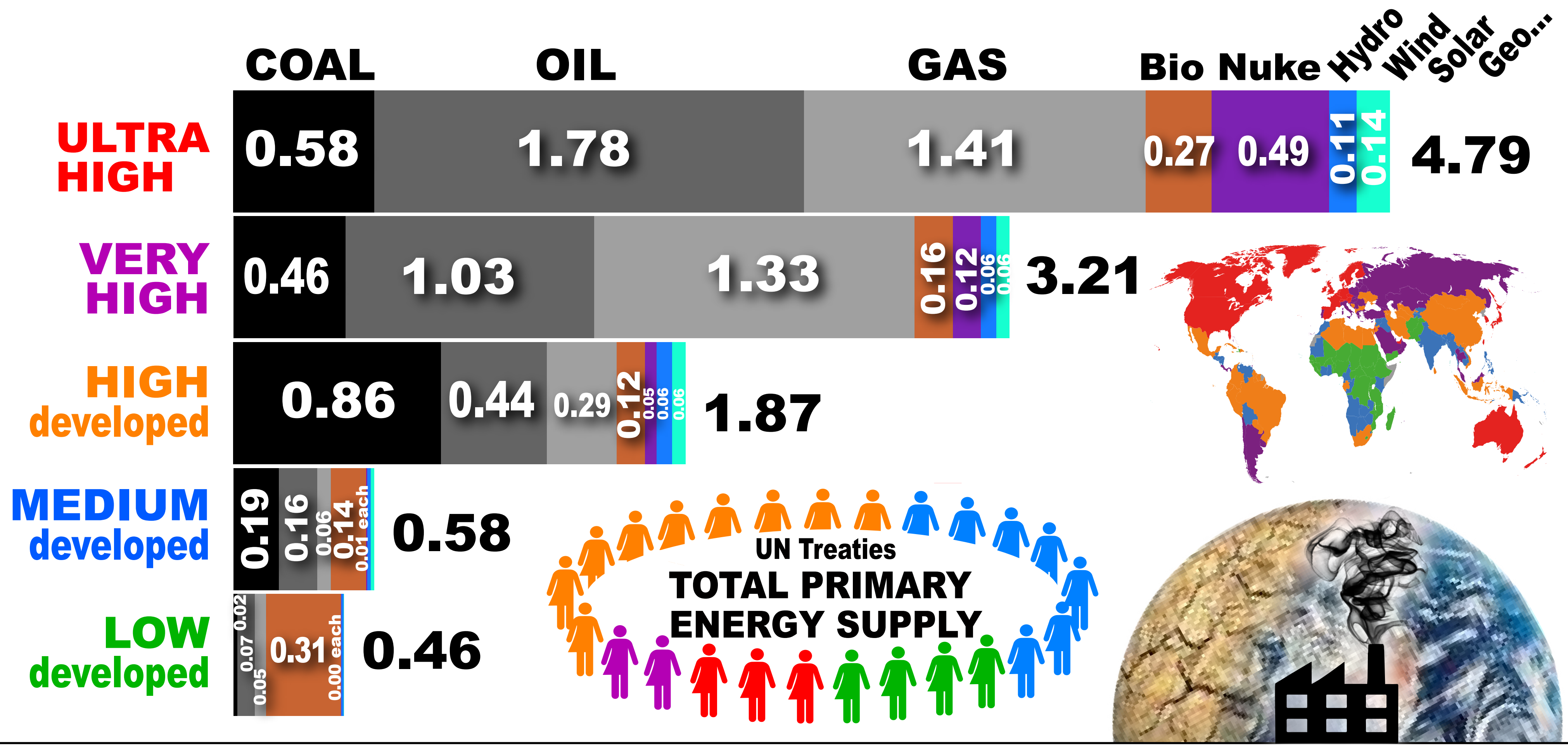
INCOME / year	total trillions	% population
$54,000	$52,000,000,000,000 = 39%	12%
$29,300	$20,000,000,000,000 = 15%	9%
$15,200	$42,000,000,000,000 = 32%	35%
$6,400	$14,000,000,000,000 = 11%	28%
$3,000 per capita	$4,000,000,000,000 = 2.7%	15%

• **EXISTENTIAL FINANCE.** To fund the entire $100 billion annual UN Climate Fund would cost Ultra High about 1 / 500th of annual income 1 / 3,000th of their wealth. Ultra High are 12% of humanity with $297 trillion (64%) of wealth, $52 trillion (39%) of income - start with them for existential finance.

DEVELOPMENT level by Education, Health, Income, UNDP [a] (% of global population)	**Education** years per capita	**Longevity** years per capita	**Income** $ / year per capita	**Wealth** $ per capita (% of global)	**Consumption historic** tonnes per capita (% of global)	**Emissions CO2 historic** tonnes historic per capita (% of global)	**Consumption current** 2019 tonnes / year per capita (trend % annual change)	**Emissions CO2 current** 2019 tCO2 / year per capita (trend % annual change)
Ultra High (12%)	**16.7**	**80.8**	**$54,000**	**$309,300** (64%)	**1,095** (37 %)	**903** (50 %)	**26.3** (+0.5%)	**13.1** (-0.1%)
Very High (9%)	**16.2**	**75.4**	**$29,300**	**$45,600** (7%)	**500** (12%)	**450** (18%)	**15.8** (+1.8%)	**7.7** (+0.3%)
High (35%)	**14.2**	**74.7**	**$15,200**	**$39,300** (33%)	**355** (34%)	**157** (25%)	**16.6** (+3.1%)	**5.4** (+2.9%)
Medium (28%)	**12.0**	**67.4**	**$6,400**	**$8,600** (4%)	**128** (10%)	**39** (5%)	**5.2** (+1.1%)	**1.6** (+2.6%)
Low (15%)	**9.5**	**61.3**	**$3,000**	**$2,200** (0.5%)	**71** (3%)	**11** (1%)	**3.1** (+0.6%)	**0.6** (+1.4%)
Humanity	**12.8**	**71.4**	**$16,750**	**$58,610**	**370**	**217**	**12.5**	**4.8**
EU60%40%	**16.8**	**80.5**	**$44,000**	**$178,300**	**906**	**670**	**18.9**	**8.2**
1 **Switzerland**	**16.5**	**84.0**	**$66,933**	**$561,244**	**1,427**	**359**	**31.1**	**14.6**
2 **Norway**	**18.2**	**83.2**	**$64,660**	**$261,520**	**1,409**	**504**	**38.8**	**9.5**
3 **Iceland**	**19.2**	**82.7**	**$55,782**	**$318,630**	**2,509**	**427**	**59.6**	**9.4 ***
4 **Hong Kong**	**17.3**	**85.5**	**$62,607**	**$465,937**	**3,080**	**226**	**112.6**	**11.7**
5 **Australia**	**21.1**	**84.5**	**$49,238**	**$410,824**	**1,469**	**743**	**46.8**	**14.8**
6 **Denmark**	**18.7**	**81.4**	**$60,365**	**$330,530**	**1,107**	**717**	**25.9**	**8.3**
7 **Sweden**	**19.4**	**83.0**	**$54,489**	**$285,657**	**940**	**488**	**26.7**	**6.9**
8 **Ireland**	**18.9**	**82.0**	**$76,169**	**$184,497**	**1,281**	**462**	**49.3**	**10.6**
9 **Germany**	**17.0**	**80.6**	**$54,534**	**$209,679**	**1,084**	**1,144**	**19.4**	**10.5**
10 **Netherlands**	**18.7**	**81.7**	**$55,979**	**$309,799**	**1,346**	**693**	**32.3**	**10.0**
11 **Finland**	**19.1**	**82.0**	**$49,452**	**$147,580**	**1,440**	**597**	**36.7**	**10.0**
12 **Singapore**	**16.5**	**82.8**	**$90,919**	**$297,253**	**1,546**	**361**	**50.4**	**28.2**

unesco **OPEN DATA to stop trends to social-economic collapse**

TPES Total primary energy supply in tonnes oil-equivalent per year per capita (IEA 2020)



ULTRA HIGH (red) LEAD ALL NATIONS TOWARD SOCIAL-ECONOMIC COLLAPSE

- Ultra High Developed per capita COAL use alone equals ALL energy used by Medium and Low; Ultra High COAL+OIL+GAS fossil fuel use is 2x, 6x, 10x ALL High, Med, Low energy use.
- After 50 years of warnings to change, Ultra High's emitting energy is 85% non-emitting, nuclear is 10%, hydro 2% (difficult to expand), wind-solar-geo-tidal-etc. is only 3% TPES.

Total primary energy supply, Medium & Ultra High developed - biomass labour to natural gas leisure - to which all naturally aspire.*

** Natural gas has more than half the CO2 of coal - don't use it.*

EMISSIONS tonnes CO2 cumulative 905

40

10

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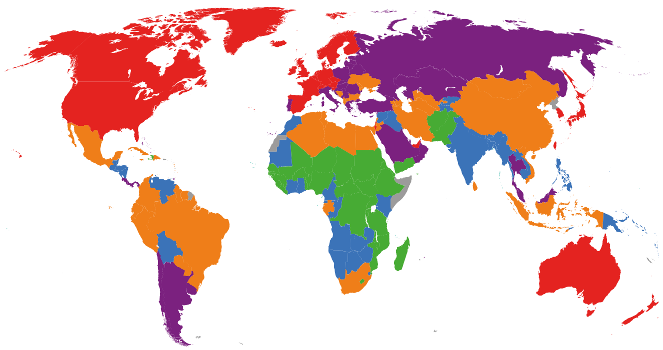
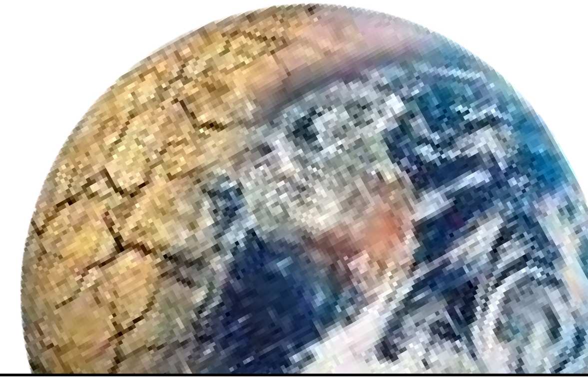
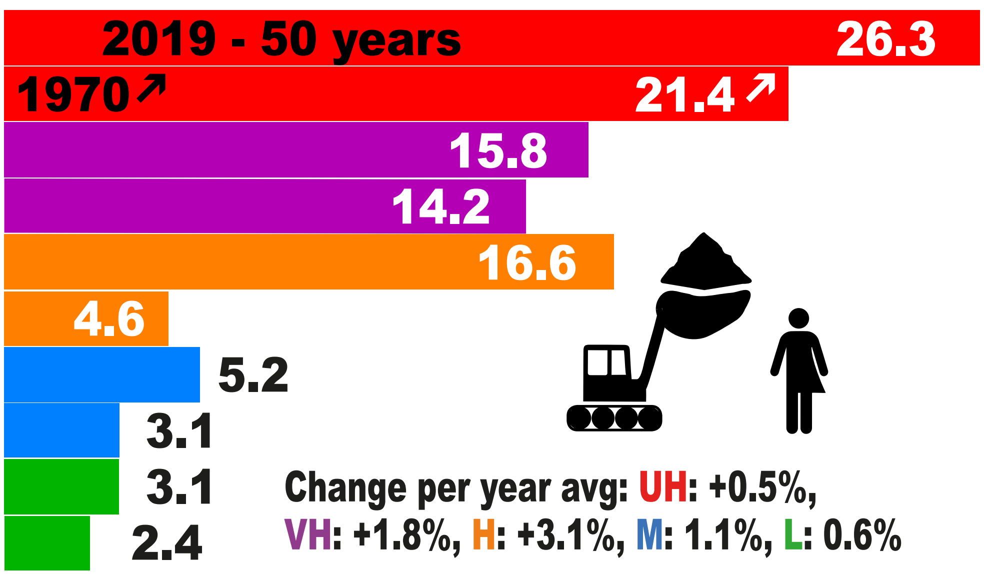
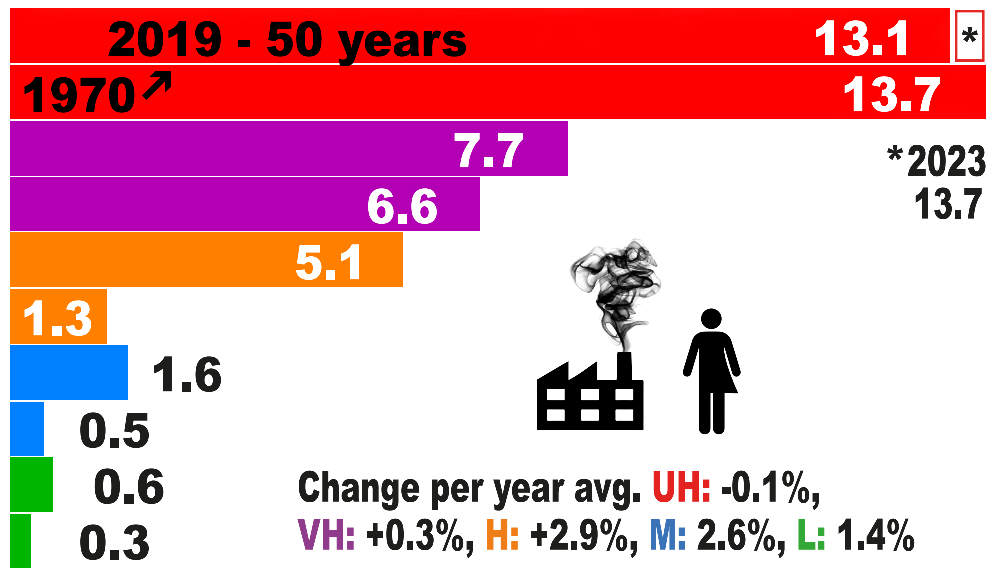




CONSUMPTION tonnes / year 2019 & 1970 per capita



EMISSIONS tonnes CO2 consumption / year 2019 & 1970



ULTRA HIGH (red) LEAD HUMANITY TOWARD SOCIAL-ECONOMIC COLLAPSE

- UN Ultra High - the most educated, healthy and wealthy - set the STANDARDS; 12% of humanity have 64% of wealth and cause 50% of emissions and 37% of consumption cumulatively.
- In the 50 years of science warnings (above) though they said they could, would and must Ultra High have NOT reduced emissions or consumption - and are INCREASING both now.

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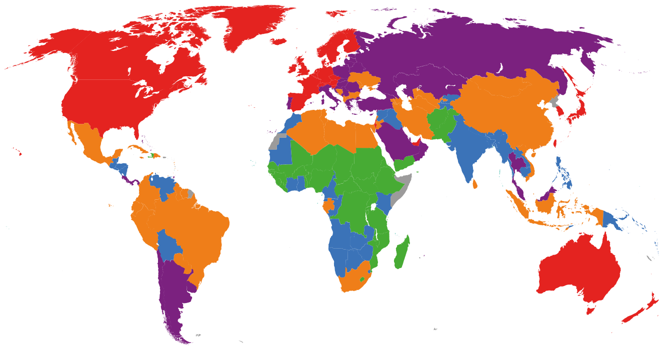
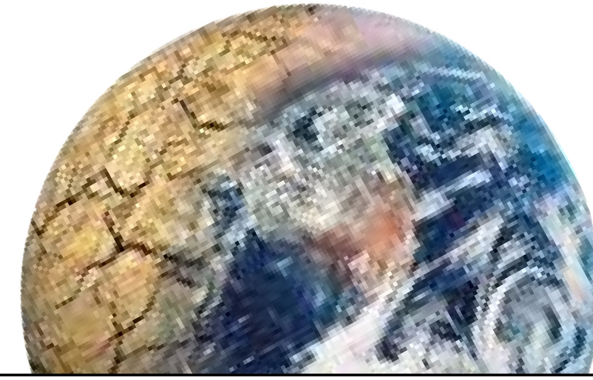
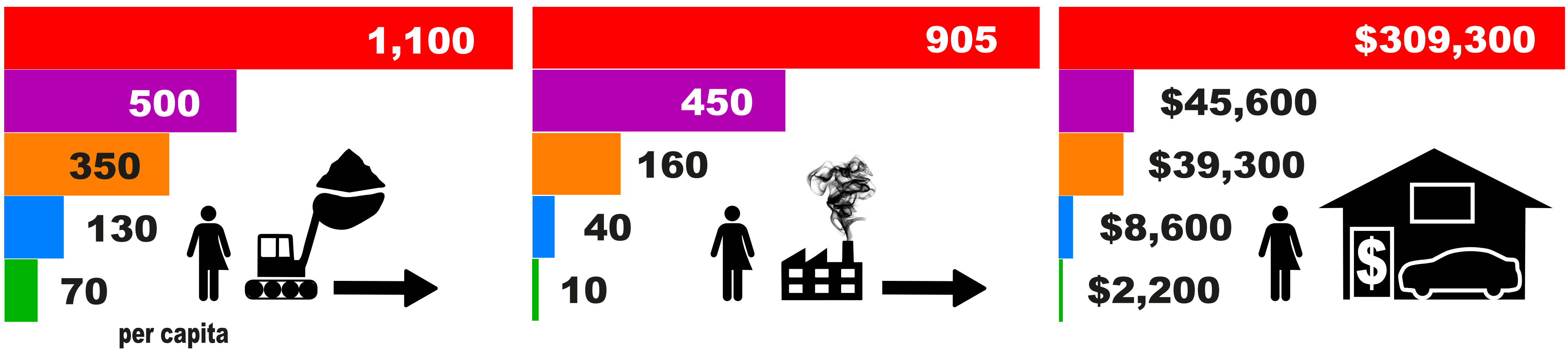


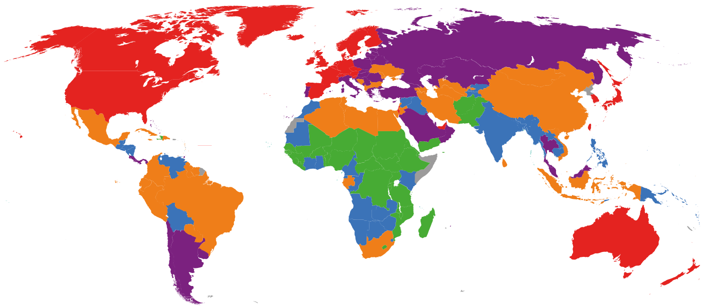


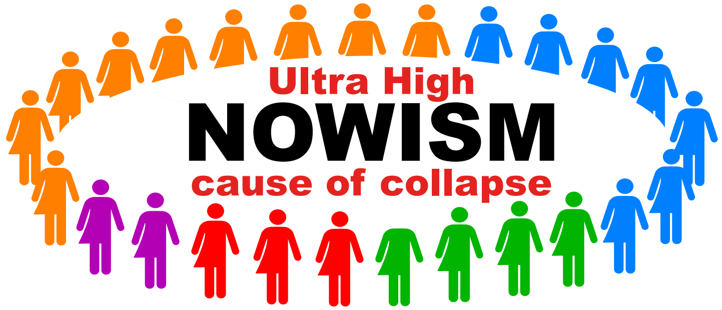
CONSUMPTION tonnes cumulative | EMISSIONS tonnes CO2 cumulative | WEALTH



ULTRA HIGH (red) LEAD HUMANITY TOWARD SOCIAL-ECONOMIC COLLAPSE

- Ultra High per capita cumulatively consume 1,100 tonnes of natural resources and emit 905 tonnes CO2 to realize their current $309,300 wealth, 142 times greater than Low developed (green).
- To attain desired Ultra High living standards, 169 less developed nations, 88% of global population are rapidly INCREASING their consumption and emissions toward the standard of Ultra High - these are trends to imminent global SOCIAL-ECONOMIC COLLAPSE.





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cause of climate, consumption

Ultra High lead humanity in “NOWISM, everything for the present nothing for the future - maintain and increase living standards for me now”.


NOWISM - everything for the present
nothing for the future - ENDED
197 nation Parties
UN TREATIES
2,000 years
9 years
15 years
NOWISM - "Me More New Now" - ENDED
9%

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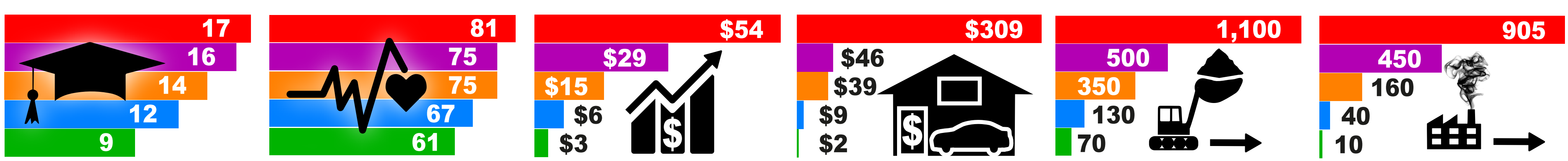
SOLUTIONS / RESPONSIBLE actions

CONSUMPTION tonnes current / year	Reduce per year now for 1 EARTH	EMISSIONS tonnes CO2 consumption current / year	Reduce per year now for 2ºC	Reduce per year now for 1.5ºC
26.3	-4%	13.1	-15%	-78%
15.8	-3.5%	7.7	-9%	-37%
16.6	-3%	5.4	-6%	-23%
5.2	+ 2%	1.6	-1%	-5%
3.1	+ 4%	0.5	+ 1%	-1%

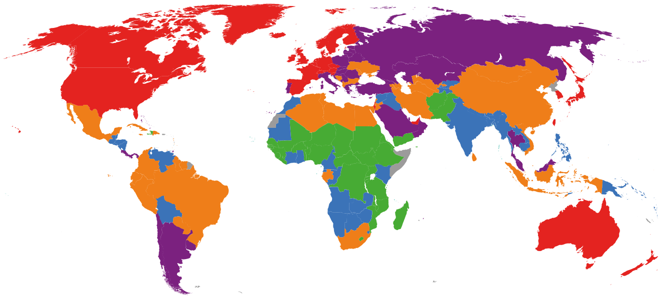
UN agreement is that action is by RESPONSIBILITY for "contribution to environmental degradation" - above are reductions / increases to be on UN IRP and IPCC LIMITS:

- **IRP limit for sustainable natural resource extraction is 7 tonnes per year per capita by 2050.**
- **IPCC limit (best 83% likelihood) for 1.5ºC / 2ºC is 29 / 96 tonnes CO2 per capita 2021 onward.**

All 197 nation Parties' data and action by current emission-consumption responsibility follows.



DEVELOPMENT level by Education, Health, Income, UNDP [a] 2022/10/30	**LIVING STANDARD**, Wealth, Credit Suisse [b]	**BIODIVERSITY LOSS**, **90% caused by consumption** of extracted natural resources, IRP [c]		**BIODIVERSITY TREATY**, **7 tonnes consumption** per year per capita by 2050, "1 Earth" science limit, IRP [d]	**CLIMATE CHANGE**, **emissions CO2** from consumption, GCP [e]		**CLIMATE TREATY pledges** Climate Resource [f]	**CLIMATE TREATY for 1.5˚C / 2˚C**, **CO2 reductions required**, 29 / 96 tonnes per capita 2022 - 2100, science limit, IPCC [g]	
Development UH Ultra High, VH Very High, H High, M Medium, L Low	Wealth $ / capita	Consumption Tonnes / year / capita	*15 years trend % / yr*	Consumption – CUT or + ADD % per year now	Emission CO2 Tonnes / year / capita	*15 years trend % / yr*	Pledge as average % per year 2021 - 2030	Emission CO2 – CUT or + ADD % per year now, for 1.5ºC	for 2ºC
Ultra High Developed	**$ 309,300**	**26.3**	*+0.5%*	**-4.4%**	**13.1**	*-0.9%*	**-4.0%**	**-77.8%**	**-15.3%**
Very High Developed	**$ 45,600**	**15.8**	*+1.7%*	**-2.8%**	**7.7**	*+1.3%*	**+0.4%**	**-36.3%**	**-8.8%**
High Developed	**$ 39,300**	**16.6**	*+4.5%*	**-2.7%**	**5.5**	*+4.5%*	**+1.0%**	**-20.8%**	**-5.5%**
Medium Developed	**$ 8,400**	**5.2**	*+3.7%*	**+2.0%**	**1.6**	*+5.2%*	**+3.2%**	**-5.4%**	**-1.0%**
Low Developed	**$ 2,200**	**3.1**	*+4.4%*	**+5.3%**	**0.6**	*+4.2%*	**+1.2%**	**-0.9%**	**+1.5%**
Humanity	**$ 58,600**	**12.5**	*+2.6%*	**-1.2%**	**4.7**	*+1.7%*	**+0.3%**	**-19.0%**	**-5.1%**
European Union	**$ 178,300**	**18.9**	*+0.0%*	**-3.7%**	**9.2**	*-1.7%*	**-3.3%**	**-44.9%**	**-10.4%**
1 **Switzerland**	**$ 561,200**	**31.1**	*+0.5%*	**-4.7%**	**14.0**	*+0.3%*	**-4.5%**	**-87.7%**	**-16.5%**
2 **Norway**	**$ 261,500**	**38.8**	*+1.9%*	**-5.2%**	**9.3**	*+0.6%*	**-8.8%**	**-45.7%**	**-10.5%**
3 **Iceland**	**$ 318,600**	**59.6**	*+0.6%*	**-7.0%**	**10.2 ***	*+0.9%*	**-9.1%**	**-39.9%**	**-9.4%**
4 **Hong Kong**	**$ 465,900**	**112.6**	*-0.2%*	**-9.2%**	**14.9**	*+1.4%*	*na*	**overlimit ****	**-18.0%**
5 **Australia**	**$ 410,800**	**46.8**	*+2.4%*	**-5.7%**	**15.3**	*+0.5%*	**-2.4%**	**overlimit ****	**-18.2%**
6 **Denmark**	**$ 330,500**	**25.9**	*+1.3%*	**-4.3%**	**8.5**	*-2.5%*	**-2.0%**	**-39.5%**	**-9.4%**
7 **Sweden**	**$ 285,657**	**26.7**	*+2.5%*	**-4.2%**	**6.8**	*-1.7%*	**-2.1%**	**-29.3%**	**-7.4%**
8 **Ireland**	**$ 184,500**	**49.3**	*+2.6%*	**-6.2%**	**8.7**	*-3.2%*	**-3.1%**	**-40.7%**	**-9.6%**
9 **Germany**	**$ 209,700**	**19.4**	*-1.2%*	**-3.7%**	**10.3**	*-1.7%*	**-4.6%**	**-52.7%**	**-11.7%**
10 **Netherlands**	**$ 309,800**	**32.3**	*+0.7%*	**-5.3%**	**8.8**	*-1.6%*	**-4.7%**	**-42.0%**	**-9.9%**
11 **Finland**	**$ 147,600**	**36.7**	*+1.6%*	**-5.8%**	**11.7**	*-2.4%*	**-3.1%**	**-65.0%**	**-13.5%**
12 **Singapore**	**$ 297,300**	**50.4**	*+1.6%*	**-6.5%**	**19.6**	*-0.1%*	**+1.3%**	**overlimit ****	**-24.6%**
13 **Belgium**	**$ 296,300**	**33.5**	*+1.1%*	**-5.2%**	**15.4**	*-1.6%*	**-5.0%**	**overlimit ****	**-18.7%**
13 **New Zealand**	**$ 334,500**	**30.7**	*+1.7%*	**-4.6%**	**8.4**	*+0.1%*	**-1.8%**	**-38.2%**	**-9.2%**



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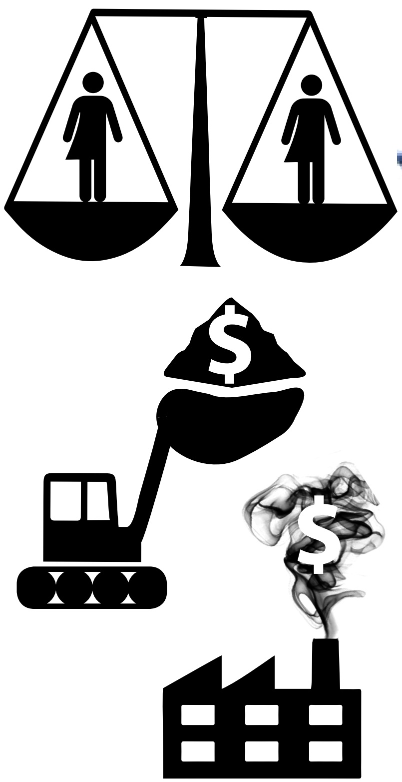
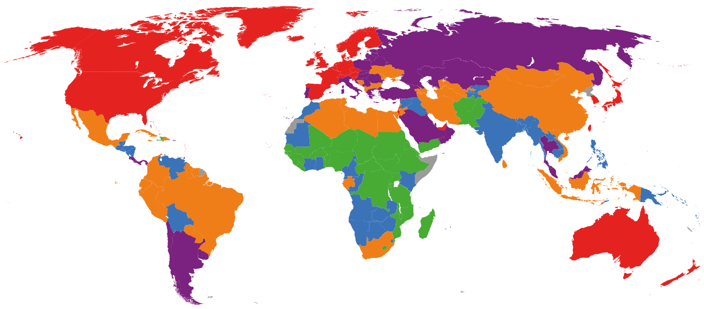


Responsibility App, equitable emission-consumption

Using science - responsibility apps - by law within and between nations ▶ emissions and consumption can be limited fairly, ▶ costs to do so be paid responsibly, ▶ staying within 1.5ºC / 2ºC / 1 Earth science limits, ▶ equitably securing everyone's future.



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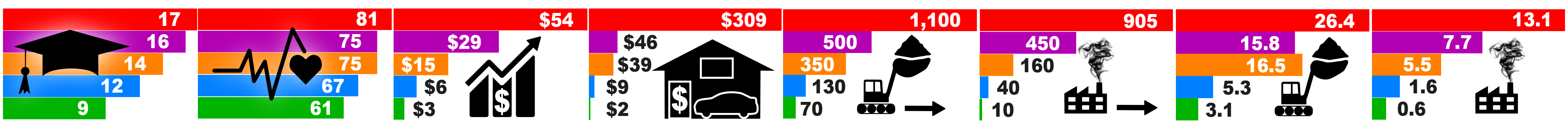
LIVING STANDARD UN Ultra High developed

• University degree, • 81 years longevity, • $54,000 income,
• 26 tonnes consumption plus • 13 tonnes CO2 per year =

• 4ºC+ global warming,
• 6 Earths+ consumption =
COLLAPSE



• "If electorates don't demand it governments won't do it". INFORM Ultra High citizens of RESPONSIBLE consumption-emission reductions required to realize UN Climate & Biodiversity Treaties, so they can demand adequate GOVERNMENT ACTION NOW -

• If Ultra High act responsibly, ALL NATIONS will likely follow, relentlessly accelerating trends to social-economic collapse will be stopped, children's future will be secured.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1.2°C global warming + 1.5 Earths consumption = one-third underwater,
4.0°C (3.3 times more) + 6.0 E (4 times more) = ??????? underwater.
“The People are being deceived and sent off to die potentially in the hundreds of millions”.

<u>Cause</u> of climate change

104,736,585,697

EVERY 1 HOUR: 5 million tonnes CO2, EVERY YEAR 40 billion tonnes -

Dangerous 1.5ºC global warming in 4 years

Disastrous 2ºC in 17 years

Catastrophic 4ºC by 2100 -

per year now 2ºC 1.5ºC

-15% -78%

-9% -37%

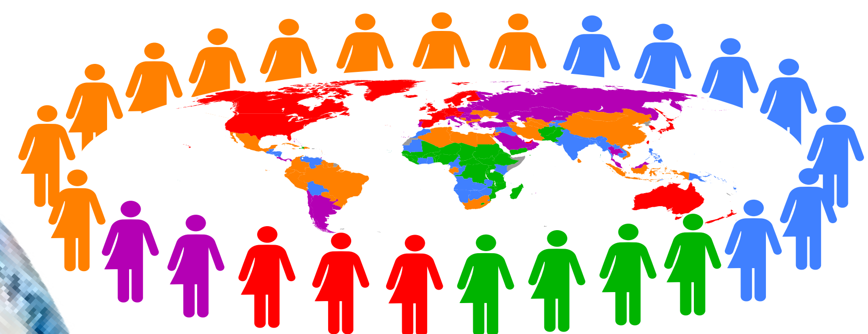
UN Climate Treaty

-6% -23%

Responsible action NOW

-1% -5%

+ 1% -1%



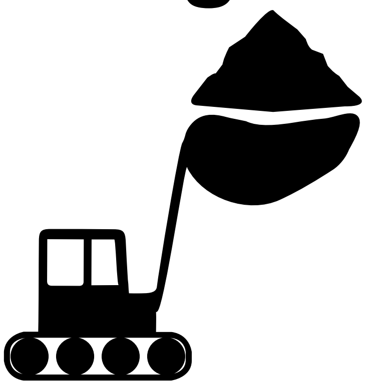

unesco OPEN DATA
1.2ºC global warming + 1.5 Earths consumption = East Africa drought,
4.0ºC (3.3 times more) + 6.0 E (4 times more) = ???? global drought.
“The People are being deceived and sent off to die potentially in the hundreds of millions”.

Cause of 90% biodiversity loss

-,11,0,659,075,78

EVERY HOUR: 12 million tonnes consumption, EVERY YEAR 104 billion tonnes -

Dangerous 1.5 Earths consumption now



Ruinous 3 Earths 2055

Uninhabitable 6 Earths 2100 -

per year now 1 Earth

-4%

-3.5%

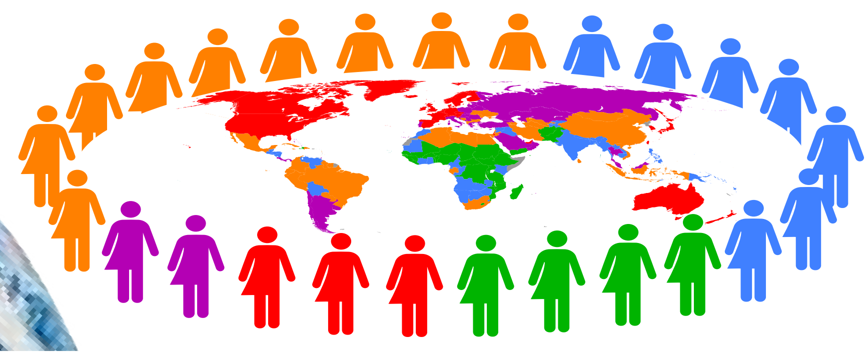
UN Biodiversity Treaty

-3%

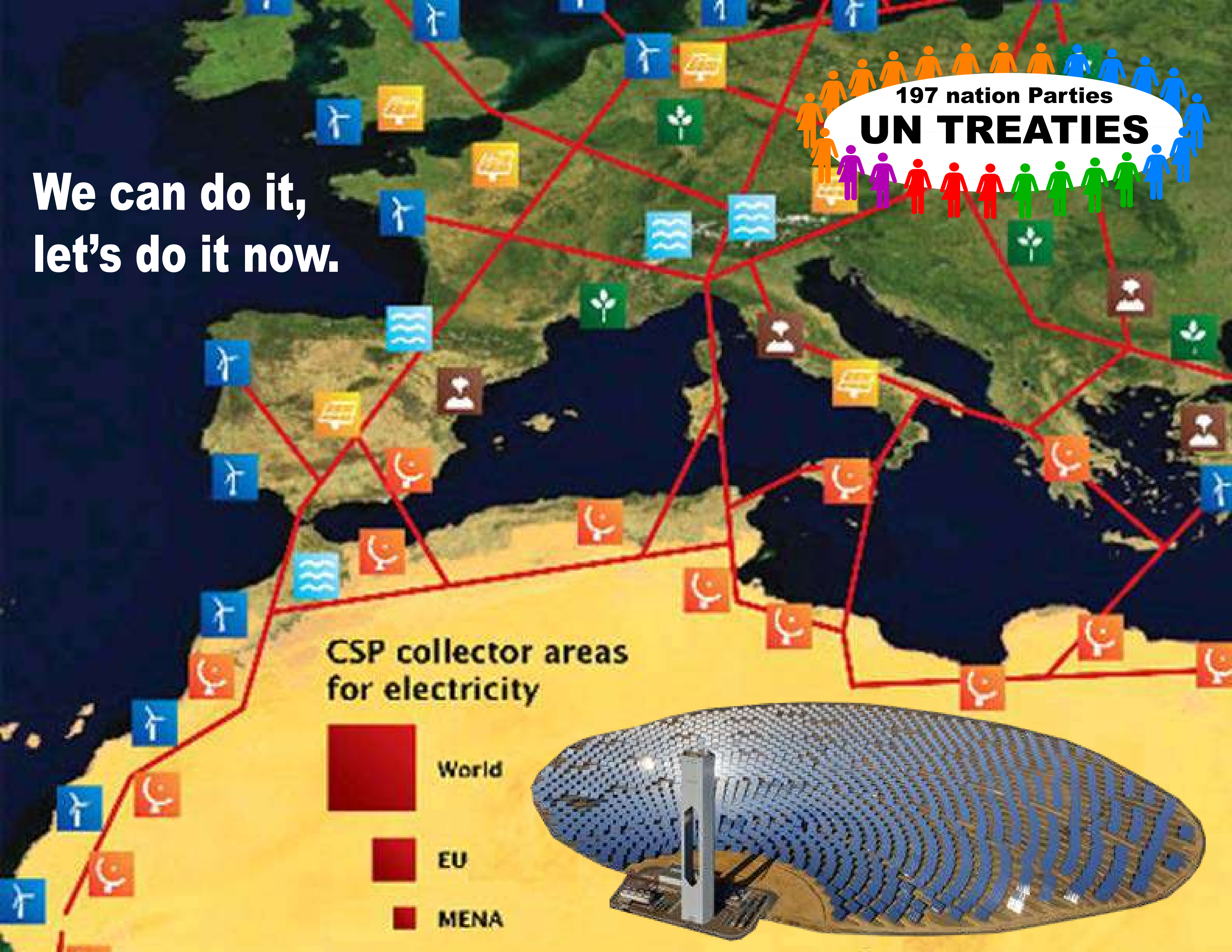
Responsible action NOW

+2%

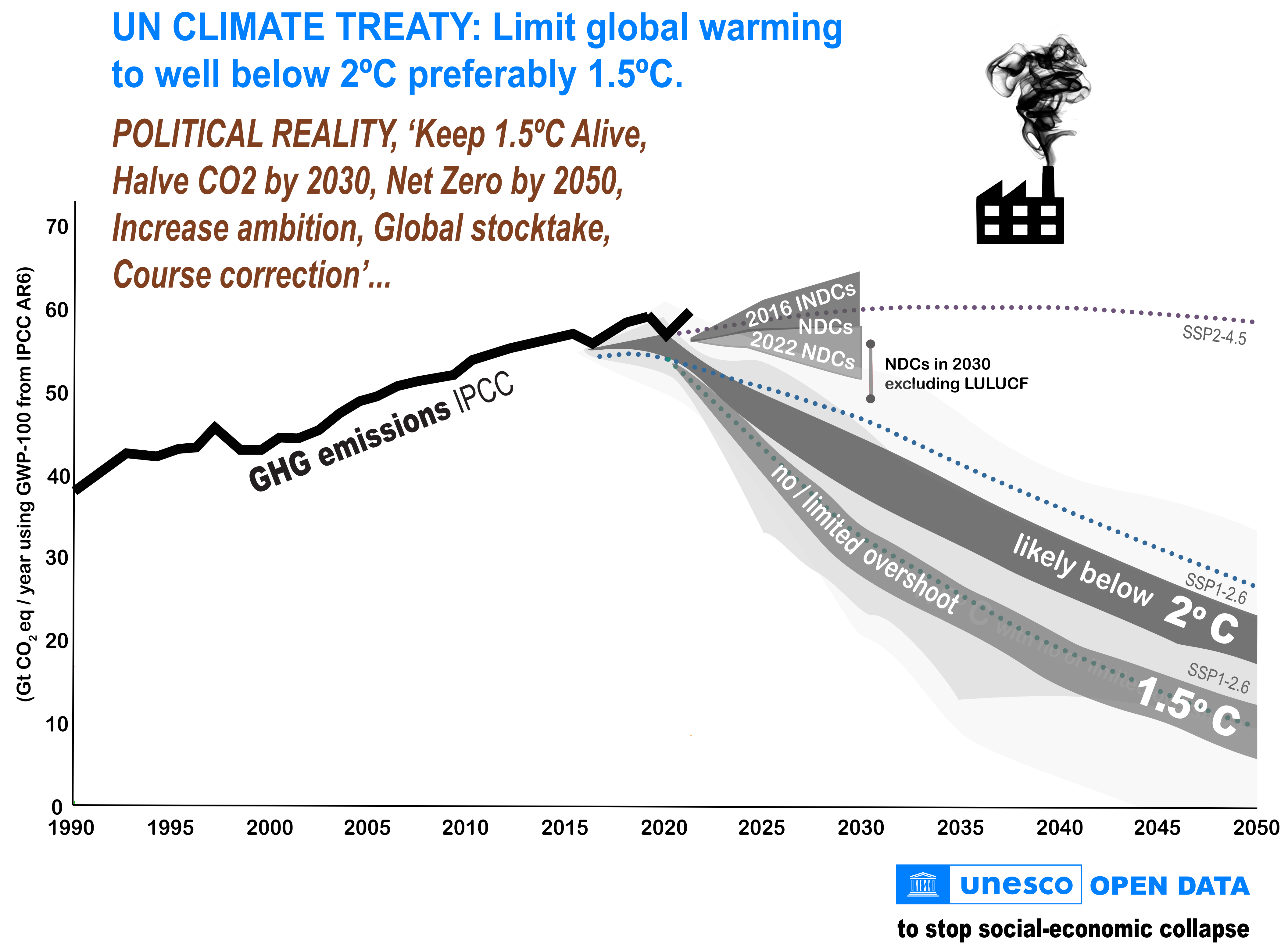
+4%




We can **easily** do **it**,
so let's do it **NOW** !



We can do it,
let's do it now.
197 nation Parties
UN TREATIES
CSP collector areas
for electricity
World
EU
MENA


UN CLIMATE TREATY: Limit global warming
to well below 2ºC preferably 1.5ºC.
POLITICAL REALITY, 'Keep 1.5ºC Alive,
Halve CO2 by 2030, Net Zero by 2050,
Increase ambition, Global stocktake,
Course correction'...
(Gt CO2 eq / year using GWP-100 from IPCC AR6)
70
60
50
40
30
20
10
0
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
GHG emissions IPCC
2016 INDCs
NDCs
2022 NDCs
NDCs in 2030
excluding LULUCF
SSP2-4.5
SSP1-2.6
SSP1-2.6
no / limited overshoot
likely below 2º C
1.5º C
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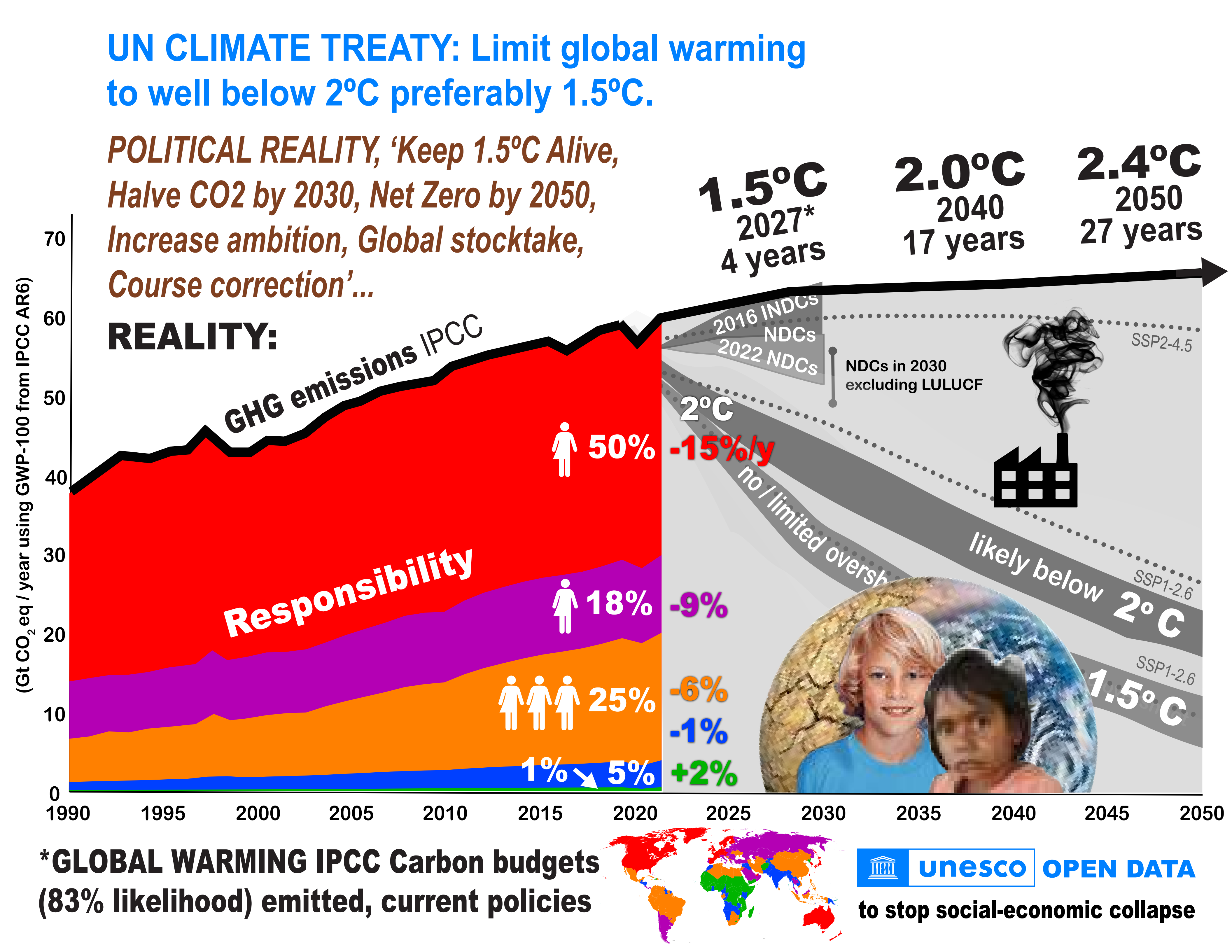
to stop social-economic collapse


UN CLIMATE TREATY: Limit global warming to well below 2ºC preferably 1.5ºC.
POLITICAL REALITY, 'Keep 1.5ºC Alive, Halve CO2 by 2030, Net Zero by 2050, Increase ambition, Global stocktake, Course correction'...
REALITY:
GHG emissions IPCC
Responsibility
1.5ºC 2027* 4 years
2.0ºC 2040 17 years
2.4ºC 2050 27 years
2016 INDCs
NDCs
2022 NDCs
NDCs in 2030 excluding LULUCF
SSP2-4.5
2ºC
-15%/y
no / limited oversh
likely below 2º C
SSP1-2.6
SSP1-2.6
1.5º C
50%
18%
25%
1%
5%
-9%
-6%
-1%
+2%
(Gt CO2 eq / year using GWP-100 from IPCC AR6)
70
60
50
40
30
20
10
0
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
*GLOBAL WARMING IPCC Carbon budgets (83% likelihood) emitted, current policies
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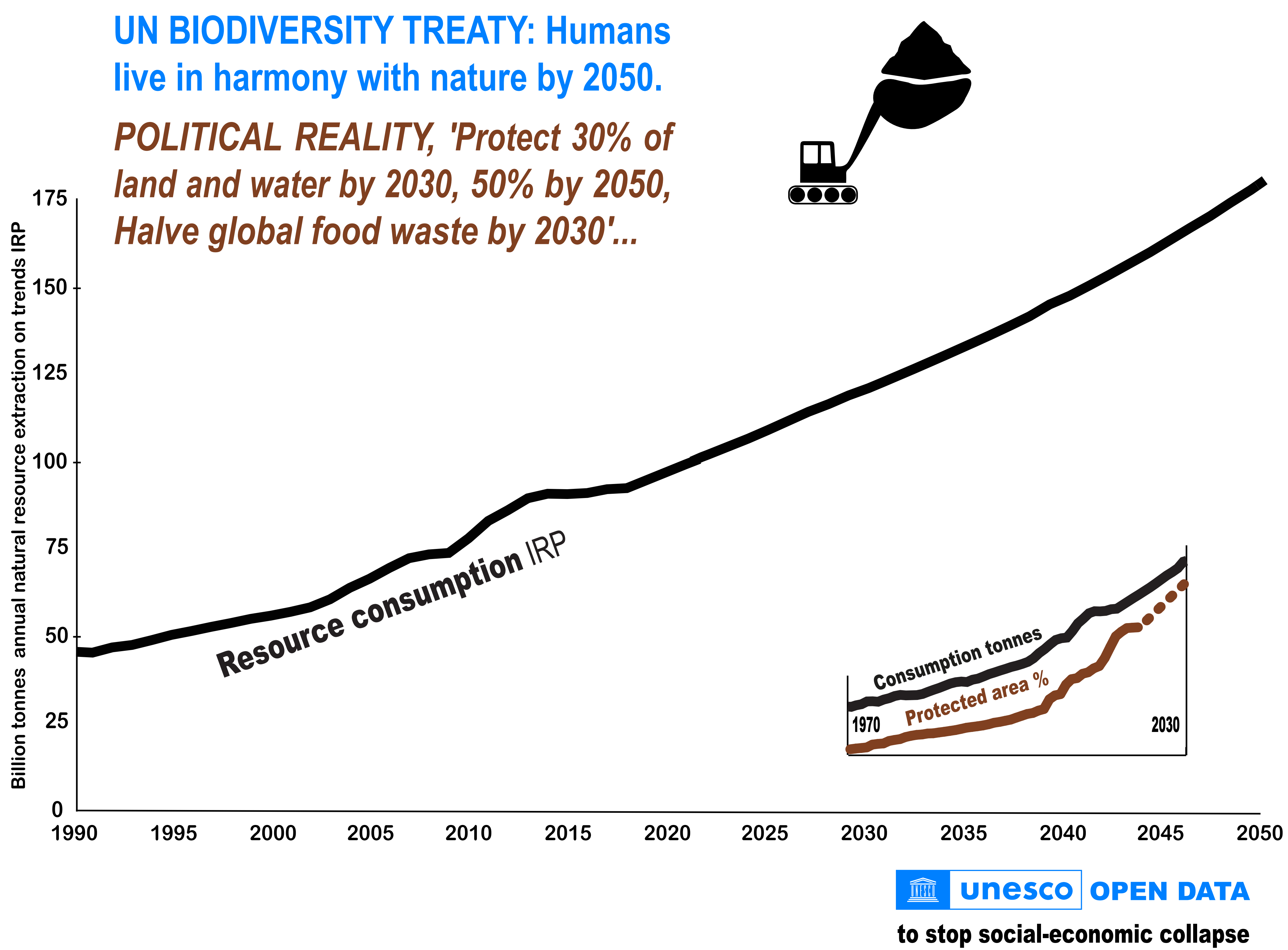
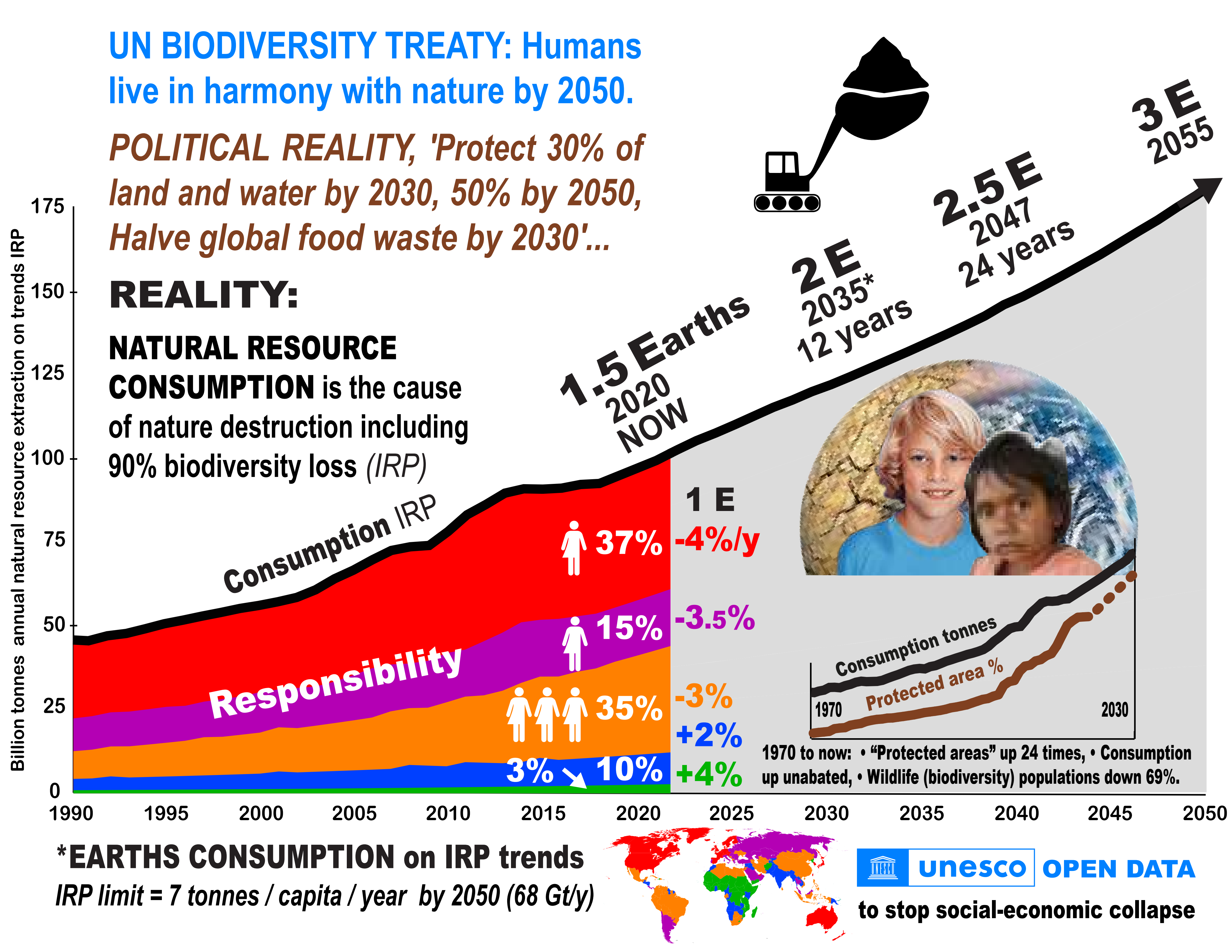
to stop social-economic collapse



UN BIODIVERSITY TREATY: Humans live in harmony with nature by 2050.
POLITICAL REALITY, 'Protect 30% of land and water by 2030, 50% by 2050, Halve global food waste by 2030'...
Billion tonnes annual natural resource extraction on trends IRP
175
150
125
100
75
50
25
0
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Resource consumption IRP
Consumption tonnes
Protected area %
1970
2030
unesco OPEN DATA
to stop social-economic collapse


UN BIODIVERSITY TREATY: Humans live in harmony with nature by 2050.
POLITICAL REALITY, 'Protect 30% of land and water by 2030, 50% by 2050, Halve global food waste by 2030'...
REALITY:
NATURAL RESOURCE CONSUMPTION is the cause of nature destruction including 90% biodiversity loss (IRP)
Billion tonnes annual natural resource extraction on trends IRP
175
150
125
100
75
50
25
0
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Consumption IRP
Responsibility
37%
15%
35%
3%
10%
1 E
-4%/y
-3.5%
-3%
+2%
+4%
1.5 Earths 2020 NOW
2 E 2035* 12 years
2.5 E 2047 24 years
3 E 2055
Consumption tonnes
Protected area %
1970
2030
1970 to now: • "Protected areas" up 24 times, • Consumption up unabated, • Wildlife (biodiversity) populations down 69%.
*EARTHS CONSUMPTION on IRP trends
IRP limit = 7 tonnes / capita / year by 2050 (68 Gt/y)
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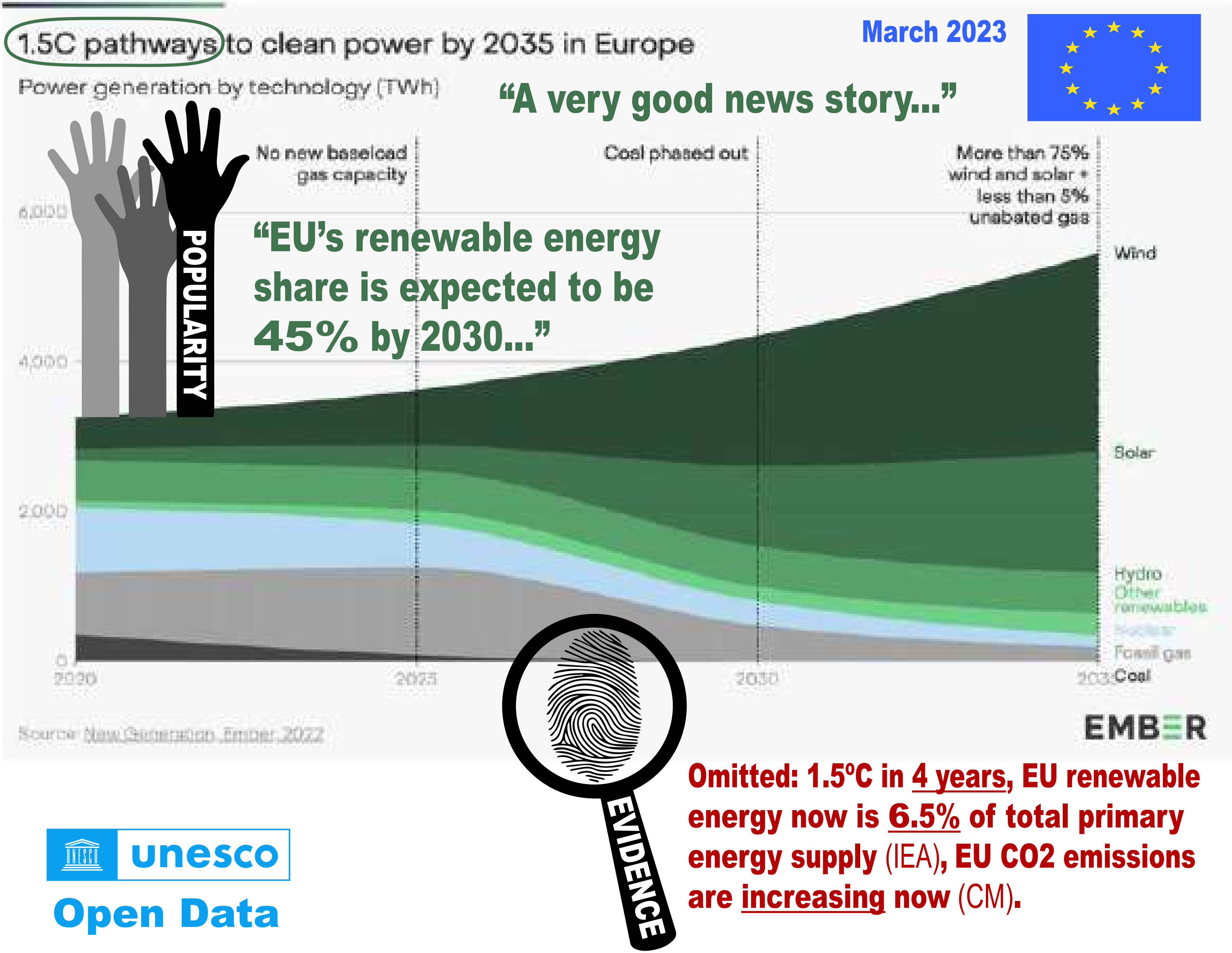
to stop social-economic collapse



Omitted: 1.5°C in 4 years, EU renewable energy now is 6.5% of total primary energy supply (IEA), EU CO2 emissions are increasing now (CM).

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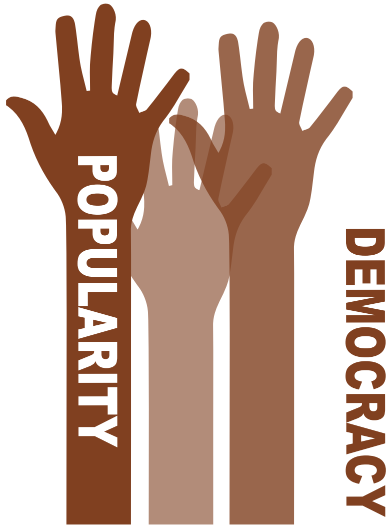
Open Data



The laws of nature must obey the laws of humans or we won't be reelected.

POLITICAL REALITY, "a state of things as they don't actually exist", popularity, good news, positive stories.

UN Ultra High Developed Nations: Swiss Academy of Sciences, Norwegian Academy of Sciences & Letters, Australian Academy of Science, Royal Danish Academy of Sciences & Letters, Royal Swedish Academy of Sciences, Royal Irish Academy, German National Academy of Sciences Leopoldina, Union of German Academies of Sciences & Humanities, Royal Netherlands Academy of Arts & Sciences, Council of Finish Academies, Singapore National Academy of Sciences, Royal Academies Sciences & Arts of Belgium, Royal Society of New Zealand, National Research Council of Canada, Luxembourg National Research Fund, Royal Society United Kingdom, Science Council of Japan, Korean Academy of Science &Technology, National Academy of Sciences United States, Israel Academy of Sciences & Humanities, Slovenian Academy of Sciences and Arts, Austrian Academy of Sciences, Royal Academy of Exact, Physical & Natural Sciences of Spain, Royal France Academy of Sciences, European Academy of Sciences & Arts, European Academies Science Advisory Council... PLUS UNFCCC, CBD, UNEP, UNDP, WMO, IPCC, IRP, IPBES...

The laws of humans must obey the laws of nature or humanity will not survive.

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Open Data

REALITY, "the state of things as they actually exist", accurate, unbiased scientific evidence.

INDIVIDUAL SCIENTISTS: IPCC Co-Chairs Dr Valérie Masson Delmotte, Dr Panmao Zhai, Dr Hans Pörtner, Dr Debra Roberts, Dr Jim Skea; UNEP Emissions Gap Reports' "intellectual leaders" Dr Bert Metz, Dr John Christensen; IRP Co-Chairs Dr Janez Potocnik, Dr Izabella Teixeira, founding Co-Chairs Dr Ashok Khosla, Dr Ernst Weizsaecker. Only One Earth Science UN 75th Anniversary, Dr Jian Liu, Chief Scientist UNEP, Dr Pavel Kabat, Chief Scientist WMO, Dr Soumya Swaminathan, Chief Scientist WHO, Dr Youba Sokona, Vice Chair IPCC, Dr Shamila Nair-Bedouelle, Director General Science UNESCO, Dr Guido Schmidt-Traub, Executive Director UNSDSN, Dr Elizabeth Mrema, Executive Secretary CBD, Dr Stefan Swartling Peterson, Director Health UNICEF.... **PLUS... ?**

SCIENCE ORGANIZATIONS: UNESCO Open Data... **PLUS... ?**

The Role of Science, Technology and Innovation in achieving the SDGs in OIC Countries

Zakri Abdul Hamid FIAS
Founding Fellow, International Science Council
Science Advisor to the Sixth Prime Minister of Malaysia
Chairman, Atri Advisory, Malaysia

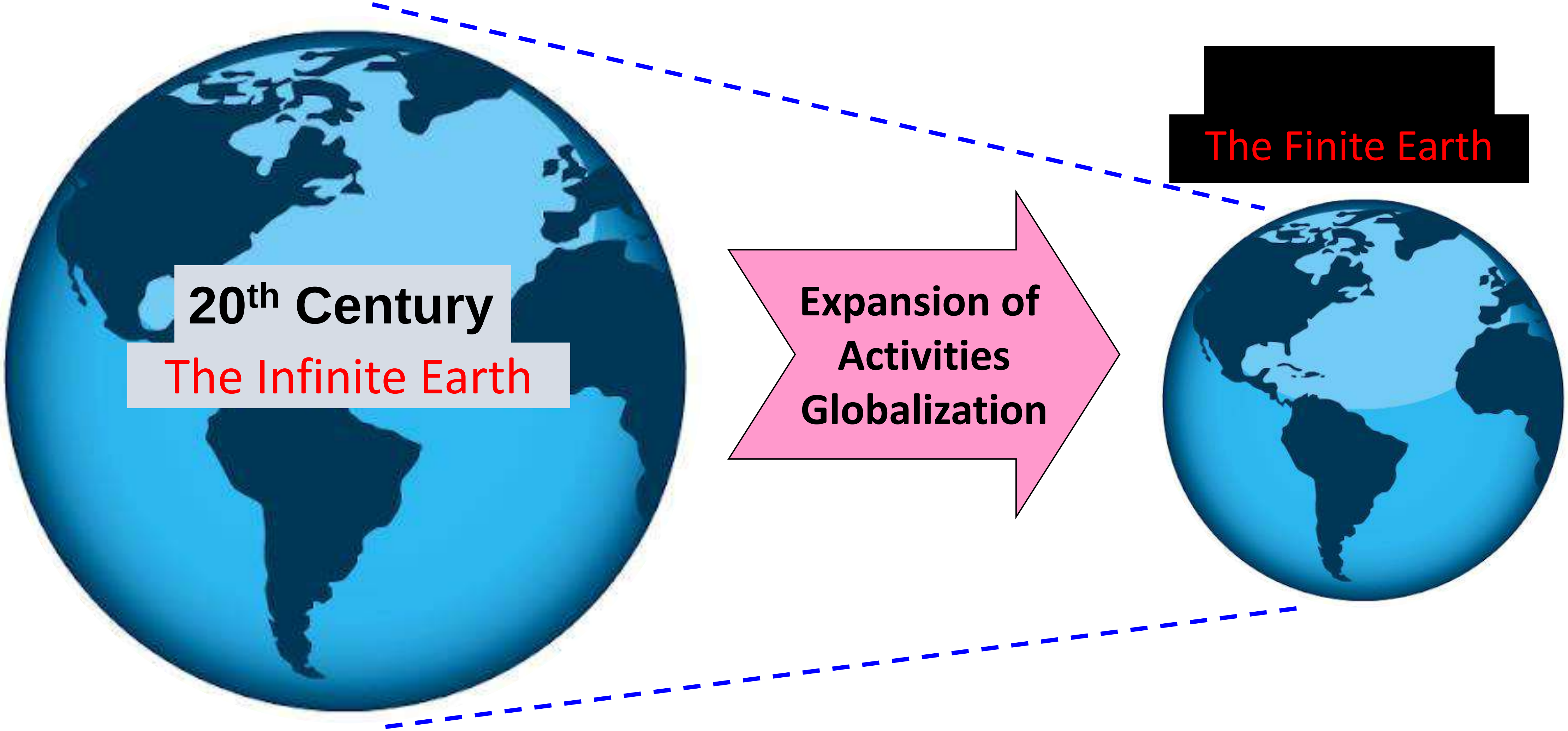
Abstract

The three pillars of sustainable development (economic, social and environment) are underpinned by STI. Any country that aspires to achieve the 17 SDGs must equip itself through investment in the institutional structures of science and technology and earmarking funds for R&D. Three 2nd WW2-ravaged countries that strongly demonstrate this prerequisite are Germany, Japan and South Korea. Their average spending in R&D hover around 3% of their GDP. In contrast, no OIC country could even come close to that figure. At best, our spending on R&D is around 1%, and many of the LDCs among OIC members do not even allocate funds for R&D. To exacerbate matters, the laggard countries do not have a proper institutional structure to support the advancement of STI, e.g. academies of sciences, science advisory mechanisms, and capacity building with an emphasis on science, technology, engineering and mathematics (STEM). SDG#17 calls for international collaboration. This is where relevant bodies like the IAS, COMSTECH, OIC, IsDB and TWAS must band together to develop a Programme of Work based on STI to lift our sister countries out of this socioeconomic underdevelopment.

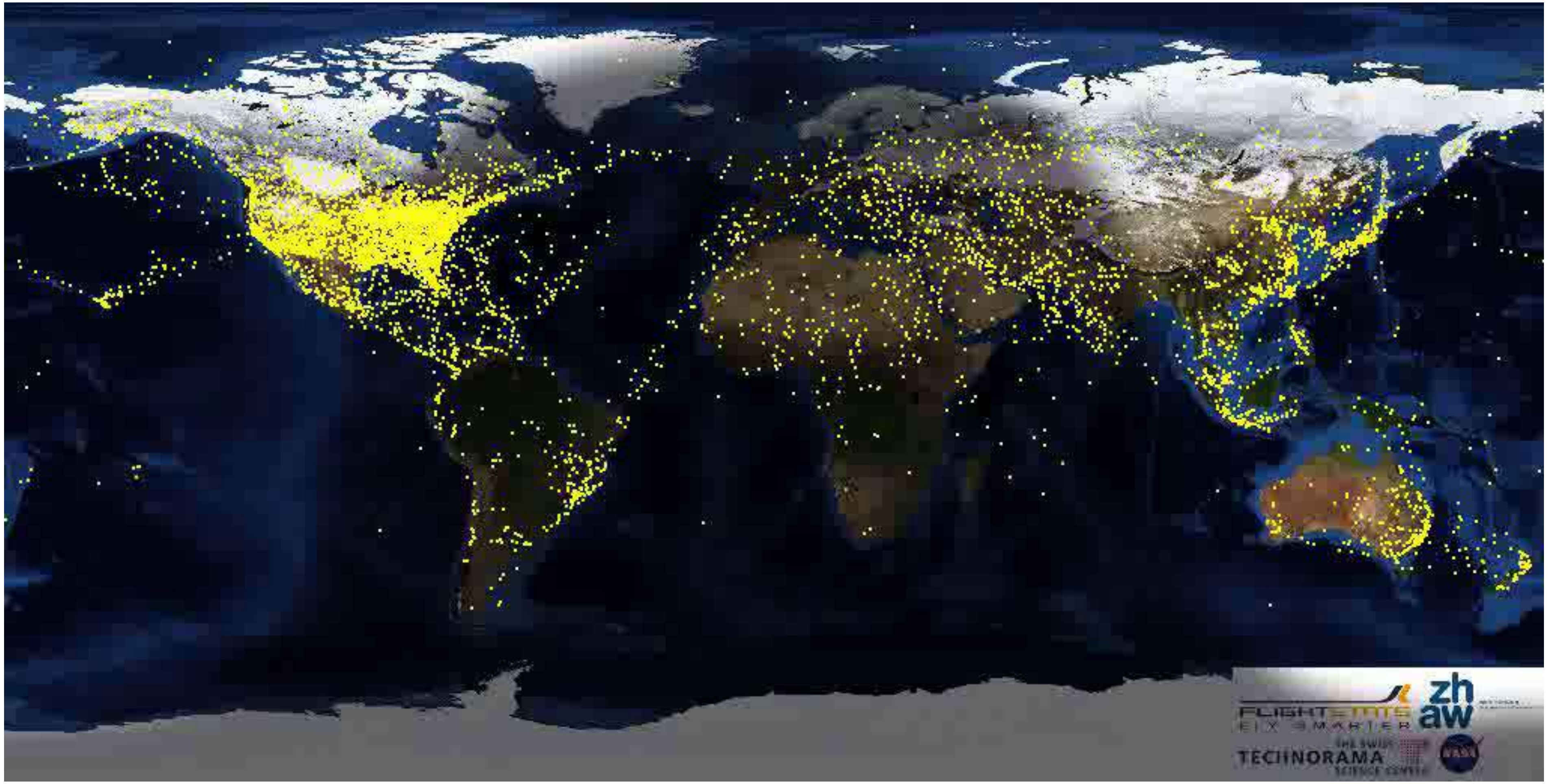
ACHIEVING THE SDGS THROUGH SCIENCE, TECHNOLOGY AND INNOVATION

Zakri Abdul Hamid, FIAS, FISC

Founding Director, International Institute for Science Diplomacy and Sustainability, UCSI University


20th Century
The Infinite Earth
Expansion of
Activities
Globalization
[redacted]
The Finite Earth

Human-Dominance – Anthropocene Epoch



Humans as agent of geological change

For the first time in human history, our technologies and the ways people use them have the capacity to transform the biosphere itself

Climate Change

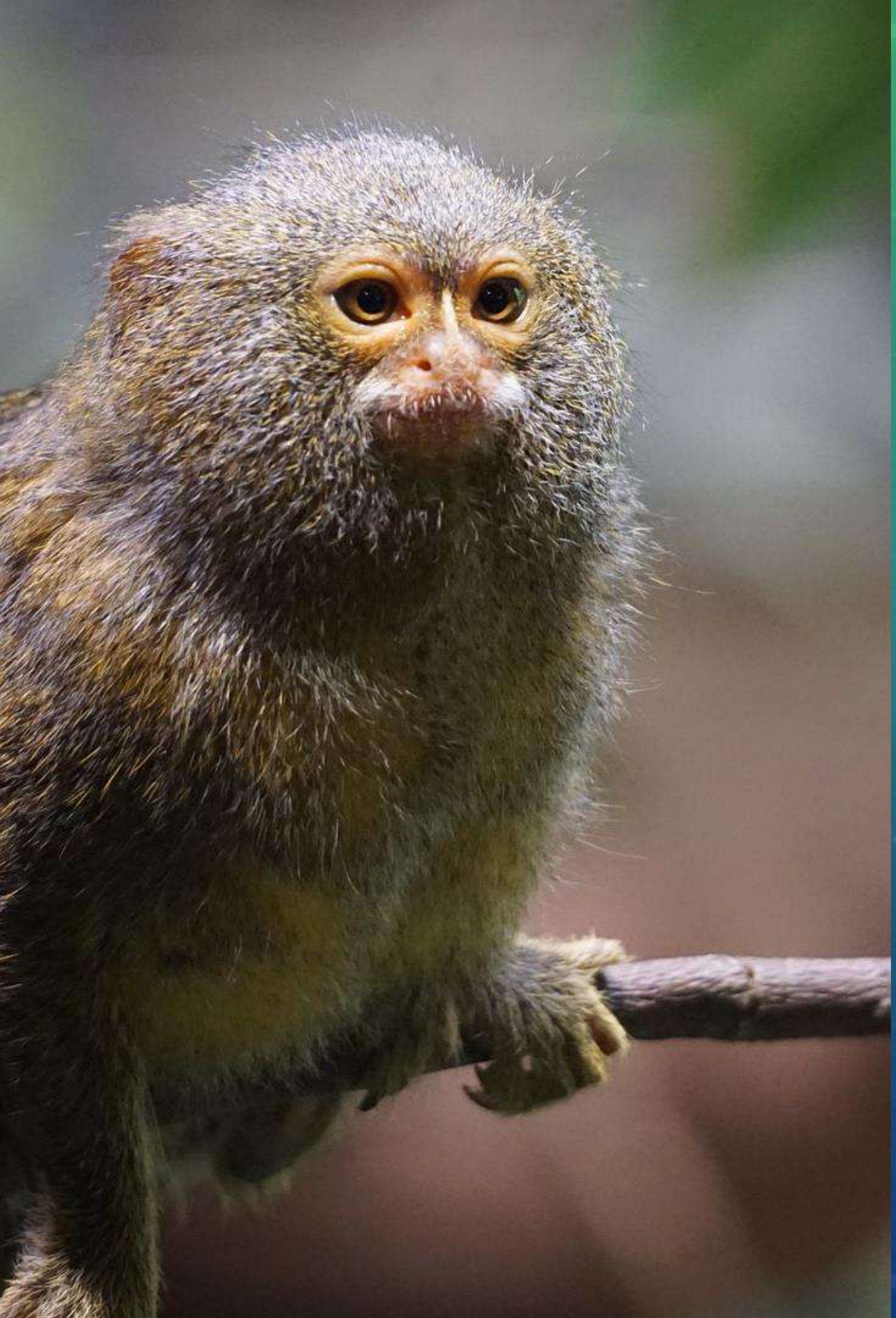
Climate Change

Climate Action

The world is on the brink of a climate catastrophe and the window to avert it is closing rapidly. To limit warming to 1.5 Celsius, global greenhouse gas emissions must decline by 43% by 2030

However, under current global net-zero commitments, emissions are still projected to increase by almost 14% over the next decade

Therefore, immediate and deep reductions are needed to meet obligations agreed in the Paris Agreement



Biodiversity Loss

- Biodiversity and ecosystem services are declining at an unprecedented rate
- We're well acquainted now with the startling prospects: 1 of every 8 birds, 1 of every 4 mammals and 1 of every 3 amphibians is threatened with extinction.
- The same is true of 6 of every 7 marine turtles, and of one-third of our reef-building corals
- Some **75%** of genetic diversity of agricultural crops has been lost
- Three-quarters of world fisheries are fully or over-exploited
- According to IPBES, one million species are now threatened

Biodiversity loss

Plastic Pollution

Main Problems in Our Unsustainable World


SUSTAINABLE DEVELOPMENT GOALS
17 GOALS TO TRANSFORM OUR WORLD
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

SCIENCE DIPLOMACY IN ACTION

UNSG Ban Ki-moon’s Scientific Advisory Board

- Analyzes the role of science, the data revolution, the science-policy-society interface, and efforts to reduce inequalities and makes recommendations on addressing them.
- Science "deserves to be valued more highly, employed more widely, and used more effectively by decision-makers at all levels,”
- All nations must invest more in science, technology and innovation (STI), saying they “can be a game changer" in dealing with "nearly all the most pressing global challenges” and that STI should play a key role in achieving the Sustainable Development Goals (SDGs).

Ban’s Scientific Advisory Board’s findings

- Only 12 countries invest over 2.5% of their gross domestic product (GDP) on research and development (R&D)
- It calls on all countries, including the poorest, to invest a minimum of 1% of their GDP on research
- The most advanced countries should spend at least 3% of their GDP on R&D, it argues, underscoring the role of such investment in reinforcing science education and improving girls’ access to science courses
- The Board observes that science can help narrow economic and opportunity gaps, and recommends bringing together indigenous and local knowledge with science to provide appropriate solutions for sustainable development, particularly when implementing the SDGs at local levels.

Ban’s Scientific Advisory Board’s findings

- The Board recommends that political leaders give science more consideration in decision-making, pointing out that nearly 25 years elapsed between the scientific community’s first warning about climate change and the adoption of the Paris Agreement on climate change in 2015
- “Decisions are often taken in response to short-term economic and political interests, rather than the long-term interests of people and the planet.”

How do we fare in the OIC countries?

Prerequisite for productive and innovative research

State of the art infrastructure

Well-educated and highly trained scientists

Comprehensive management system for research monitoring

Enough provision of funds for research and development

Taking practical measures to implement the research policies by removing the cultural, political and security hurdles

Top-10 countries in research productivity for 2018 (n=39,46,933)

- 1 United States 6,83,003 17.30
- 2 China 5,99,386 15.18
- 3 United Kingdom 2,11,710 5.36
- 4 Germany 1,80,608 4.57
- 5 India 1,71,356 4.34
- 6 Japan 1,31,198 3.32
- 7 France 1,20,908 3.06
- 8 Italy 1,19,405 3.02
- 9 Canada 1,11,561 2.82
- 10 Australia 1,06,228 2.69
- Total 24,35,363 61.70

Top-10 OIC member countries in research productivity for 2018 (n=3,27,555)

- 16 Iran 60,268
- 19 Turkey 45,582
- 23 Malaysia 33,295
- 24 Indonesia 32,456 32
- 32 Saudi Arabia 23,469
- 35 Egypt 22,018
- 38 Pakistan 20,548
- 49 Nigeria 9,299
- 51 Tunisia 8,706
- 52 Iraq 8,486

Higher Education and Number of Researchers

- Higher education institutions and universities have been playing an important role in knowledge creation and research productivity.
- THE world university ranking 2020 has been used to find out the share of OIC members.
- A total of 1,396 universities of 92 countries are included in the ranking, University of Oxford, UK is the top-ranked university of the world, followed by California Institute of Technology, USA and University of Cambridge, UK.
- In the top 50 universities, 23 universities of US, 7 from UK, 3 each from Germany and Canada are included. There is not even a single university by OIC members reached in the top 200 universities of the world.

Numbers of researchers per one million people

- The highest numbers, 8,250 researchers in one million people are found in Israel, followed by Sweden (7593) and South Korea (7514).
- There 4652 researchers among the one million people in the USA, 4377 in UK and 1235 in China.
- In the list of the highest number of researchers among OIC member countries, UAE has been ranked first with 2407 researchers among OIC countries, followed by Malaysia (n=2358), Tunisia (n=1965), Turkey (n=1386), Egypt (n=669), Iran (n=671), Jordan (n=601) and Pakistan (n=354)

OIC countries in global research

- The share of OIC countries in global research output has 3,27,555 (8.29%), and 1,087 (3.41%) journals and source publication published are indexed in SJR in 2018
- There are 14 universities from the Muslim world in the top 500 universities in the THE world university ranking 2020
- OIC member countries average spend less than 0.5% of their GDP on R & D, while the rest of the world spends 1.78% and most advanced countries spend up to 3% on R & D

OIC countries…

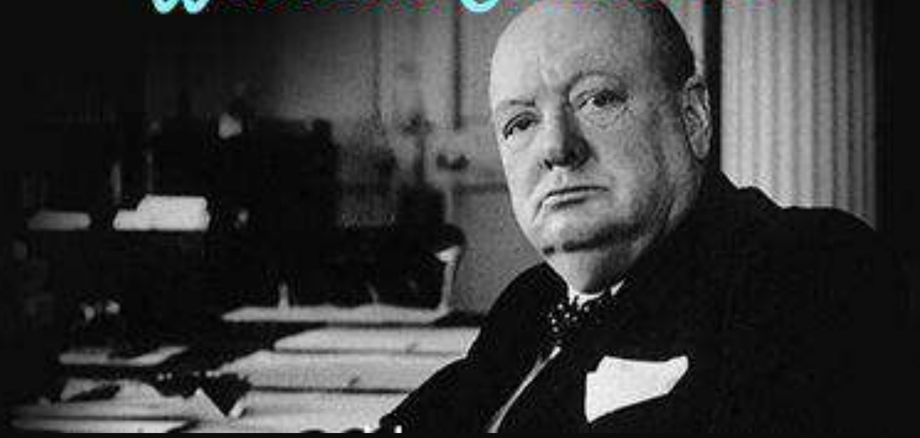
- The indicators of research productivity, global university rankings and average number of researchers showed that OIC members need to improve their allocation for R & D to compete with the rest of the world
- Most of OIC members have already reformulated the education policy and making sure that every citizen of their countries has equal opportunities to get basic to advanced level and education
- The QUESTION is can we do more, in particular to the Least Developed Countries

Parting words

- The long-term and sustainable growth of the OIC group depend on the educational, scientific and technological development of all member countries
- All OIC member countries should seriously sit together to resolve their internal and external issues and pay more attention to the development of knowledge, science and technology
- The literacy ratio is getting amplified in resource-rich countries, and they should provide necessary financial and technological assistance to deprived and less developed OIC countries
- It would be a great initiative if OIC countries could attract their native but non-resident scientists with lucrative packages to overcome the brain drain dilemma and hire foreign researchers to train young scholars in developing analytical thinking and research skills

THE EMPIRES OF
THE FUTURE ARE
THE EMPIRES OF
THE MIND

Winston Churchill



STANDARDISATION OF PRODUCTION DATA OF MEDICAL RADIONUCLIDES UNDER GERMAN-PAKISTAN COOPERATION

SYED M. QAIM[1,2] FIAS AND MAZHAR HUSSAIN[2]

[1]Institute of Neurosciences and Medicine: INM-5 (Nuclear Chemistry), Forschungszentrum Jülich (FZJ), Jülich, Germany

[2]Department of Physics, Government College University Lahore (GCUL), Pakistan

ABSTRACT

Good cooperation had existed between the Forschungszentrum Jülich (FZJ), Germany, and several universities and research institutes in Pakistan since the 1970s. However, from 2003 onwards, with the appointment of Syed M. Qaim from Jülich as an Honorary Professor of Physics at the Government College University Lahore (GCUL), the cooperation was intensified, especially in the field of medical radionuclides. Besides a large number of specialized lectures held at GCUL, which led to the development of M. Phil. courses in Applied Radioactivity as well as in Medical and Radiation Physics, a Ph.D. programme on standardisation of nuclear data related to accelerator-based production of medical radionuclides was initiated. The first two research scholars (Mazhar Hussain and Naveed Aslam) played pioneering roles in this endeavour. Under the distance guidance from Jülich and with financial support of the Higher Education Commission (HEC) of Pakistan, they got experience in nuclear model calculations and data evaluation methodology at the University of Debrecen, Hungary, and at the International Atomic Energy Agency (IAEA), Vienna, Austria. On completion of standardisation work on several important radionuclides, like Cu-64, Pd-103, I-124, Re-186, etc., they were awarded Ph.D. degrees in 2010. Through further guidance and international collaborations, particularly with ATOMKI Debrecen in Hungary and LBNL Berkeley in USA, two other persons also completed doctoral work. This way, data for a large number of potentially useful radionuclides could be evaluated in Pakistan, leading to about 20 publications in international journals, a few of which are listed below [1-5]. The group was invited by the IAEA to participate in a 5-year Coordinated Research Project (CRP) – a great recognition for scientists working in a developing country. The GCUL and COMSATS in Lahore appointed each a tenured Faculty Member in this field, and the University of Education in Lahore established a tenure-track position. The work concentrates now on novel positron emitters and therapeutic radionuclides which are presently attracting great attention because of their theranostic applications, also known as "Personalized Medicine". In the meantime, a network has been formed, and today this type of nuclear data work is carried out in five public sector institutions in Pakistan, namely, the three universities in Lahore mentioned above as well as the National Centre for Physics (NCP) and the Pakistan Nuclear Regulatory Authority (PNRA) in Islamabad. Furthermore, good contacts have been established between GCUL and a few nuclear medical centres in the vicinity of Lahore. The development of the nuclear data field in Pakistan has been recently described in a review article [6].

1. M. Hussain, S. Sudár, M.N. Aslam, H.A. Shah, R. Ahmad, A.A. Malik, S.M. Qaim, Appl. Radiat. Isot. **67**, 1842 (2009).
2. M.N. Aslam, S. Sudár, M. Hussain, A.A. Malik, H.A. Shah, S.M. Qaim, Radiochim. Acta **97**, 669 (2009).
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4. N. Amjed, A.M. Wajid, N. Ahmed, M. Ishaq, M.N. Aslam, M. Hussain, S.M. Qaim, Appl. Radiat. Isot. **165**, 1 (2020).
5. S.M. Qaim, M. Hussain, I. Spahn, B. Neumaier, Frontiers in Physics **9**, 639290 (2021).
6. M. Hussain, W. Ali, N. Amjed, A. M. Wajid, M. N. Aslam, Radiochim. Acta **110**, DOI: 10.1515 / RACT-2022 - 0012 (2022).

Standardisation of Production Data of Medical Radionuclides under German-Pakistan Cooperation

Syed M. Qaim[1] and Mazhar Hussain[2]

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[2] Department of Physics, Government College University Lahore (GCUL), Lahore 54000, Pakistan; Presently Alexander von Humboldt Fellow at INM-5 of FZJ, Germany

Keynote Lecture given at the 24th International Science Conference of the Islamic World Academy of Sciences (IAS), Karachi, Pakistan, 7-8 March 2023

Mitglied der Helmholtz-Gemeinschaft

JÜLICH Forschungszentrum

Outline

- General introduction

  - brief overview of cooperations

  - medical radionuclides and radiotracers

  - institutions GCUL and FZJ

- Cooperation between FZJ (Germany) and GCUL (Pakistan)

  - development of new courses

  - research on radionuclides

  - highlights of research results

- New directions in radionuclide applications

- Concluding remarks and applications

General Introduction

Brief Overview of Cooperations

- **Peaceful applications of nuclear sciences (1970 – 1994)**
  (Ishfaq Ahmad, Noor M. Butt)
  mainly with FZK and FZJ
  - neutron scattering
  - analytical methods
  - radionuclides in medicine and agriculture

- **Development of natural medicinal drugs (1965 – to date)**
  (Salimuzzaman Siddiqi, Atta-ur-Rahman, Iqbal Chowdhary)
  mainly with Univ. Tübingen
  - structure analysis
  - chemical synthesis
  - biological effects, toxicity, etc.

- **Higher education and research (2000 – onwards)**
  with several German institutions (*Atta-ur-Rahman)*
  - Indigenous scholarships under HEC
  - foreign faculty/scientist programme of HEC
  - Georg Förster fellowship for experienced scientist

Individual cooperative projects have been constantly running under mutual agreements between participating institutes

Medical Radionuclides

Areas of Work

Production of radionuclides
(using reactors and accelerators)

- Development of radiotracers
  (physical, chemical and pharmaceutical aspects)

- Radiation physics
  (organ imaging, radionuclide-targeted therapy, dosimetry)

Emphasis in this talk is on production of radionuclides

Radiotracers

Definition: Radionuclide in a well-defined chemical form

Significance:

- Dynamic studies from outside of the system
- Investigation of physiological function
- Biological equilibrium undisturbed
  (organ imaging at real molecular level)
- Quantitative uptake studies through PET

Status of use:

- **60 million patients/year undergo routine diagnosis (via SPECT/ PET) or therapy using radiation.**
- **PET is a fast expanding imaging technology; Presently > 1000 cyclotrons are under construction.**
- **Novel radiotracers are opening new vistas in medical research.**

Novel Radionuclides in Medicine

- Non-standard positron emitters
  - to study slow metabolic processes
  - to quantify targeted therapy

- Novel low-range highly ionising radiation emitters for internal radiotherapy
  - for targeted therapy

Emphasis is on accelerator-produced metal radionuclides

Four Pillars of Radionuclide Development Work

- Nuclear data
  - decay properties
  - production cross sections
- High current targetry
- Chemical processing
  - isolation of radionuclide and recovery of enriched target material
- Quality control
  - radionuclidic, radiochemical, chemical, specific activity

- Purity requirements are stringent

- Special organometallic chemistry needs to be developed

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Government College University, Lahore (GCUL), Pakistan

- Oldest educational institution in Pakistan
- Great personalities educated or worked here
  - Muhammad Iqbal (National Poet / Philosopher)
  - Abdus Salam (Nobel Prize in Physics)
  - Har Gobind Khorana (Nobel Prize in Physiology)
- Many leading scientists and officials educated here
- Good tradition in natural sciences and humanities (Physics: ***Small accelerator*** in 1950s; Rafi M. Chaudhri)
- College raised to the status of a university (2002)
- Several foreign faculty members appointed through HEC
- Syed M. Qaim appointed Honorary Professor of Physics (2003)

Fast strides towards development

Forschungszentrum Jülich (FZJ), Germany

- Member of Helmholtz-Gemeinschaft
- Largest research centre in Germany (> 7200 employees; about 900 guest scientists from 65 countries)
- Multidisciplinary (cooperation with > 15 universities); **budget: 10^9 Euro**
- INM-5 world leader in development of accelerator-based radiotracers; close contacts with University of Cologne

JÜLICH Forschungszentrum

Cooperation between FZJ and GCUL

(since 2002)

Development of Curricula in Physics

Contact Persons at GCUL: Khalid Aftab; Hassan A. Shah; M. Rafiq; Riaz Ahmad; from 2012 onwards also Mazhar Hussain

- **Advanced condensed lecture courses held on:**
  - Applied radioactivity
  - Nuclear data for science and technology
  - Nuclear methods of analysis
  - Radiotracers in medicine
  - Interdisciplinary utilization of accelerators
  - Scientific and environmental aspects of energy production

Hundreds of students attended (many from other universities as well).

- Advanced lectures helped establish three new courses at different levels

a) Medical Physics	***B.S.***
b) Applied Nuclear Physics and Nuclear Data Applications	***M.Phil.***
c) Nuclear Data for Science and Technology	***Ph.D.***

Research on Radionuclides: Nuclear Data

Theme

- Evaluation and standardisation of fundamental production data

Emphasis on

- Non-standard positron emitters for PET (e.g. ^{64}**Cu,** ^{86}**Y**)
- Novel radionuclides for internal radiotherapy (e.g. ^{103}**Pd,** ^{67}**Cu**)

Scope

- Advanced nuclear model calculations
- Use of statistical fitting procedures
- Recommend data for optimum production of radionuclides
- Validation of evaluated data through integral tests

Intercomparison of evaluated data at international level would establish the quality of work

Nuclear Model Calculations

Statistical Model (Code: STAPRE)

- Formation of compound nucleus
- Decay of compound nucleus
  (considering angular momentum and level structure:
  Hauser-Feshbach formalism)

Precompound Exciton Model (Code: ALICE-IPPE)

- Penetration of the projectile, formation of particles and holes, denoted as exciton number
- particle emission probability calculated for each exciton number

Codes combining statistical and precompound model: EMPIRE, TALYS

All codes are available at GCUL

Evaluation Methodology of Medical Data

- Compilation and normalization of data for experimental conditions
- Comparison of normalized data with the results of nuclear model calculations (ALICE-IPPE, STAPRE, EMPIRE-2.19, TALYS 1.9) over a given energy range

Basic consideration	$\sigma_{ev}(E) = f(E)\,\sigma_{model}(E)$

where $\sigma_{ev}(E)$, $\sigma_{model}(E)$ and $f(E)$ are the evaluated cross section, model calculated cross section and the energy-dependent normalization factor, respectively.

- Ratio of experimental to calculated data plotted as a function of energy, followed by a polynomial fitting to estimate the $f(E)$.
- Evaluation procedure repeated with all model calculations.
- Recommended data generated by averaging the normalized model calculations.

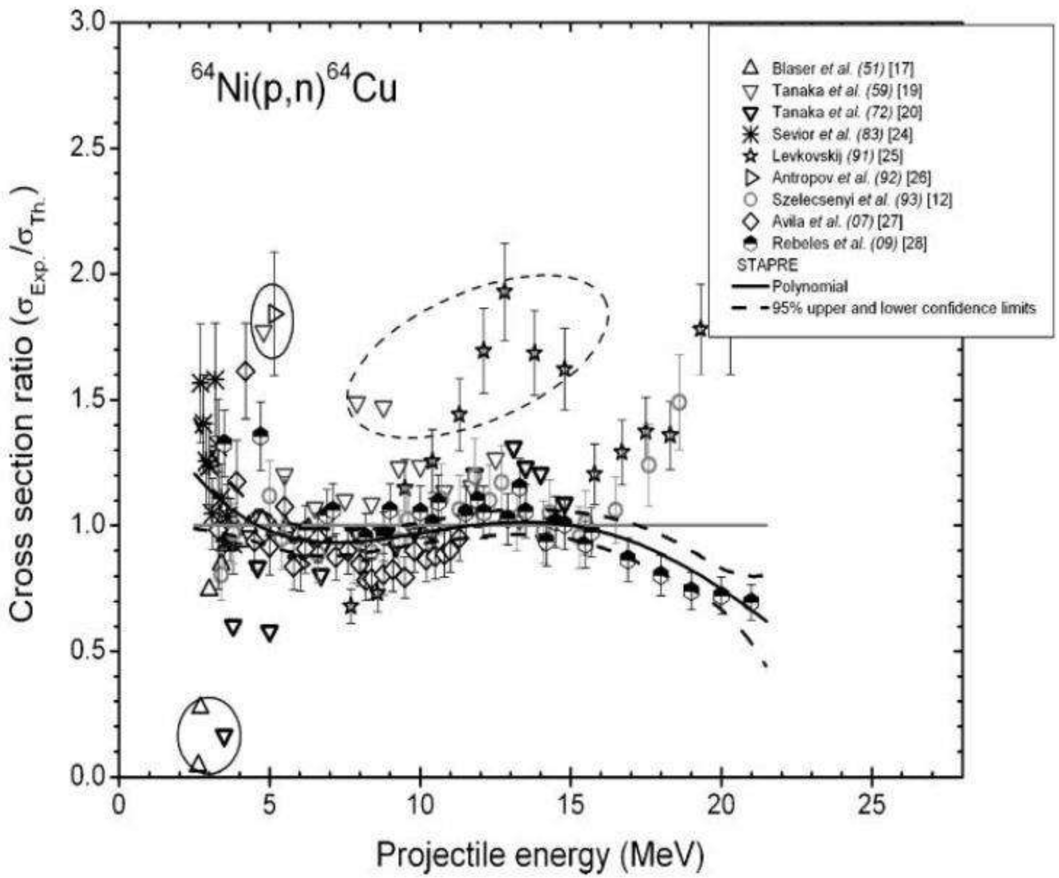
Example: Copper-64

$T_{1/2}$ = 12.7 h; E_{β^+} = 0.65 MeV; I_{β^+} = 17.8 %)

Organo-metallic chemistry of Cu is very advantageous

Production reaction: $^{64}Ni(p,n)^{64}Cu$

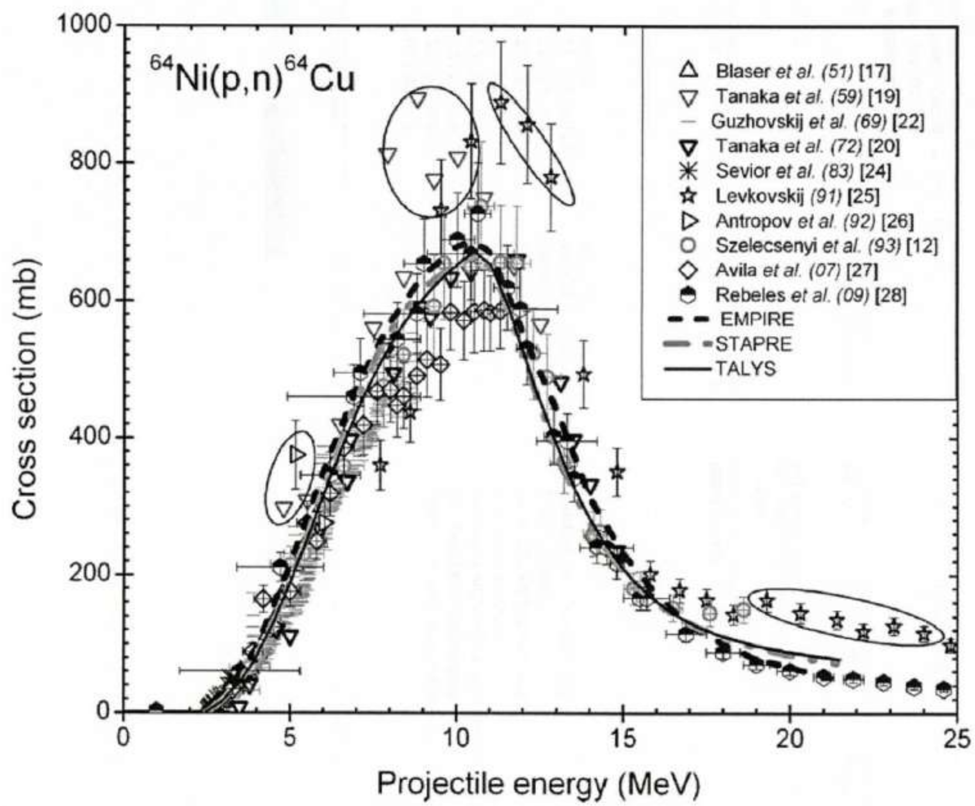
Evaluation of production data: Aslam et al, RCA **97**, 669 (2009)



Variation of $\sigma_{exp}/\sigma_{theor}$ as a function of E_p

estimation of *f(E)*

Excitation Function of $^{64}Ni(p,n)^{64}Cu$ Reaction



Aslam et al, RCA 97, 669 (2009)

Comparison of experimental data with results of three nuclear model calculations.

Based on optimized data, clinical scale production technology developed at FZJ.

Optimum energy range for production of ^{64}Cu

E_p: 12 → 8 MeV
Yield: 304 MBq/µAh

Production methodology adopted by industry

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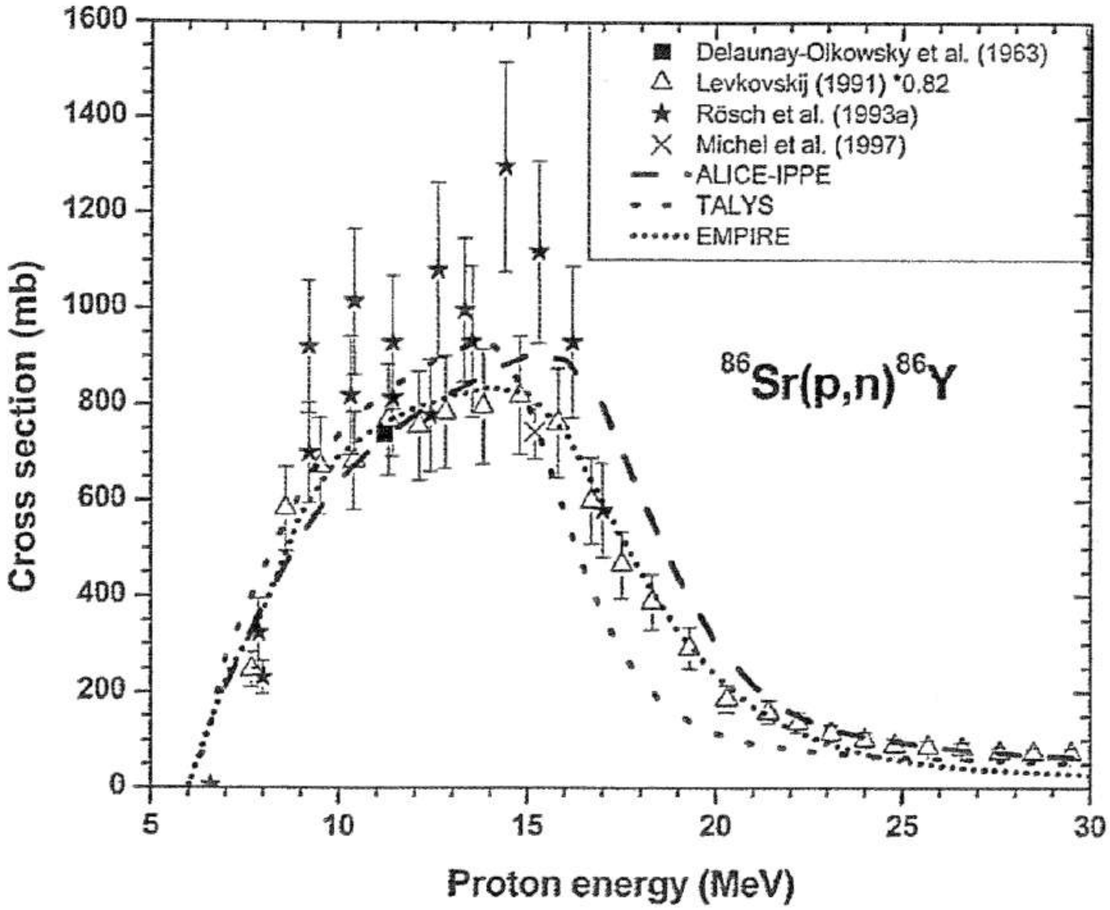
Example: Yttrium-86

($T_{½}$ = 14.7 h; $E_{\beta+}$ = 1.6 MeV; $I_{\beta+}$ = 34 %)

Trivalent metals form good metallic complexes (peptide and antibody targeting)

Excitation Function



Production technology developed at FZJ; adopted by industry

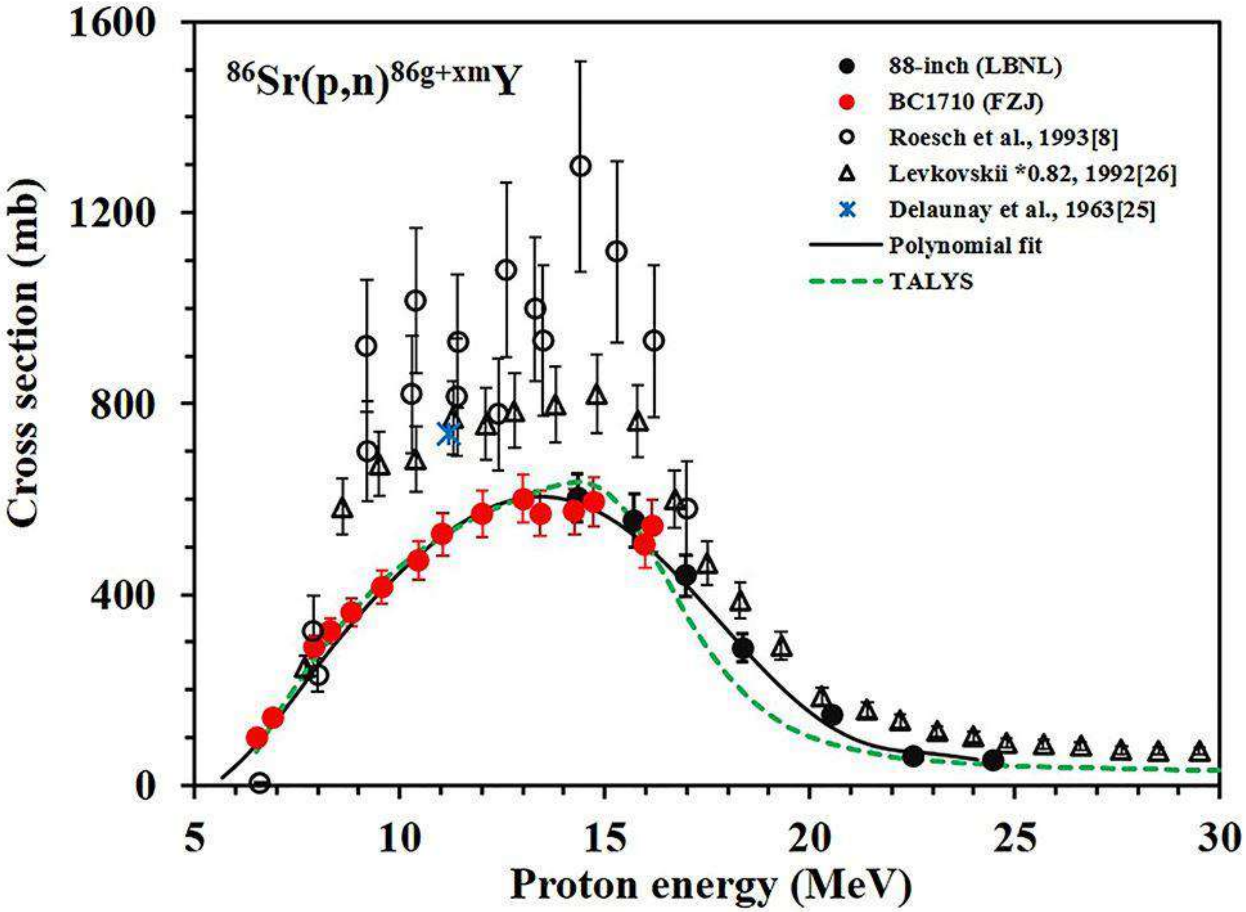
Data evaluated by Zaneb et al, ARI **104**, 232 (2015)

Considerable discrepancy revealed need of more precise measurement.

New Precise Measurement of Excitation Function

under international cooperation (FZJ, LBNL, Debrecen, Dhaka, GCUL)

Uddin et al, RCA **108**, 747 (2020)



- **Good agreement between experiment and theory**
- **Good agreement between calculated integral yield and batch production yield**
- **Discrepancy removed**

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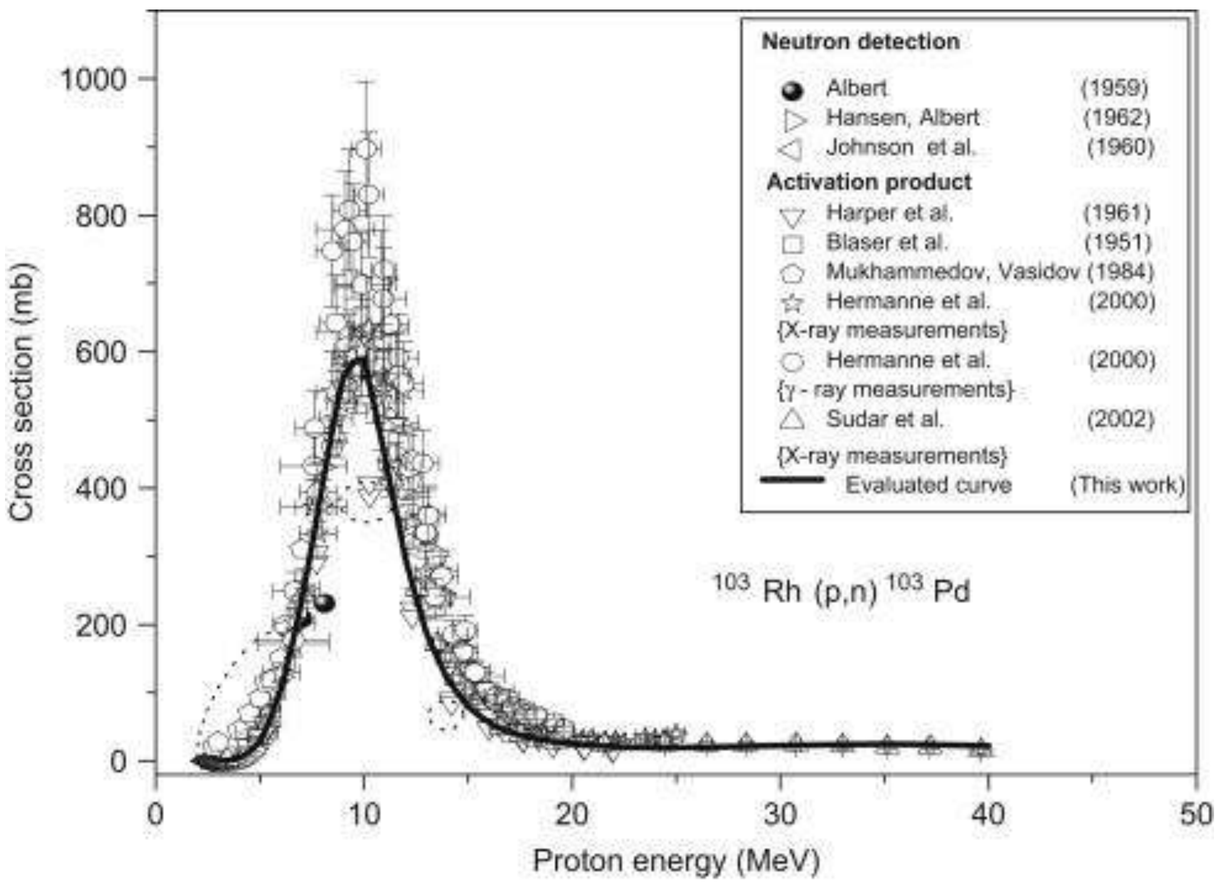
Example: Palladium-103

($T_{½}$ = 17.0 d; EC = 100 %; Avalanche of X-rays and Auger electrons)

Extensively used in prostate cancer therapy

Production reaction: $^{103}Rh(p,n)^{103}Pd$

Excitation Function



Cross sections measured using neutron, γ-ray and X-ray counting

Data **evaluated** by Hussain et al, ARI **67**, 1842 (2009)

- ***Standardised data are based on X-ray measurement***
- ***Good agreement between calculated and production yield achieved***

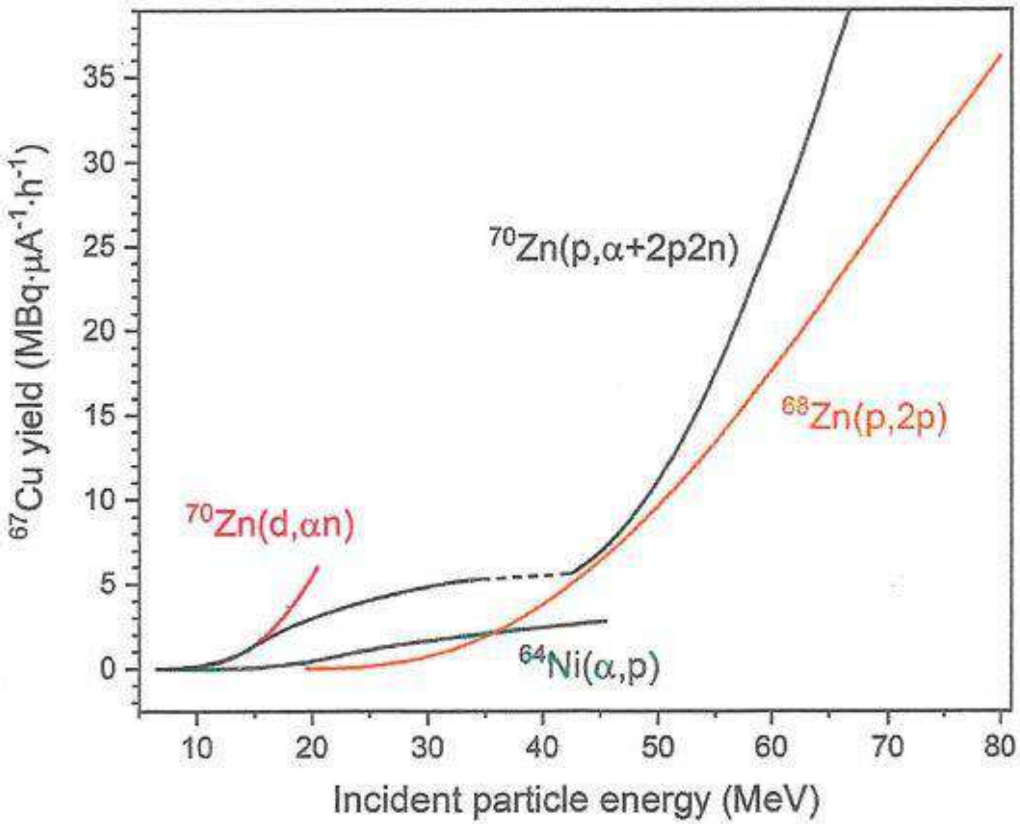
Example: Copper-67

($T_{½}$ = 17.0 d; EC = 100 %; Avalanche of X-rays and Auger electrons)

Useful for targeted radionuclide therapy

Charged particle production

^{70}Zn(p,x); ^{70}Zn(d,αn); ^{68}Zn(p,2p); ^{64}Ni(α,p)



(Jülich, Ispra, Nantes, Brookhaven, Chiba, etc.)

Qaim, Hussain, Spahn, Neumaier, Frontiers in Physics (2021), Vol. 9, Article 63290

- For large scale production, E_p = 80 → 40 MeV is needed.

Highlights of Research Results Achieved

- 6 scholars completed Ph.D.; therefrom 3 hold now faculty positions (Mazhar Hussain; Naveed Aslam; Nouman Amjed)
- Published about 20 papers in international journals *(for details cf. Hussain et al, RCA **100**, 645 (2022))*
- Group on **"Medical Nuclear Data Analysis"** established. Participation in a "***Coordinated Research Program (CRP)"*** of the IAEA, 2013-2018 (Leader: Mazhar Hussain). This is an exceptional recognition of a group from a Developing Country.
- Mazhar Hussain awarded the prestigious Alexander von Humboldt Fellowship to work at FZJ (2023/2024).
- Links established between this research group and radiotracer specialists at nuclear medical centres in Lahore and Gujranwala. A network of nuclear data specialists in Pakistan has also been created.

Award of Medal of Honour of GCUL to Syed M. Qaim on 22 November 2018

New Directions in Radionuclide Applications

- **Theranostic approach**

(combination of PET/Therapy: Personalized medicine)

$^{64}Cu/^{67}Cu$, $^{86}Y/^{90}Y$, $^{68}Ga/^{177}Lu$, etc.

(“matched” or “analogous” pair)

Radiation dose assessment via PET

Radionuclide targeted therapy is of great timely interest

Multimode imaging

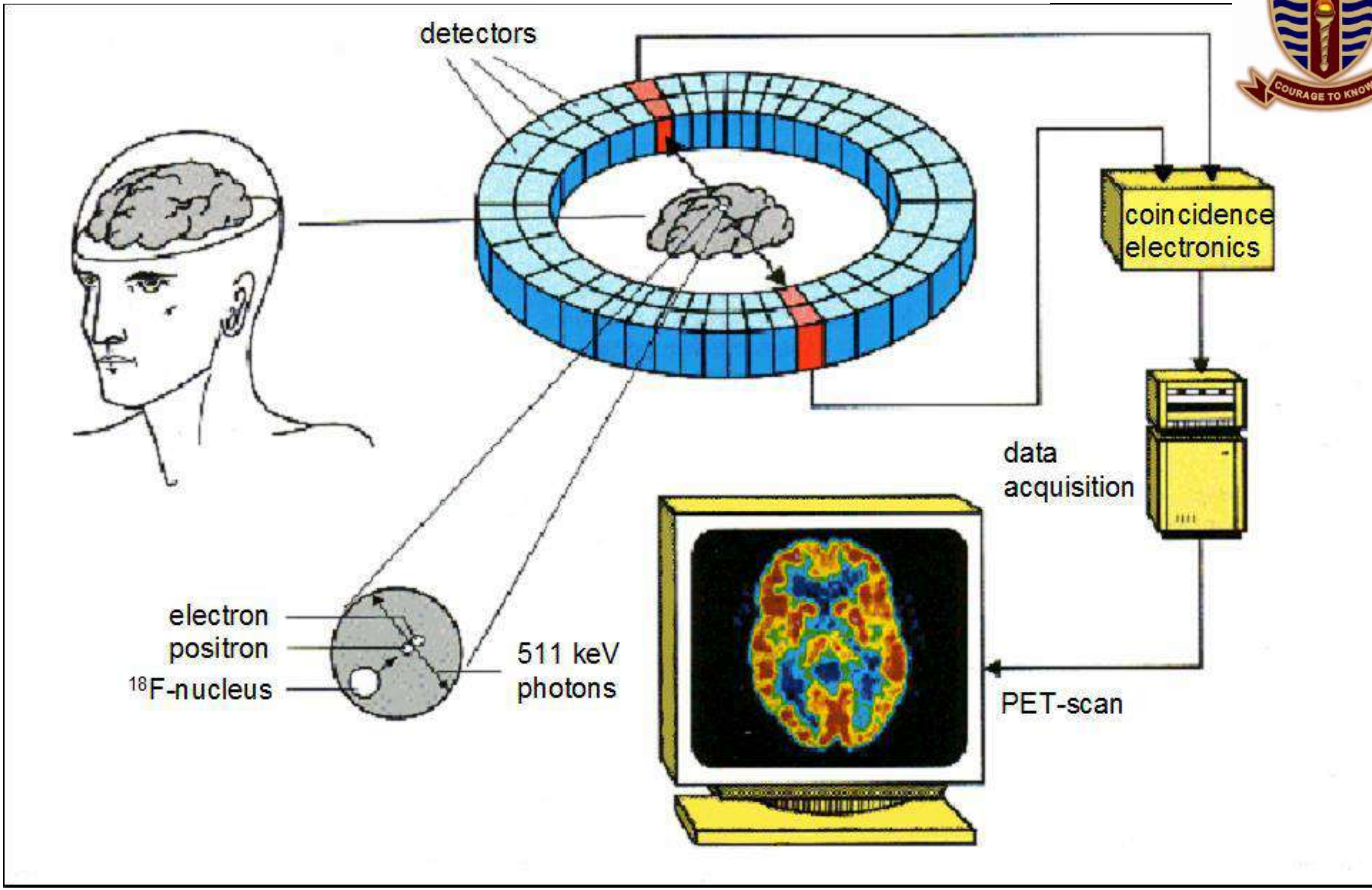
(combination of PET/CT and PET/MRI)

ImmunoPET

Labelling of antibodies with metallic positron emitters, e.g. ^{89}Zr, to trace their way to tumours.

Metallic radionuclides are versatile.

Positron Emission Tomography (PET)



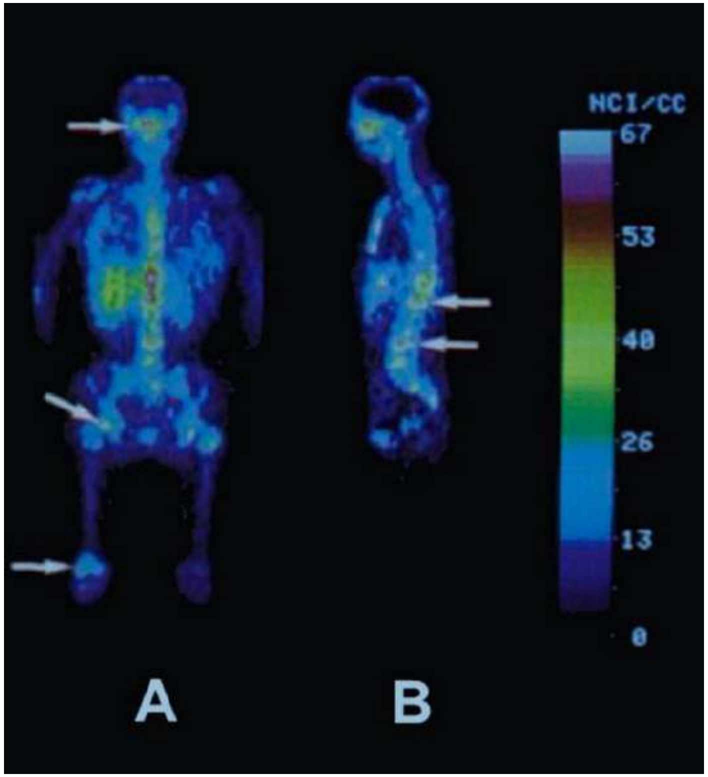
Courtesy: H. Herzog, FZ Jülich

Application

Beginning of real theranostic approach

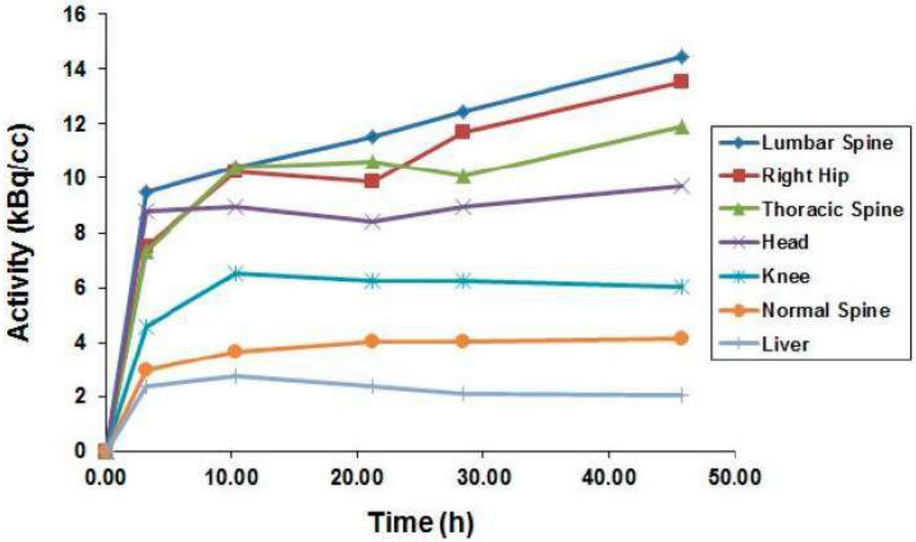
- Use of β⁺ emitting ^{86}Y prior to the therapy nuclide ^{90}Y ("matched pair")
- Uptake of [^{86}Y] citrate determined using PET

Herzog et al., JNM **34**, 2222 (1993).



(A) Anterior (B) Sagittal

Arrows show metastases



Accurate dose calculation possible in targeted β⁻ or α-therapy

Rösch, Herzog, Qaim, Pharmaceuticals **10**, 56 (2017)

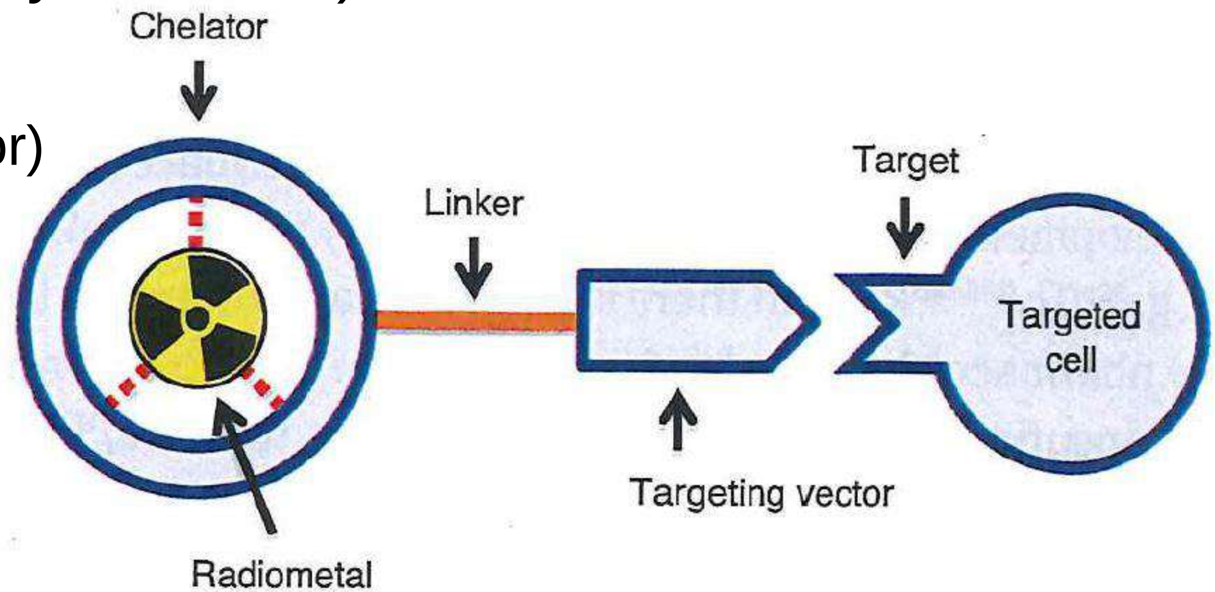
Targeted Therapy

- **Direct use of metal radionuclide rather seldom**
- **Special demands on radionuclide and chemistry**

  (trivalent metals very attractive)

Scheme

- Radiometal (chelator)
- Linker
- Targeting vector



- Radiometal tightly coordinated to chelator (DTPA, DOTA, etc.)
- Linker (amino acid, PEG, etc.) connects chelator to targeting vector
- Targeting vector (peptide, antibody, etc.)
  (reaches biological target through cellular receptor, antigen, etc.)

Targeted α-Radiation Therapy

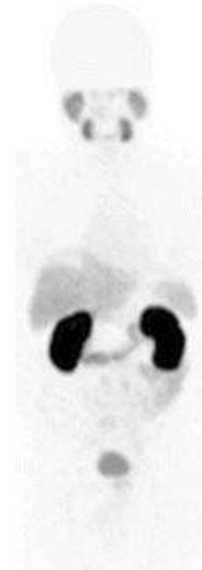
Example: ^{213}Bi ($T_{½}$ = 46 min; E_{α} = 5900 keV) from ^{225}Ac generator

Prostate-specific membrane antigen radioligand therapy (PSMA-RLT)

- ^{68}Ga/^{177}Lu-PSMA successfully applied (“analogous pair”)
- **New approach**: ^{68}Ga/^{213}Bi-PSMA

M. Sathekge et al., EJNMMI **44**, 1099 (2017)

^{68}Ga-PSMA (PET-CT scan)
Pre-therapy



^{68}Ga-PSMA (PET-CT scan)
Post-therapy
(11 months after ^{213}Bi-PSMA)

Targeted α-radiation therapy appears promising.

JÜLICH Forschungszentrum

Concluding Remarks

- Good and friendly relations have always existed between Germany and Pakistan.
- Long-term cooperations in many areas of science
- Extensive cooperations in fields of mutual interest

Appreciation

- Special thanks to Germany for facilitating and encouraging cooperation with Pakistan; thanks to Pakistan for appreciating and honouring the cooperative efforts; appreciation to dedicated co-workers.
- Acknowledgement to supporting bodies/programmes: HEC, TOKTEN, NTP, Abdus Salam ICTP, IAEA, PAS, PAEC, COMSTECH

PRODUCING AFFORDABLE BIOTECH MEDICINES FOR THE ISLAMIC WORLD: *OPPORTUNITIES AND REQUIREMENTS*

AHMED AZAD FIAS
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CSIRO Division of Biomolecular Engineering, Australia

ABSTRACT

Introduction: The provision of lifesaving medicines to even the poorest is very important for achieving Health Equity in the Islamic world. Islamic countries, including economically disadvantaged ones, have been very well served by the availability of relatively inexpensive Generic medicines. A small number of Islamic countries have been producing high quality generic medicines and exporting them worldwide. In recent times the pipeline of small molecule originator drugs, from which Generics are copied, has almost dried up. This provides an *opportunity for Islamic countries to step in to develop novel small molecule drugs from indigenous Biota*. Lately multinational drug companies have turned their attention almost exclusively to Biologics. These highly specific and efficacious protein-based drugs are extremely expensive and beyond the reach of all except wealthy countries and rich individuals. There is, therefore, a *unique opportunity for the Islamic world to produce more affordable copies of the originator Biologics, known as Biosimilars*. These two drug development initiatives would be dependent on multidisciplinary collaborations across the Islamic world. IAS and COMSTECH could play important catalytic and enabling roles in these product development and capacity-building initiatives, in which the least developed countries (LDC) should also be enabled to make a positive contribution.

Rational Bioprospecting of Indigenous Biota: Islamic countries, including LDC and technology-lagging ones, are endowed with diverse hotspots of unique flora and fauna, and very rich knowledge of traditional medicines. Marrying of traditional knowledge with modern technologies is likely to open up a treasure trove of drug candidates present in the indigenous biota, and lead to discovery and development of novel pharmaceuticals.

Ethnobiologists, ethnopharmacologists and medicinal chemists from all over the Islamic world have been very prolific in publishing large numbers of scholarly research articles on natural products, but unfortunately very little of this has translated into scientifically-verified, safe and efficacious modern medicines. Inclusion of molecular biosciences would strengthen natural products research and help to identify disease-specific molecular targets and develop highly selective bioassays based on these. "Rational bioprospecting" of natural product and isolated chemical libraries with such disease-specific and selective bioassays would greatly enhance chances of discovering novel and very promising lead molecules. These could then be optimised into candidate medicines using a range of biomolecular technologies. Since these medicines are based on disease-specific molecular targets, they are not likely to affect normal host biology and as such expected to exhibit little or no adverse side effects. All the above steps could generate new IP that can be exploited in partnership with local industry for commercialisation. For this particular project, the International Centre for Chemical and Biological Sciences (ICCBS), could serve as a major resource and training centre for the entire OIC region. Other regional research centres could also provide support to scientists from disadvantaged countries in their neighbourhood.

Development of Affordable Biosimilars through Reverse-Engineering and Recombinant DNA Technology: To meet local healthcare needs, and to keep abreast of current technological developments, the pharmaceutical sector in the Islamic world needs to get involved in the development of recombinant Biosimilars, which are relatively cheaper copies of highly expensive protein-based Biologics. The first step in producing more affordable Biosimilars would be to produce the active chemical ingredients (ACI) locally. A few Islamic countries, including Bangladesh, have already produced a limited number of Biosimilar from "seed clones" kindly provided by the International Centre for Genetic Engineering and Biotechnology (ICGEB). Similar seed clones from commercial sources are exorbitantly expensive. The most efficacious monoclonal antibody (mAb)-type Biologics are not only extremely expensive but are also patent protected. Development cost and time to market could be drastically reduced if the seed clones could be produced locally, and if IP restrictions could be circumvented. LDCs in the Islamic world can help out as they are exempt from patent restrictions till 2033, and thus free to copy and develop any ACI for any Biosimilar irrespective of patent status. This provides a huge competitive advantage to LDCs over possible rivals from more advanced countries. Bangladesh, an LDC, has developed the required competencies for upstream processing technologies for producing seed clones for any type of Biosimilars. Thus, Bangladesh can supply seed clones to competent pharmaceutical companies in the Islamic world till at least 2026, and then transfer technology to other LDCs to allow WTO's patent waiver to continue till 2033, provided an integrated microbioreactor system is available for selection of highly expressing clones of the desired recombinant Biosimilar. Bangladesh can also provide Biosimilars produced under cGMP conditions and ready for human clinical trials in other Islamic countries. Besides meeting healthcare needs, affordable Biosimilars will also lead to cost saving and wealth creation as the market value for mAb-type Biosimilars is growing exponentially and projected to surpass $0.5 trillion by 2026. Capturing even a modest fraction of this market will greatly benefit the Islamic world and its pharmaceutical sector.

IAS and COMSTECH could Play an Enabling and Coordinating Role: The above drug development initiatives would involve researchers from different Islamic countries, including disadvantaged ones, through development and adequate funding of multidisciplinary collaborations between research groups possessing complementary expertise and facilities. Discovery and development of new biotech drugs is only the first step. Commercialisation would require management and funding of IP, development of simplified and uniform guidelines to expedite and reduce cost of clinical trials and regulatory affairs, and forging of productive partnerships with local pharmaceutical companies with required competencies. IAS and COMSTECH could coordinate and provide logistics support to this OIC-wide initiative, and also convince governments of strategically located and richer Islamic countries to host resource centres and technology platforms which would also be accessible to researchers from neighbouring disadvantaged countries. IAS and COMSTECH, with OIC and TWAS, could jointly persuade IsDB to substantially fund the collaborative research networks involved in producing essential biotech medicines for the Islamic world.

Producing Affordable Biotech Medicines for the Islamic World: *Opportunities and Requirements*

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Chief Research Scientist, Biomolecular Engineering, CSIRO, Australia

Director of Research and Professor of Medical Biotechnology, University of Cape Town

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Honorary Positions (2007-Present)

Secretary General, Islamic-World Academy of Sciences (till Dec 2022)

Honorary Professor, Faculty of Health Sciences, University of Cape Town, South Africa

Incepta Distinguished Professor, Bangladesh University of Health Sciences

TWAS Research Professor, BRAC University, Bangladesh

TWAS Research Professor, CARS, Dhaka University, Bangladesh

Incepta Research Professor, CARS, Dhaka University, Bangladesh

Advisor, Biotech Medicines, INCEPTA Pharmaceuticals, Bangladesh

Visiting Professor, ICCBS, University of Karachi, Pakistan

Economic Status and S&T Proficiency in Islamic World

- Of 57 OIC-Member Countries
    - *None* classified as *Developed Country*
    - *21* classified as *Least Developed Countries (LDC)* [most in SSA]
    - *Majority* of countries are classified as *Scientifically-Lagging*

- Socioeconomic development is critically dependent on Excellence in need-based *Higher Education* and *Postgraduate Research* (PhD and Postdoc) and *Technological Proficiency*

- *LDCs and Technology-poor countries must not be left behind* in the quest for socioeconomic development of the entire Islamic World

Research Collaborations within Islamic World in Areas of Common Interest and Highest Priorities

- Difficult for most OIC-member countries, especially LDCs, to be internationally competitive in all areas of research due to lack of trained manpower and adequate scientific resources

- Need to *focus* on, and adequately fund, R&D in areas of common interest, existing strength, and *development priorities (Food Security, Health Equity, Green Energy, Climate Change, Environment etc*.)

- Research productivity can be maximised through *multidisciplinary* and *multi-institutional collaborations* between research groups in different Islamic countries that possess *complementary expertise and facilities*

- **Discovery and Development of essential Biotech Medicines** can involve researchers from Islamic countries at varying levels of economic and scientific development

Two Areas of Drug Development Research that Provide Best Opportunities for Collaborations and Product Development

1. Rational Bioprospecting of BIOTA for Discovery of Novel Drugs
    - *Huge opportunity for OIC-wide collaborations and productive involvement of LDCs and scientifically-lagging countries*
    - *Immense prospects for Intellectual Property (Patents) development at different stages of the drug discovery and development process*

2. Development of Affordable Biosimilar Medicines through Reverse Engineering of very expensive Patented Biologics
    - *Meet healthcare needs of Islamic countries, including economically disadvantaged ones*
    - *Huge opportunity for capacity development and wealth creation, and strategic involvement of LDCs*

Rational Bioprospecting for Discovery and Development of Novel Drugs

Combines Traditional Knowledge with Modern Sciences to Discover and Develop Modern Medicines from Indigenous Flora and Fauna

Rational Bioprospecting Indigenous Biota for Novel Drugs

Existing Strengths and Resources:

Indigenous Knowledge / Traditional medicines

Regional Flora and Fauna / Biodiversity Hotspots

- *Ethno-pharmacology* (impressive scholarly publications)
- ***Extract Libraries*** *from plants/living organisms* (organize and catalogue)
- *Chemistry of novel secondary metabolites from medicinal plants/Biota* (impressive scholarly publications)
- ***Secondary Metabolite Libraries*** *from Biota* (organize and catalogue)
- *Natural product-derived Extract and Secondary Metabolite Libraries are* ***Goldmines of undiscovered wonder drugs!***

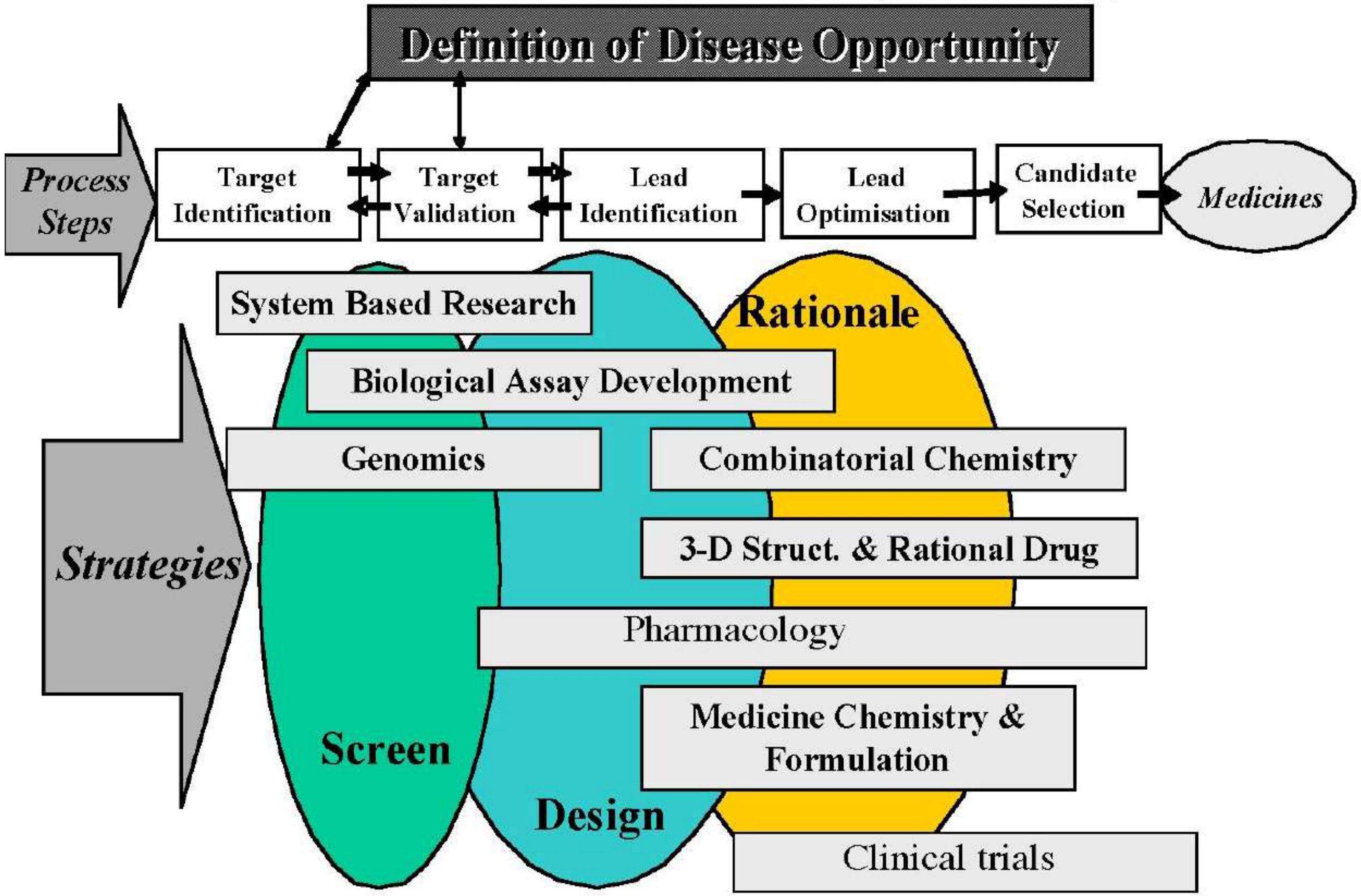
Extensive research publications have not resulted in too many modern medicines!

What is needed to translate research into new medicines?

✓ *Multidisciplinary collaborations, and* ***involvement of molecular biosciences***
✓ *Generation and utilization of IP (Patents);* Funding for patent protection?
✓ *Interaction and partnership with modern drug companies*

The Drug Discovery and Development Process:

RESEARCH PROCESS MAP (Early & Preclinical)



Rational Bioprospecting of Biota for Novel Drugs

Combining strengths in **traditional knowledge**, and medicinal chemistry, with **modern molecular biosciences:**

- ➢ *Bioprospecting of natural product-derived extract and isolated chemical libraries with **Disease-Specific Molecular Target-based Bioassays** could result in*
  - ✓ *Much higher levels of lead identification*
  - ✓ *Candidate drugs with high specificity and insignificant side effects*

- ➢ *Ample opportunities for IP generation, and Technology Transfer (academia-Industry partnership) for Commercialisation*

- ➢ Very high potential for *multidisciplinary and multi-institutional collaborations*, and *involvement of scientists from LDCs and scientifically-lagging countries*

- ➢ *High Market demand* (as no new small molecule drugs being developed)

Discovery and Development Pathway for Novel Drugs from Biota
(*Expertise and Facilities Required):*

Discovery Research

- Identification and validation of **disease-specific molecular targets*** [**new IP**]
  - (*molecular and cell biology, genomics, proteomics, computational biology, animal and tissue models*)

- Development of **disease-specific molecular target-based bioassays*** [**new IP**]
  - (*Molecular Biosciences and immunochemistry*)

- Natural product libraries (extracts and isolated secondary metabolites):
  - *(Ethnopharmacology and Medicinal Chemistry)*

- Identification of **new lead compounds** by screening NP libraries with *highly specific* molecular target-based *bioassays* **[new IP]**

*****Find and involve researchers in disease pathogenesis and assay development

Discovery and Development Pathway for Novel Drugs from Biota
(*Expertise and Facilities Required):*

Development Research

- ❖Molecular target-based Bioassay-directed lead molecule purification and characterisation [**new IP**]

- ❖Optimisation of lead molecules into possible candidate drugs [**new IP**]
  - ❖(*combinatorial and synthetic chemistry, structural biology, computational chemistry/drug design*)

- ❖Selection of best candidate drug
  - ❖(*preclinical animal studies, and human clinical trials)*

Commercialisation

- ❖Regulatory affair, manufacturing under GMP conditions, marketing

Disease-Specific Molecular Targets, and Target-Based Bioassays for Identification of *Therapeutic Leads Against COVID-19*

Example 1:

Disease-Specific Molecular Target:

Receptor-binding domain (RBD) of SARS-COV-2 Spike Protein: Responsible for *virus attachment/entry to* human cells by *binding specifically to human receptor ACE 2*

Target-Based Bioassay (in vitro binding of virus RBD to human ACE2)

Therapeutic *lead compounds* (in NP extracts) could *prevent/disrupt binding of viral Spike Protein to human ACE 2,* without affecting biological activity of ACE 2

Example 2:

Disease-Specific Molecular Target

RNA-dependent RNA Polymerase (RDRP) of SARS-COV-2: Responsible for Viral RNA genome replication in infected human cells

Target-based Bioassay (Viral RDRP dependent viral RNA synthesis) :

Inhibitors (present in NP extracts) could specifically inhibit viral RNA synthesis without inhibiting any human RNA/DNA polymerases

Biologicals, Biosimilars and Biobetters

Peptide- and Protein-based Therapeutics produced by Recombinant DNA Technology

Human Protein/Peptide-Based Medicines Produced by Recombinant DNA Technology

Biologics: Patented Bioactive human proteins/peptides produced by recombinant DNA technology

- 1st Generation: Insulin, Interferon, Erythropoietin, Growth Factors etc.

- Monoclonal Antibodies (Mab): Therapeutic antibodies (originally produced by hybridoma technology, and then by recombinant DNA technology)

- Fc-Fusion Proteins: Recombinant Protein in which a bioactive protein/peptide linked to constant Fc domain of a Mab

  - *Mabs and Fusion proteins are mostly patent-protected and extremely expensive (>$50,000/person/year)*

Human Protein/Peptide-Based Medicines Produced by Recombinant DNA Technology

- ❖ *Generics:* Exact copies of small-molecule drugs produced by synthetic chemistry (*Clinical Trials not needed*)

- ❖ ***Biosimilars:*** Cheaper versions of Biologics produced by recombinant DNA technology with same therapeutic properties, but structurally not identical to the original Biologics (*Clinical Trials a requirement for regulatory approval*)

BIOSIMILARS: Low-Hanging Fruit Ready for the Picking

- Pharmaceutical companies in some Islamic countries sell Biosimilars "repackaged" with imported ACI (from China, Korea, India, Brazil etc.)
- A few have produced ACI for Biosimilars (Insulin, Interferon, EPO, growth factors etc.) from seed clones obtained from *ICGEB*
- To produce affordable Biosimilars of new generation patent-protected Biologics (Mab / FC-Fusion Proteins) their ACI (seed clones) need to be locally produced
- Patent restriction can be circumvented (till 2033) by carrying out the upstream R&D in a LDC that has the required competencies
- Besides making very expensive modern drugs available to Islamic countries, this is also an excellent opportunity for wealth creation
- Global market for Biosimilars was $2.5 billion in 2014 and expected to **exceed $69 Billion in 2025** (and possibly multi-Trillion $ in 2030)

Golden Opportunity for Production of Affordable Mab and Fc-Fusion Biosimilars for Islamic and Developing Countries

- Cheaper *Mab and Fc-Fusion Biosimilars* (of expensive and patented Biologics) are desperately needed for Islamic World and poorer developing nations

- LDCs can legally copy any patented drug to produce and market cheaper new generation Biosimilars as they are exempt from patent restrictions till 2033

- This provides a huge competitive advantage over likely competitors in developed and developing countries (Korea, China, India, Brazil, Argentina)

- Excellent opportunity for LDCs, with required competencies and low labour costs, to take advantage of WTO's patent concession to produce affordable Biosimilars for the Islamic and Developing World

- Are there any LDCs in the Islamic World that have the required *upstream* competencies, trained manpower and resources to develop Biosimilar seed clones, and the *downstream* technologies to manufacture Biosimilars for clinical use in humans?

Golden Opportunity for Production of Affordable Mab and Fc-Fusion Biosimilars for Islamic and Developing Countries

- Incepta Biotech (Bangladesh) has already produced and marketed new generation Biosimilars from (imported) seed clones, and also demonstrated competencies for producing own seed clones by reverse engineering

- An independent team of young researchers in Bangladesh (mentored by AAA) have developed all *upstream competencies for producing any Fc-Fusion seed clone* of choice

- With suitable operating funds, sponsored trainees (research scholars) and a semi-automated clone selector, this research team (from Bangladesh) can develop any seed clone for production of latest high-value Biosimilars

- Very important to know if any other LDCs also have competencies and trained manpower for the development of seed clones of latest Biologics?

- Bangladesh could help to *train and transfer technology to other LDCs* in the Islamic World till 2026 (when it loses its LDC label)

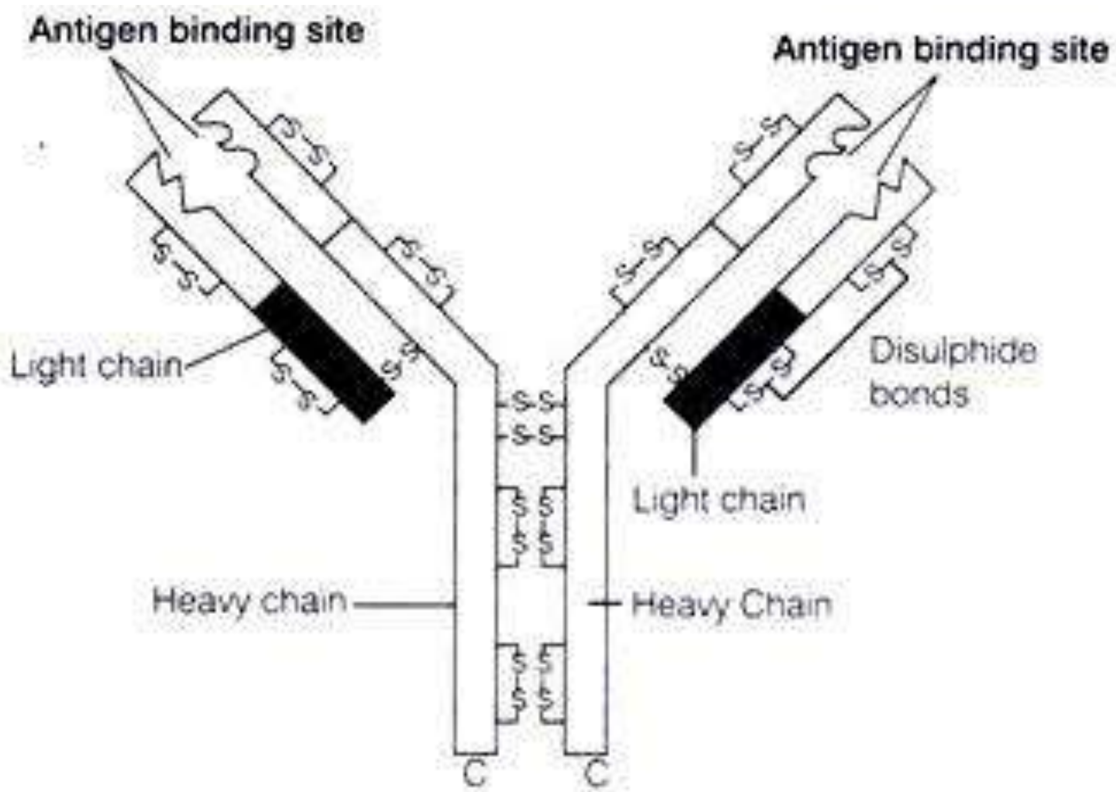
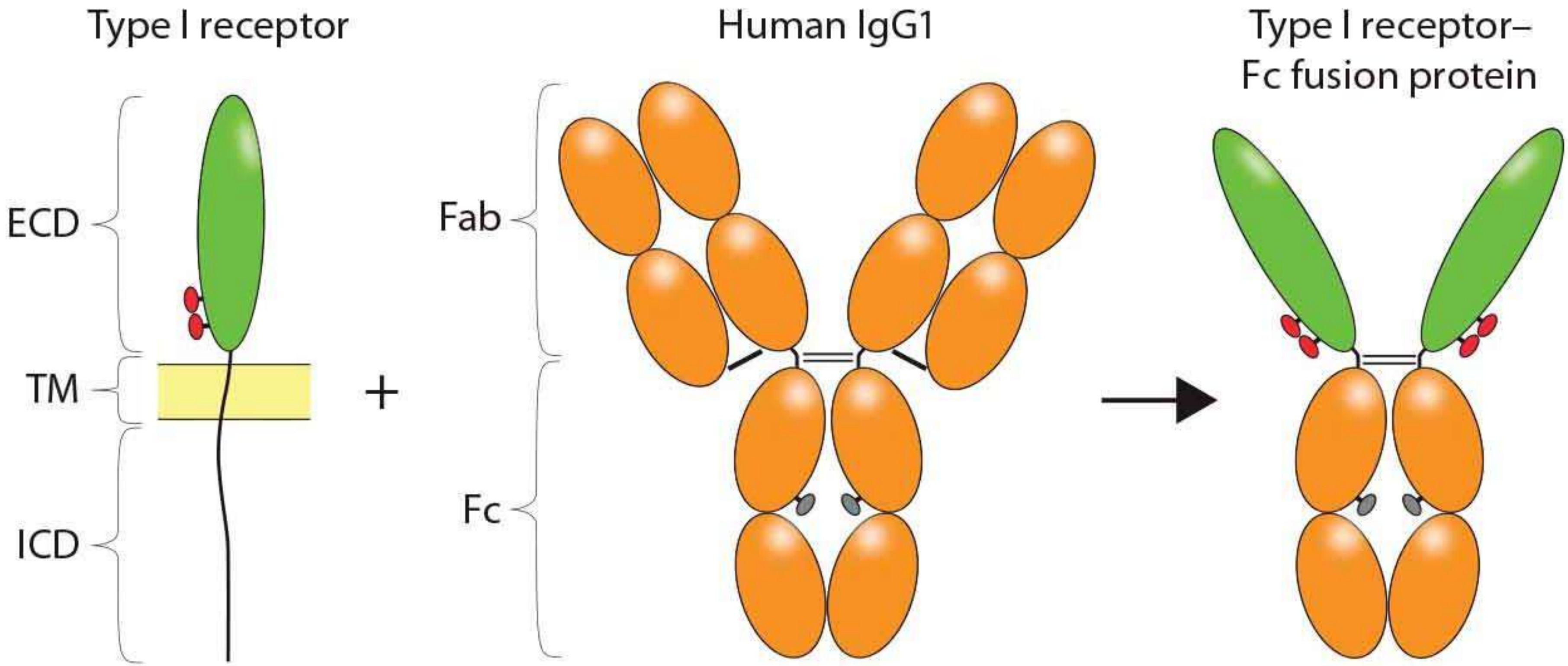
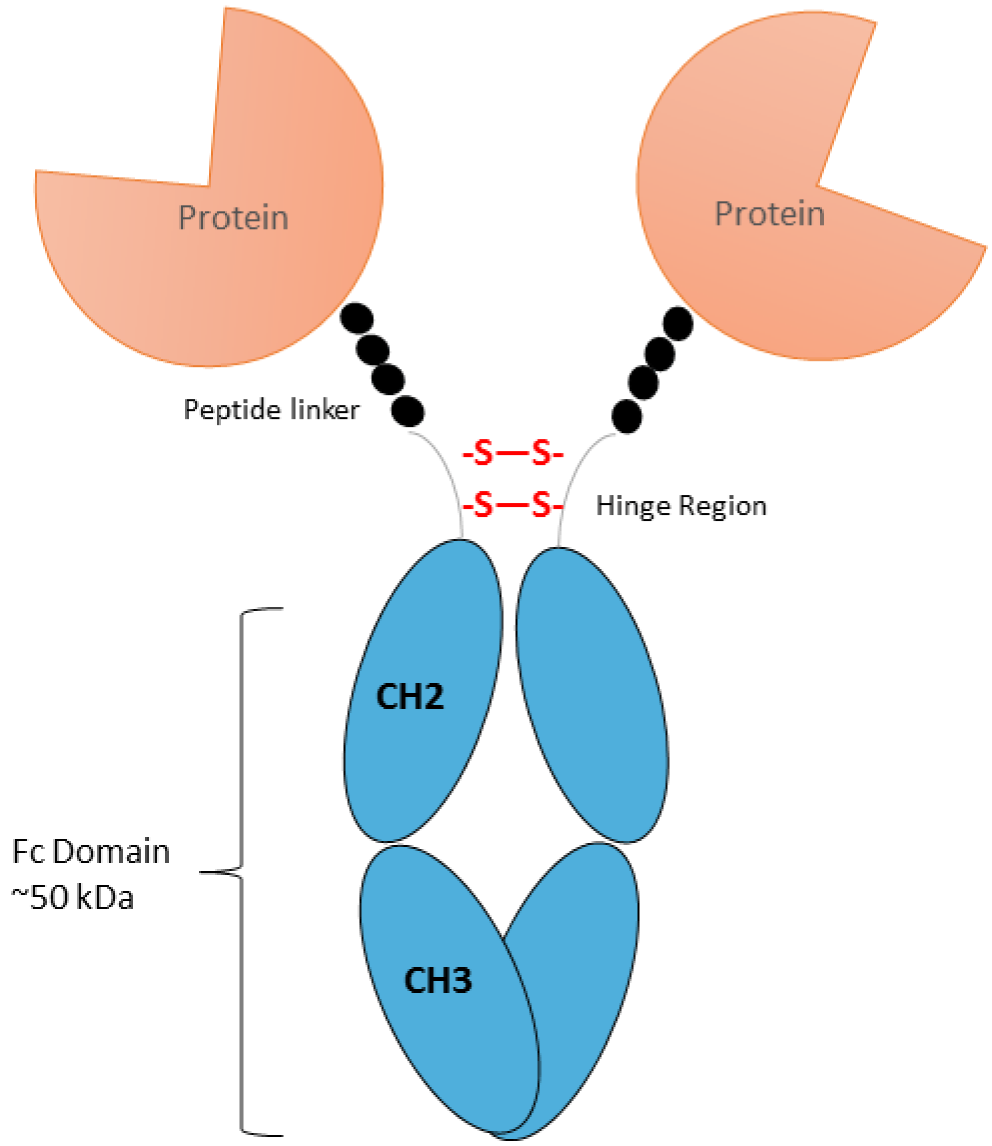


Fig 8.2 Structure of an antibody molecule


Type I receptor
ECD
TM
ICD
+
Human IgG1
Fab
Fc
Type I receptor–
Fc fusion protein



Protein
Protein
Peptide linker
-S—S-
-S—S-
Hinge Region
CH2
CH3
Fc Domain
~50 kDa

Development of Seed Clones of New Fc-Fusion Biosimilars

- **Upstream Processing (Reverse Engineering and seed clone development)**

  - Obtain amino acid sequence of the N-terminal therapeutic protein
    - ✓ *Known protein (patent/literature; Unknown protein (direct sequencing)*
    - ✓ *Need access to Tandem MS (MALDI-Tof/Tof-MS or LC-MS/MS)*

  - Design equivalent gene (for Biosimilar) using human codons
  - Chemically synthesize designed gene for Biosimilar
    - ✓ *Preferably use own polynucleotide synthesiser* (for confidentiality)

  - Integrate Biosimilar gene into suitable mammalian expression vector in which gene for constant Fc region of IgG is built-in
    - ✓ *C-terminus of therapeutic protein covalently linked to Fc N-terminus*

  - Small-scale Fermentation in CHO cells for expression of Biosimilar
    - ✓ *Ascertain integrity and biological activity* of expressed Biosimilar*

  - Selection of clone(s) with highest levels of expression of bioactive Biosimilar
    - ✓ *Semi-Automated Clone Selector* with built-in FACS and cell sorter required*

Development of New Fc-Fusion Biosimilars from Seed Clones

- Downstream Processing
  - Production of Biosimilar by batch fermentation to ascertain structure and biological activity of Biosimilar
  - Produce enough Purified Biosimilar for Preclinical Animal Studies (safety, efficacy and bioavailability)
  - *Large-scale fermentation and purification of Biosimilar under GMP conditions for human clinical trials*
- Preclinical Animal Studies
  - Contained and SPF facilities for any challenge studies (for anti-infectives)
- Human Clinical Trials (Adequate funding and appropriate expertise required)
- Regulatory Approval (OIC-wide Simple and uniform guidelines required)
- Manufacture and Marketing (Easing/removal of trade barriers within Islamic World)

Should Islamic World Produce New Generation Biosimilars?
Important Points to Consider!

1. Very high demand for cheaper Mab-type Biosimilars of highly efficacious but extremely expensive Biologics (>$50K/person/year)

2. Production costs will be greatly reduced if Biosimilars of patented Biologics are made from seed clones developed within Islamic world.

3. To circumvent patent protection, clone development and selection of highest-expressing clones could be carried out in a LDC as WTO has granted them exemption from patent restriction till 2033

4. This provides huge competitive advantage to LDCs over major competitors (China, Korea, India etc.) who can only produce and market Biosimilars of out-of-patent Biologics

Should Islamic World Produce its Own New Generation Biosimilars?
Important Points to Consider!

5. Decision, to produce molecular seed clones in LDCs, must be made without delay if full advantage is to be taken of the time remaining on patent cover for individual Biologics

6. Are there any LDCs in the Islamic world, besides Bangladesh, that have the required competencies?

7. How can more scientifically advanced Islamic countries contribute?
   - ✓Develop Bioassays to affirm biological/clinical activity of intended Biosimilar
   - ✓Host researchers from disadvantaged countries and provide access to advanced technologies
   - ✓Facilitate human clinical trials

8. Enabling and Coordinating Role for IAS and COMSTECH?

How can IAS and COMSTECH Play an Enabling and Coordinating Role in Supporting OIC-wide Research Capacity Development?

Provide *administrative, policy and logistical support* to initiatives that *bring together multidisciplinary research teams from different Islamic countries*

To promote **OIC-wide Research Capacity Development**, *IAS and COMSTECH* should undertake the following initiatives:

- *With science academies in Islamic World*, convince Governments to
  - Increase funding for *postgraduate research* and national *R&D* to minimum levels recommended by UNESCO
  - Host visiting researchers (from disadvantaged countries) for training and access to contemporary equipment and facilities
  - Encourage *academia-industry partnerships*, and *industry funding* for academic and industry R&D (in return for tax concessions and trade benefits)

- In partnership with **IsDB** and other development partners secure funding to establish a **Trust/Foundation** to adequately fund/support:
  - Collaborative research in areas of common interest and highest priority
  - PhD scholarships, Postdoctoral Fellowships, Training and Visiting Fellowships
  - Purchase of essential equipment
  - Pre-clinical animal studies and human clinical trials
  - IP/Patent generation, maintenance and protection

How can IAS and COMSTECH Play an Enabling and Coordinating Role in Supporting OIC-wide Research Capacity Development?

- Establish **strategically located world-class research centre(s)**
  - *State-of-art equipment and technologies* (that most Islamic countries cannot afford to buy or maintain individually)
  - World-class *goal-oriented research addressing development priorities* of Islamic countries
  - Internationally recognised *expertise in required scientific disciplines*
  - *Postgraduate research and training hub* for young researchers, especially from LDCs and scientifically-lagging countries

  - **A World-Class Molecular Biosciences Research Centre** to support Biomedical, Agricultural, Green Energy and Environmental Sciences Research with following shared facilities:
    - Latest gene, protein and cell technologies
    - Bioinformatics, structural biology, combinatorial and synthetic chemistry, computational chemistry (drug design)
    - World-class “contained” facilities for producing transgenic animals (as disease models), and for preclinical “challenge studies”
    - ‘Controlled environment’ glass house for transgenic plants and tissue culture

- **Technology Transfer Office(s):** *as one-stop advisory and support hub(s) for IP, Regulatory Affairs and Commercialisation, with uniform and harmonised guidelines for all OIC-member countries* (e.g. EUMA covers all EU nations)

Status and Progress in relation to Sustainable Development Goals in the Islamic World: Opportunities for Change

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Abstract

As the end of the Millennium Development Goals period (2000-2015) approached, and it became clear that many countries would not meet the eight health targets established by the United Nations (UN), a new more comprehensive list of targets were established and would come to be known as the Sustainable Development Goals (SDGs). The 17 SDGs encompass health, economic and environmental targets for countries to achieve by the year 2030. With the mid-point of the SDGs approaching, we sought to investigate how countries were performing in terms of meeting health and health related Sustainable Development Goals (HHSDGs), which included the majority of the SDGs. We identified available health and health related indicators available in Demographic Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS). Indicators that were not available in DHS and MICS, were sought from other nationally representative sources such as WHO, World Bank and UNESCO. We then determined the indicators that had two time points available to generate trends in HHSDG achievement. We further narrowed our focus on the performance of countries with predominantly Muslim populations, which will hereafter be referred to as Muslim Majority Countries (MMCs). In focusing on this group of countries and comparing them to others comparable on the basis of development, we sought to identify areas where MMCs are outperforming or falling behind other countries and consider the factors that may cause the observed disparities. This presentation will highlight salient areas of progress and stagnation, suggesting modalities for scaling up implementation and reducing inequities.

DIGITAL TRANSFORMATION: TECHNOLOGY AND INNOVATION FOR SOCIO-ECONOMIC DEVELOPMENT

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President, Islamic World Academy of Sciences
Chancellor, University of Petra
Chairman of the Board of Trustees of the University of Jordan, Jordan

ABSTRACT

Some OIC countries were successful in building culture of innovation for socio-economic development, while others failed to do so. Those who made it took measures to support science, technology and relevant quality education from childhood to higher education, which resulted in wealth creation and quality of life. They concentrated on building rich human resources in a stable political environment which have triggered the human capital potential to new frontier areas in science for a sustainable development, and made a new space among other OIC developing economies. Those who invested more in R&D and quality education harvested an enormous development as seen in major science indicators as: peer-reviewed publications, patents, higher number of scientists per one million population, and higher world ranked academic institutions and stronger links of academia with industry in developing hi-tech exports worldwide.

To alleviate poverty, and unemployment and climate change and, to meet the UN-SGDs 2030, OIC countries need a comprehensive stable policy toward a green economy in a sustainable ecosystem, capitalizing on technology, innovation and creativity as human-based rich resources.

Digital Transformation: Technology and Innovation for Socio-Economic Development

Adnan Badran,
FIAS, FTWAS, FAAS

Prof. and Chancellor,
University of Petra,
Amman, Jordan

The 24th Conference of the Islamic World Academy of Sciences (IAS)
On
Challenges to Promote Science and Technology for Socio-Economic Development in OIC Countries
Mar 7-8, 2023
Karachi-Pakistan

Digital Transformation:

- Today's buzzword after the pandemic is: "distance education and E-learning.
- Although one is dependent on the other.
- E-learning is a style of pedagogical learning includes use of technology and digital resources.

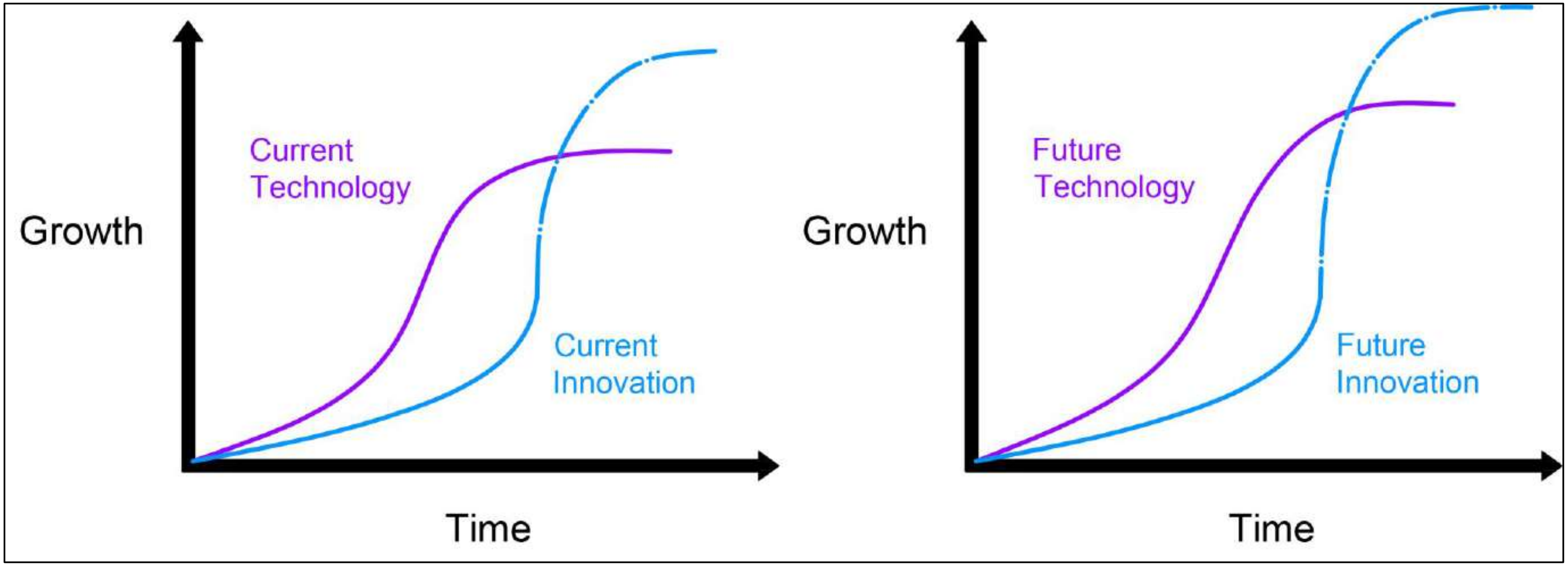
Innovation and Digital Transformation (DT):

- DT requires trust, resilience and innovation.
- Create friendly environment for new ideas.
- Bring people from various disciplines and backgrounds.
- Start from customer needs with reverse-engineering scenario.
- Breakdown silos of disciplines for integrated interdisciplinary approach.
- Build resilience into business models to withstand exogenous shocks.

How to drive Transformation by Innovation:

- Structural change for new skills, hands-on.
- Retrain workers for alignment with new opportunities created.
- Empowering capacity of human resources to release their potential in creativity and innovations.
- Adapting artificial intelligence (AI) has achieved success in the pandemic environment.
- Space for creative thinking to generate innovative ideas.
- In the digital world, variety and diversity will drive innovations and transformation to new orbits.

Diffusion: From Technology to Innovation



Rise of Technology would Raise Innovation

Fig.1 : Diffusion Curve

Trends of Technology and Innovation:

1. **Cloud** as digital foundation will attract biggest investment.
2. **Data** is the business pivot (IOT).
3. **Ecosystem** to bridge the gap of skills in building the culture of innovation.
4. **Security and Privacy**, cybersecurity to protect new technologies.

The Metaverse:

- To live within a digital universe.
- Started with Neal Stephenson: (1992) science fiction novel (snow cash), lifelike avatars, 3D Virtual Reality (VR) environment.
- Online virtual world: Augmented Reality (AR), VR, 3D holographic avatars, video communication.
- Hyper-real alternative world to live and coexist.
- Mark Zuckerberg: CEO Meta Verse (Former Facebook) expects 10 years for metaverse to become mainstream online.

Examples of Metaverse:

Metaverse is an evolution of the internet- an online space where people can socialize and play and construct as avatars. What you need VR headset connected to PC and later to iPhones.

- **Meta Facebook:** expected next platform for immersive embodied internet.
- **Microsoft:** holograms and mixed reality (MR) of Avatars.
- Reimagining Martin Luther King 1963 “I have a dream”.
- **Minecraft:** Legos for kids where players create their own digital characters.

Why Innovation Matters in Education:

- It's how to use technology to empower students to become lifelong learners and agents of change.
- Aligned to their abilities and culture and identity.
- Looking to solve problems.
- Innovate to improve. This is how Apple maintain dynamic in the marketplace from iMac to iPhone.

UNESCO Four Pillars of Education in Digital Transformation:

There are four pillars of learning for the twenty-first century, laid out by UNESCO (Jacques Delors Report):

1. **Learning to be:** To solidify my existence as a thinking person in the foundation of knowledge, and my identity as a citizen. "I think, therefore I am".
2. **Learning to know:** To develop my cognitive skills and critical intellectual skills in research, enquiry, questioning, discovery, invention, searching for the unknown and arriving at the truth.
3. **Learning to work:** to develop skills working and to excel. Continuous Education
4. **Learning to live with others:** understanding pluralism and contrast, respecting difference, and appreciating other cultures and civilizations, without discrimination.

Life-long Learning: the McDonald Model in the Digital World:

- **Fixed programs and curricula** that take a long time to change, may be of no value in a world that wants skills that respond quickly to market needs and societal changes.
- **Therefore, life-long learning will spread in the future** that provides quick meals of special educational packages, to prepare the individual according to his needs and abilities to the field of work.
- **He may return again to take other educational and learning** sandwich that lead him to another work, and thus the human resources are evolved internally in a changing world.
- **This will cut unemployment**, thus turning society into a dynamic productive society in an ever changing world, rich in diversity.

Role of Scientific Research in developing Technologies:

The university plays a major role in bringing change in economy and society.

Examples:

1. The 500-year-old university in South Korea, Sun Kye-kwan, has introduced the world to **Samsung**.
   The success story of **Iceland and Ireland** in scientific research, **medical** and **educational techniques**, **energy** and **modern management.**

2. The scientific-industrial complexes in Malaysia on the Corridor between Kuala Lumpur and the airport, technological institutes that turned into a dynamic green land, scientific incubators and industrial scientific communities.

3. Silicon Valley, which is adjacent to Stanford University in California and the scientific city in Cambridge surrounding MIT in Boston, where emerging companies startups from the research and development outputs of the university, to become giant companies that manage the market and the global economy.

Role of Scientific Research in developing Technologies: (continue)

4. Finland was based on the outputs of scientific research in communication from R&D outputs of 52 universities, each of which contains incubators and scientific-industrial complexes, invented Nokia and other advanced satellite communication.

5. The scientific-technological triangle in Canada, where Canadian universities participate to adapt their research outputs through their incubators into advanced commodity and knowledge technology, in the techno-park.

6. **Chungbuk Technopark** is a technology park located in the North Chungcheong province in South Korea for small and medium-sized companies in S.Korea, aiming to foster biotechnology and assist business incubation. The technology park is a regional innovation center for industrial development, enterprise support and job creation through collaboration between local industry, academics, local and national government.

Reforms of Education: Innovation from Schooling to E-Learning

- Contemporary education requires a new learning Digital ecosystem that is student-centered, with problem-based learning and real-world learning that spark innovation and entrepreneurship. Students should become the vehicles of change.
- Utilization of smart phones provides new learning tools for students to think “outside the box” and look for new ways of developing skills beyond the classroom.
- We have to train a new generation of teachers who overcome the traditional way of teaching, enabling them to move into technology-based-learning, **blended-learning** utilizing multi-media, and interactive debate on problem-solving.

Building a Culture of Innovation:

The WB has set a strategy for entrepreneurial assessment summarized in the following:

- Identifying current performance and opportunities.
- Designing targeted solution.
- Strengthening policy design and governance.
- Engaging globally with stakeholders.

How to Enhance a Vibrant Innovation and Entrepreneurship Ecosystem:

- Policy makers, business leaders, academia, and civil society are called on to collaborate with clear plans for job creation.
- The Forum of Young Global Leaders at the World Economic Forum (WEF) at the Dead Sea with Booz and company have put a visionary plan to engage the youth in innovation and entrepreneurship for startups to open new horizon for work for economic development.
- Entrepreneurs will be vital engines to drive the transition.

Conclusion:

- Although R&D outputs of universities in the Islamic World, are on the increase as indicated and cited in international peer-reviewed journals, much of the R&D lacks application to industry and the marketplace.
- Reforming education from early childhood to build creativity, critical thinking, an enquiry-based and student-centered education to spark the mighty minds to become inventors, problem-solvers, and disciplinary and multidisciplinary leaders.
- Policy-makers, academia, and business leaders must identify what motivate people to start up a business.
- The region with the potential of its youth and with investment in the knowledge economy will undoubtedly become a dynamic global center for entrepreneurial ventures and innovations. Big ideas may come in the future from the Islamic world as it used to be in older times.

At the end I wish to show histograms of data of the landscape of STI in the OIC as compared to the world.

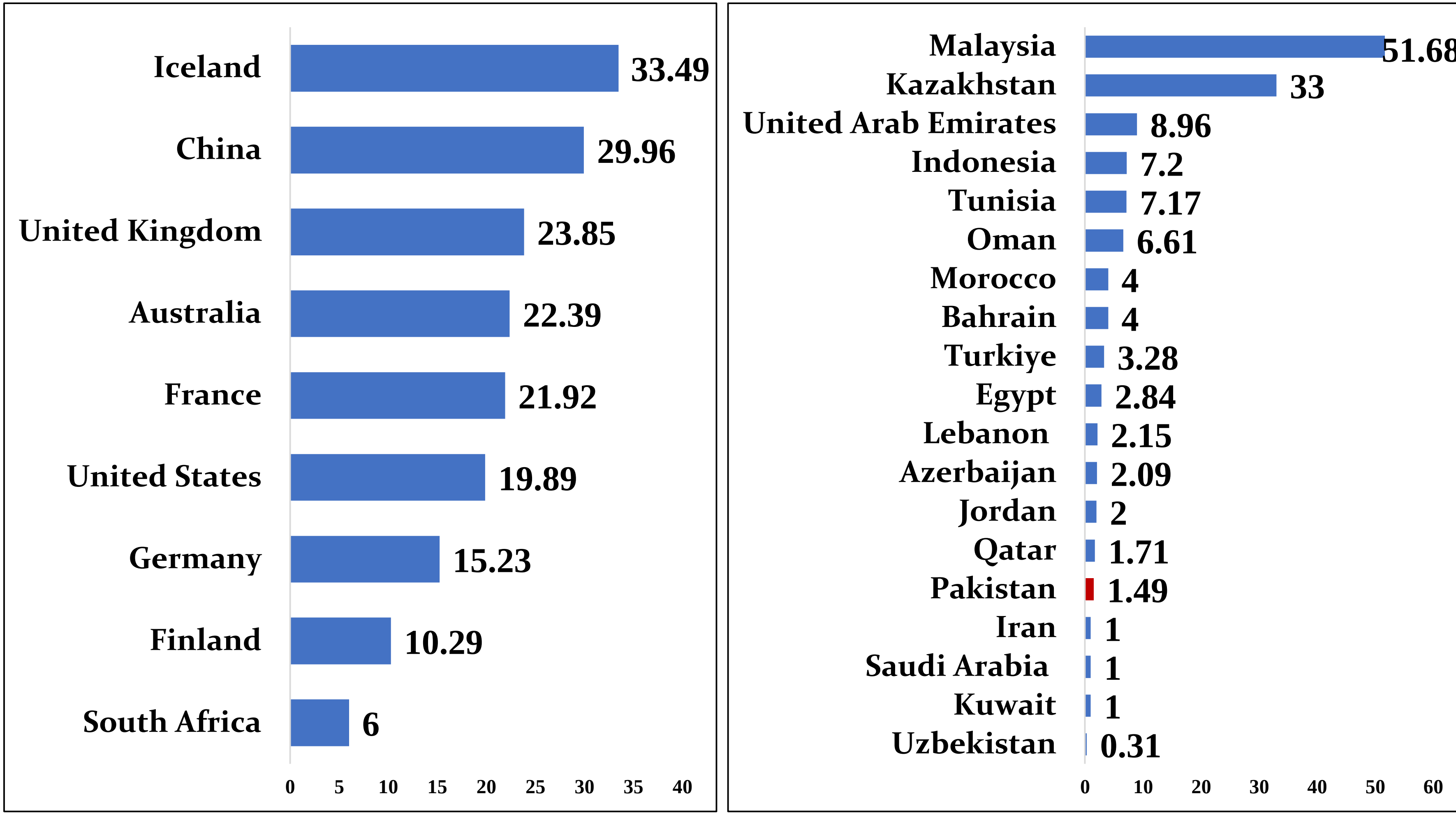


Fig 1. The ratio of high technology in total exports (% of manufactured exports) of Islamic countries as compared to the world, 2019-2021

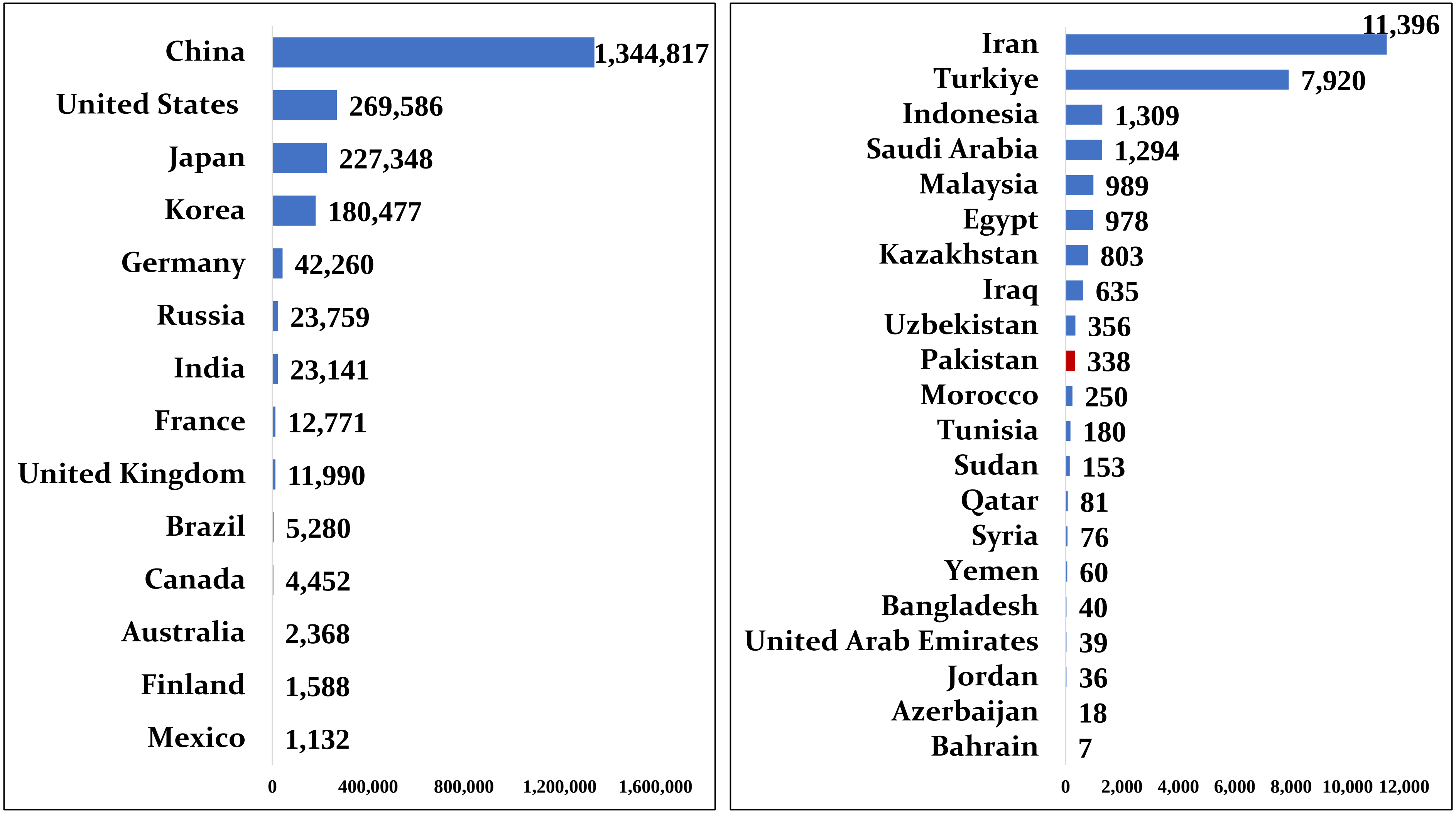


Fig.2 Patents of residents in Islamic countries as compared to the world. World Bank (2018-2020)

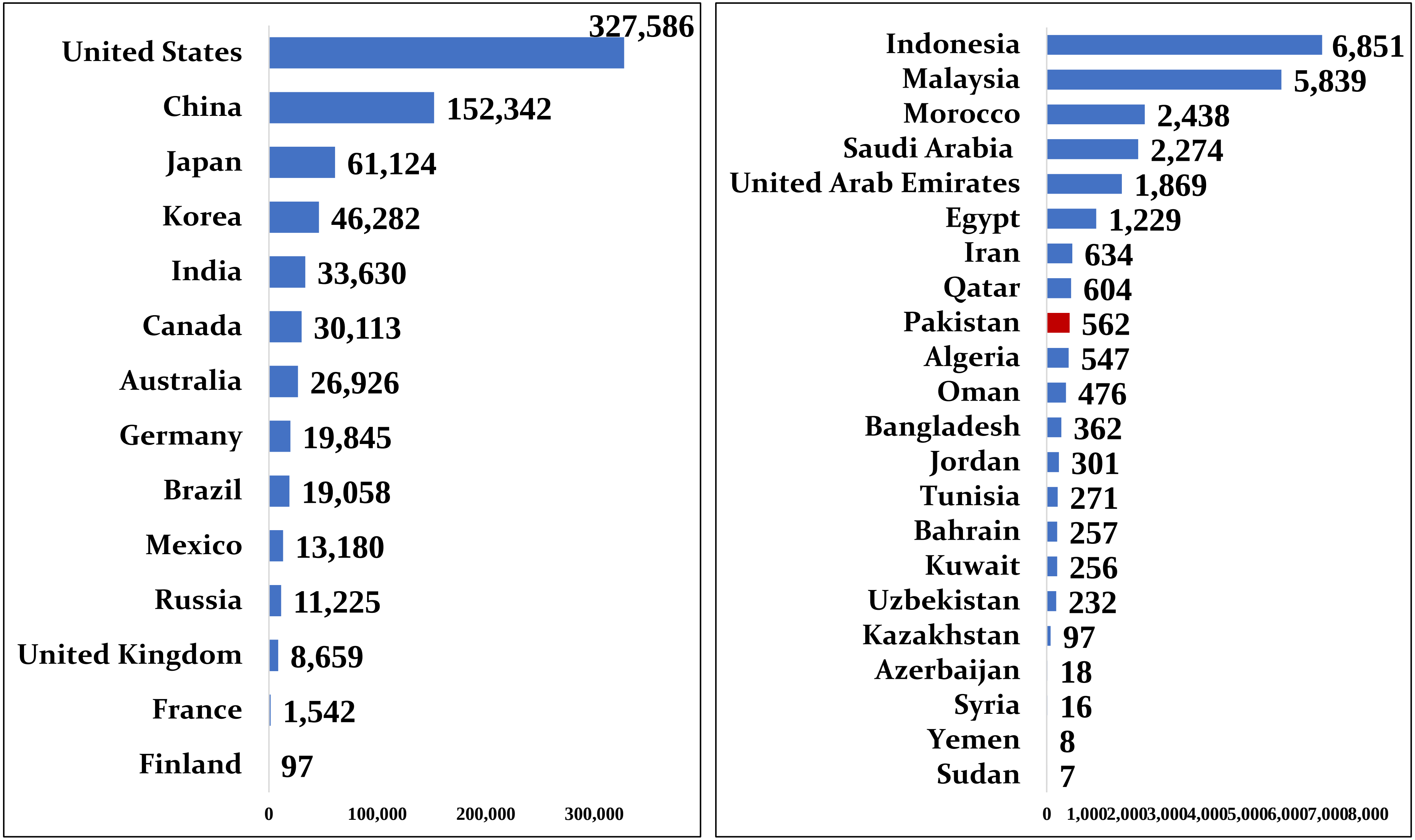


Fig.3 Patents for non-residents in Islamic countries compared to the world. World Bank (2018-2020)

my motto :

ICID

Initiate, Create
Innovate, Disseminate

For Listening

COMBATING THE DRUG DEVELOPMENT CHALLENGES WITH SUSTAINABLE AND INCLUSIVE DRUG DISCOVERY AND DEVELOPMENT - AN EMERGING PARADIGM

MUHAMMAD IQBAL CHOUDHARY* FIAS AND ATTA-UR-RAHMAN FRS

**Mustafa (PBUH) Prize Laureate, Hilal-i-Imtiaz, Sitara-i-Imtiaz, Tamgha-i-Imtiaz*

UNESCO Chair on Medicinal and Bio-Organic Natural Product Chemistry

**Coordinator General OIC-COMSTECH /*

Director, International Center for Chemical and Biological Sciences (ICCBS), Pakistan

ABSTRACT

Sustainable and inclusive drug discovery and development is based on the principles of the use of renewable resources, and green chemistry methods. Nature-based discovery of drugs against prevailing and emerging diseases can play an important role in achieving SDG-3 (Health and wellness for all). Our work in the past two decades has been focused on the discovery of new drug leads from medicinal plants, as well as synthesis of bioactive analogs by green biocatalytic transformations. We have been working largely at the interface of chemistry and biology for the discovery of chemical constituents from plants used in traditional medicines, as well as for designing of new biotransformed products with therapeutic potential. This has resulted in the identification of several novel drug leads against various therapeutic targets. Emphasis has been on the discovery of novel drug like molecules against neglected diseases, such as leishmaniasis and chronic disorders, including epilepsy, cancer, diabetes, and Alzheimer’s, and Parkinson's diseases. During this presentation, underlying philosophy and approach of our research on cost-effective discovery of naturel-based lead molecules will be highlighted.

Sustainable and Inclusive Drug Discovery and Development- An Emerging Paradigm

Muhammad Iqbal Choudhary and Atta-ur-Rahman *FRS*

Mustafa (PBUH) Prize Laureate

Distinguished National Professor/ Director ICCBS

Coordinator General COMSTECH/UNESCO Chair

International Center for Chemical and Biological Sciences

(H.E.J. Research Institute of Chemistry, and

Dr. Panjwani Center for Molecular Medicine and Drug Research)

University of Karachi, Karachi-75270, Pakistan

Current Drug Discovery Paradigm- *Unsustainable and Non-inclusive*

- **Over USD 2.0 billion to develop a new drug**
- **Over 10-15 years for development of a single drug**
- **Based on the use of fossil fuel ingredients (Earth’s non-renewable resource)**
- **Synthesis involve the use hazardous chemicals, high energy, toxic waste, etc.**
- **Technologies, such as combinatorial synthesis, high throughput screening, etc turned out to be largely unproductive.**
- **No investment on “poor man diseases”, so called neglected diseases.**

There is a need of a paradigm shift to ensure the availability of drugs for future global healthcare, including the poors of Global South

Sustainable Drug Discovery- *A New Paradigm*

- Drug for all (SDG 3)
- Drug discovery from renewable resources, zero dependence on fossil fuel (SDG 12)
- Drug discovery without the use of toxic chemicals (SDGs 13, 14, 15)
- Medicines for poor men diseases (SDGs 3, 10)

SUSTAINABLE DEVELOPMENT GOALS

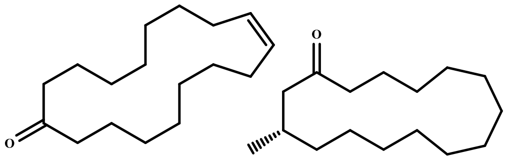
Two Examples of Our Ongoing Research

- Drugs from Nature for Neglected Tropical Diseases
- Cost Effective Drug Discovery through Repurposing

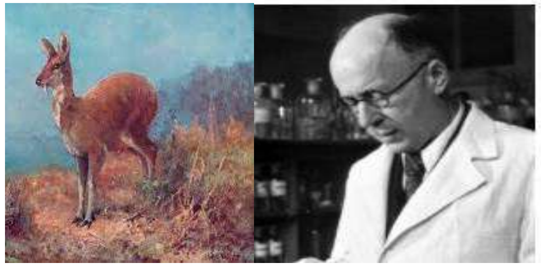
Sustainable Drug Discovery from Nature

“Natural products possess enormous structural and chemical diversity that cannot be matched by any synthetic libraries of small molecules, and continue to inspire novel discoveries in chemistry, biology, and medicine. *They are evolutionarily optimized as drug-like molecules and remain the best sources of drugs and drug leads.”*

(Newman and Cragg, *Journal of Natural Products*, 2012).

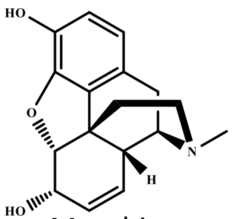


Civetone Muskone

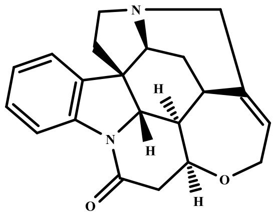


Moschus moschiferus

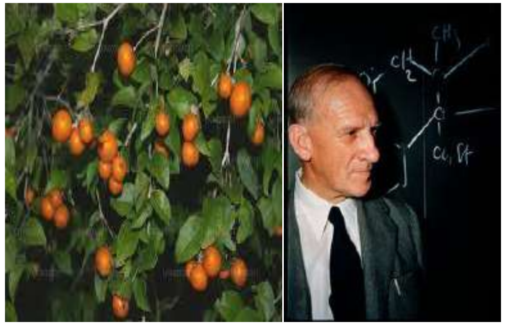
1939: Chemistry
***Leopold Ružička*:**
Muskone and Civetone



Morphine

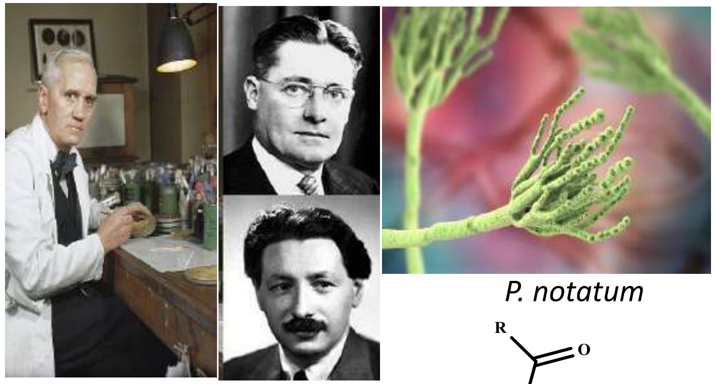


Strychnine



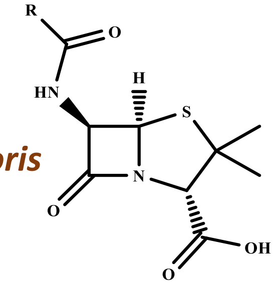
Strychnos nux-vomica

1947: Chemistry *Robert Robinson:*
Morphine, Strychnine, Cocaine, Atropine



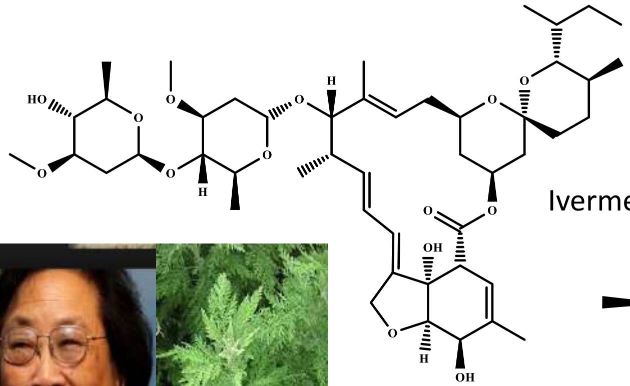
P. notatum

1945 : Medicine
***Sir Alexander Fleming, Ernst Boris Chain and Sir Howard Walter Florey“* : Penicillin**



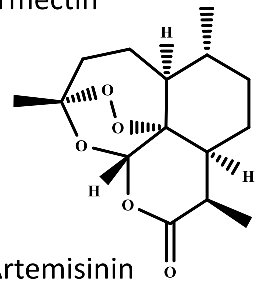
Penicillin

Nobel Prizes Based on Natural Product Drugs



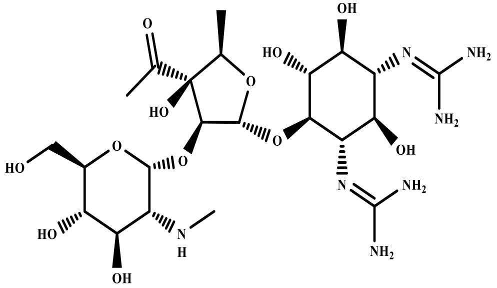
Ivermectin

Artemisia annua



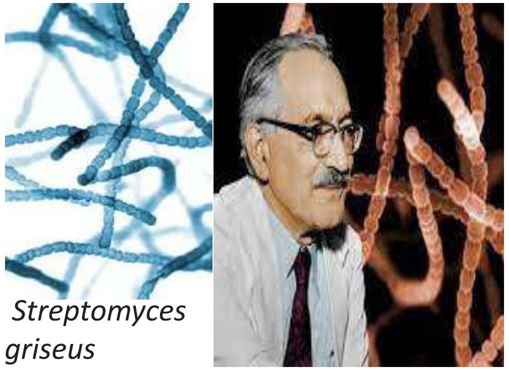
Artemisinin

2015: Physiology or Medicine
***Youyou Tu :* Artemisinin**
***William Campbell and Satoshi Omura* : Ivermectin**



Streptomycin

1952: Physiology or Medicine
***Selman Abraham Waksman* “:**
Streptomycin



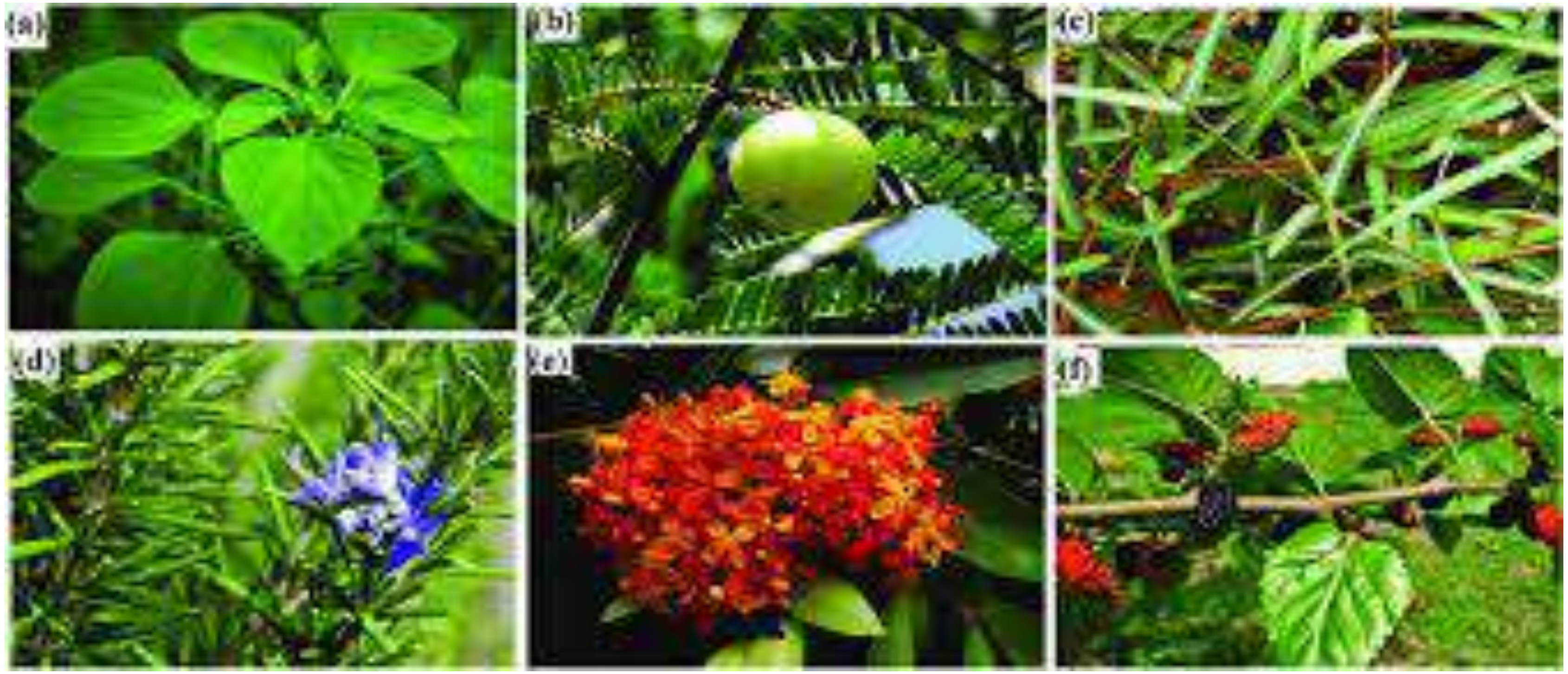
Streptomyces griseus

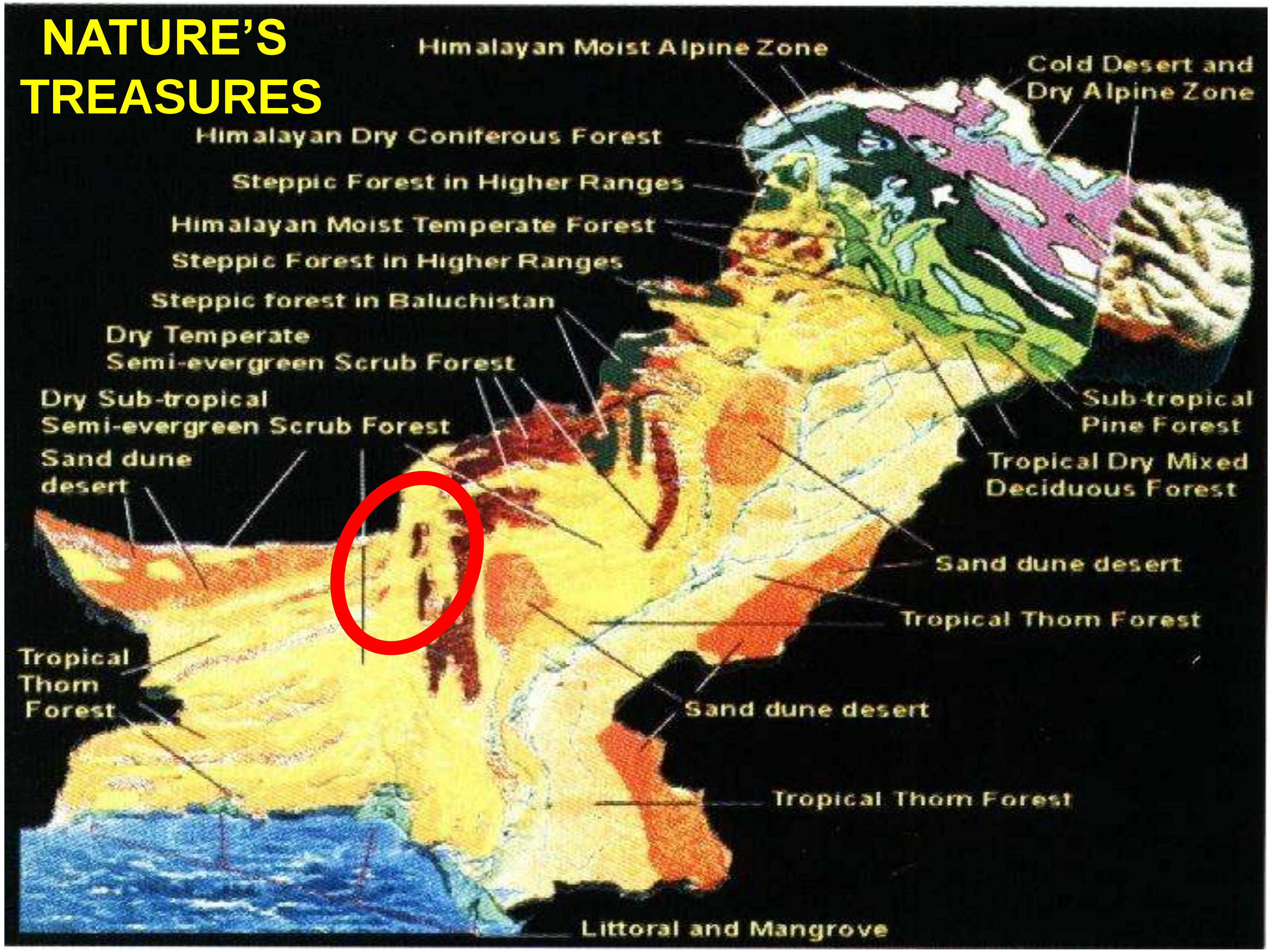
~5,000 Plant Extracts

MOLECULAR BANK

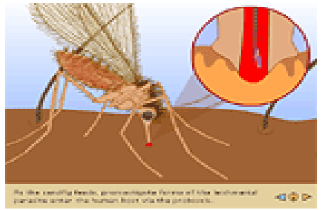
(More than 22,500 Natural Products)

ANTI-LEISHMANIAL DRUG LEADS DISCOVERY FROM NATURAL SOURCES




NATURE'S
TREASURES
Himalayan Moist Alpine Zone
Cold Desert and
Dry Alpine Zone
Himalayan Dry Coniferous Forest
Steppic Forest in Higher Ranges
Himalayan Moist Temperate Forest
Steppic Forest in Higher Ranges
Steppic forest in Baluchistan
Dry Temperate
Semi-evergreen Scrub Forest
Dry Sub-tropical
Semi-evergreen Scrub Forest
Sub-tropical
Pine Forest
Sand dune
desert
Tropical Dry Mixed
Deciduous Forest
Sand dune desert
Tropical Thorn Forest
Tropical
Thorn
Forest
Sand dune desert
Tropical Thorn Forest
Littoral and Mangrove

LEISHMANIASIS

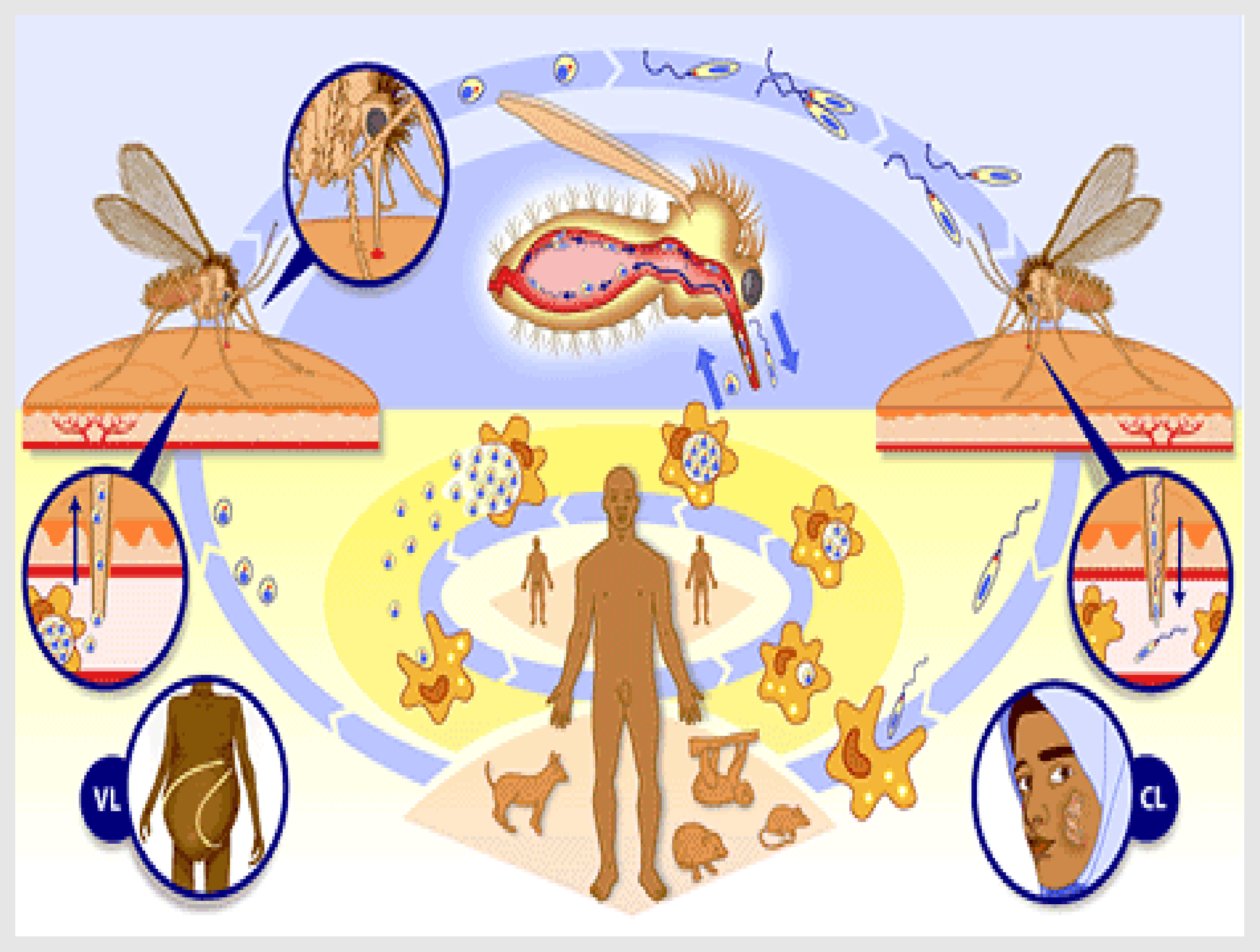


- Among the greatest public health problems in some developing countries (WHO).

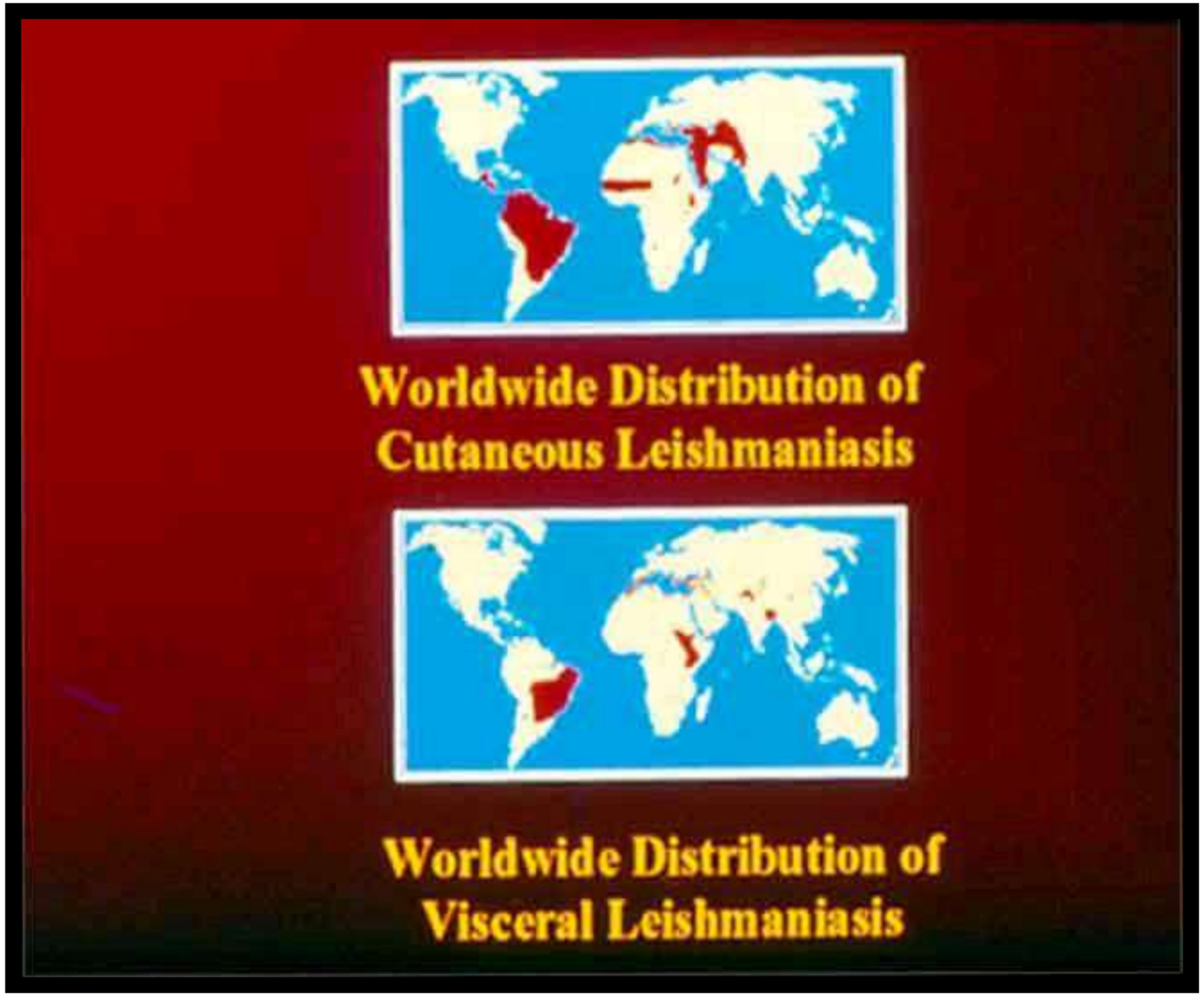
- Broad spectrum of diseases caused by different species of protozoan parasites of the genus *Leishmania.*

- Prevalent in many parts of the world, particularly Africa, Asia and Latin America.

LIFECYCLE OF *LEISHMANIA*




Typical Cutaneous Leishmaniasis
Lesion


Worldwide Distribution of
Cutaneous Leishmaniasis
Worldwide Distribution of
Visceral Leishmaniasis

Leishmaniasis in Pakistan

- **CL is endemic in Pakistan and has been reported from almost all parts.**
- **Diagnosis and treatment is difficult due to poor access to health care services**
- ***L. major* is the most common (3/4th cases) species, followed by *L. tropica.***
- **Cases of mixed- and con-infections are reported as well.**
- **A wide spectrum of clinical variants pose a major diagnostic challenge in rural Pakistan.**

Map showing distribution of cutaneous leishmaniasis in Pakistan and surrounding countries of South Asia.

Recent Outbreaks of Cutaneous Leishmaniasis in Pakistan

HOME (https://www.samaaenglish.tv) > Health (https://www.samaaenglish.tv/health)

Leishmaniasis outbreak in Dadu causes alarm

At least 1,633 people have been affected

SAMAA | Hamid ur Rehman (https://www.samaaenglish.tv/author/hamidrehman/)

Posted: Feb 4, 2022 | Last Updated: 2 months ago

Leishmaniasis spreads in Dadu, suburbs like a wildfire

y: News Desk Published: 06:24 PM, 7 Feb, 2022

DAWN

Several thousand affected by vector-borne skin disease across Kachho belt

DADU: A severe skin infection, attributed by health officials to sandflies' sting, has turned into an outbreak as it has already spread across 13 UCs of Kachho belt in the west of Dadu district.

Establishment of centres for skin disease put on backburner

By Our Correspondent

DADU: Cutaneous leishmaniasis is fast spreading in Kachho area but health department has not yet set up any centre at basic healthcare facilities near patients' villages, and failed to make available ample supply of glucantime injection, the only antidote for the skin disease, at the area's hospitals.

The patients complained to Dawn the other day that the health department had put on the backburner plans for the establishment of centres in Kachho while shortage of the injection had multiplied patients' misery.

The patients, who staged a demonstration along with their families in Johi town against shortage of injections and required drugs in Kachho area, especially in Johi taluka hospital, said that the health department had failed to provide injections to basic health units in Drigh Bala, Wahi Pandhi, Tando Rahim, Sawaro, Haji Khan, Gozo, Chhinni and other areas.

Wazir Ali, Khadim Khoso, Hussain Faqir and Ramzan Jamali, who led the protest, complained that sores and boils were spreading on patients' faces, arms, feet and hands but health officials were not ready to treat them at healthcare facilities near their villages, neither were they spraying insecticides to kill the disease carrying sand flies.

Johi taluka hospital's medical superintendent Dr Zubair Ahmad Panhwar said that the number of follow-up and fresh cases was reported at 6,000 only in the taluka hospital, which was more than the hospital could cope with. He had informed senior officers of shortage of the injection, he said.

He said that the available injections were being used but once they were finished the hospital would need more to treat the patients whose number was fast increasing.

DG health Dr Mohammad Juman Bahuto said that health teams were conducting spray in affected areas to kill the sand flies and centres for the skin disease treatment would also be set up wherever needed.

Dr Niaz Jamali, additional DHO, said that his office was receiving 100 to 150 injections daily from the DG health office, which were being distributed among hospitals. The government hospitals in Dadu, Khairpur Nathan Shah and Mehar also faced shortage of the injection, said sources.

Our Strategy

Nationwide wide ethnobotanic survey, focusing on leishmaniasis and other infectious skin diseases

Evaluation of selected medicinal and dietary plants, and other natural products against *Leishmania* parasites *in vitro*

Pre-clinical studies and clinical trials

Selected Plants against Leishmaniasis

Physalis minima L.

Allium sativum

Phytochemistry and Clinical Trials For Cutaneous Leishmaniasis

80% Ethanolic Extract of Aerial Parts of

***Physalis minima* L.**

Std: Amphotericin B : 0.12 ± 0.105 μg/mL

at

Leprosy Center

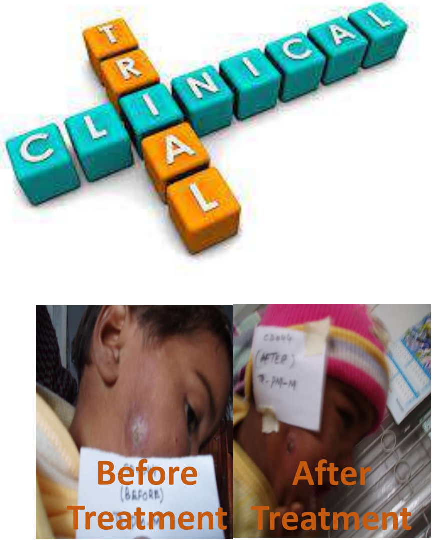
Shaheed Benazir Bhutto University of Health Sciences, LARKANA

BIOLOGICAL AND PHARMACOLOGICAL IMPORTANCE OF *PHYSALIS MINIMA*

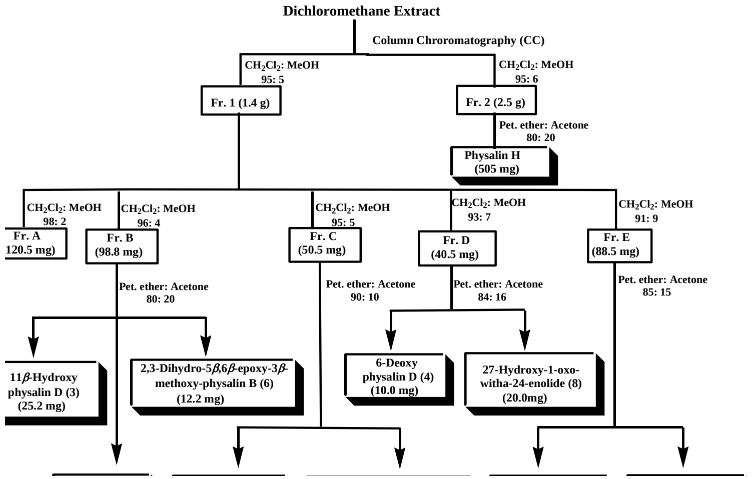
- ***Physalis minima*** **(Linn. var. *indica*) is a herb which is bitter in taste and widely used in folk medicines.**
- **The plant is used in various ailments (gallbladder disorders, burning sensation, bronchitis, chronic inflammation, enlargement of spleen, urinary and abdominal troubles and headache).**
- **The roots are used as a vermifuge and febrifuge.**
- **The 50% alcoholic extracts of the plant is also used as antimalarial agent.**

SCHEME OF WORK

Extraction of aerial parts of *Physalis minima*



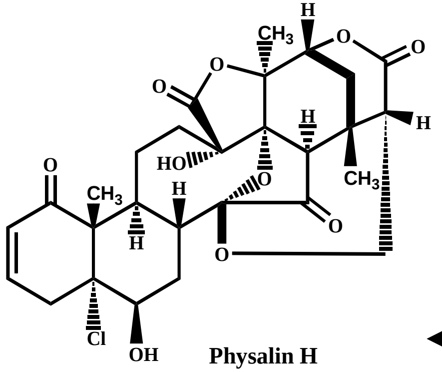
Clinical trails of **80% Ethanolic Extract of Aerial Parts of *Physalis minima***



Isolation and Purification of Physallins

Characterization of pure compounds using IR, UV, Mass spectrometry, and NMR

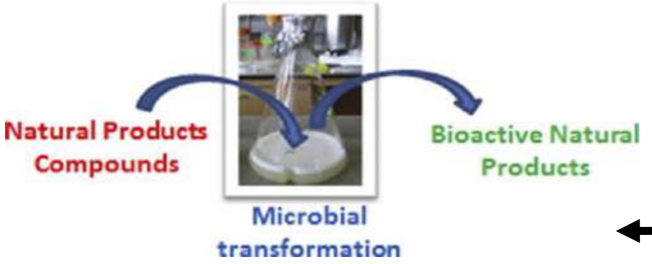
Anti-leishmanial activity of pure compounds



Physalin H

IC_{50} (µM)= 3.39 ± 0.005

Identification of antileishmanials *i.e.,* Physallins



Biotransformation of the lead molecule Physallin H

EXTRACTION OF *PHYSALIS MINIMA*

Ethanolic Extract
(1.7 Kg)

Suspended in water (5 L)
Extracted with pet. ether (10 L)

Pet. ether Extract
(200.8 g)

Inactive

Aqueous Extract

Extracted with CH_2Cl_2 (35 L)

Dichloromethane Extract
(85 g)

L. major, IC_{50} (µg/mL)= 19.01 ± 0.07
L. tropica, IC_{50} (µg/mL)= 26.5 ± 1.1

Aqueous Extract

Extracted with Ethylacetate (25 L)

Ethylacetate Extract
(40.3 g)

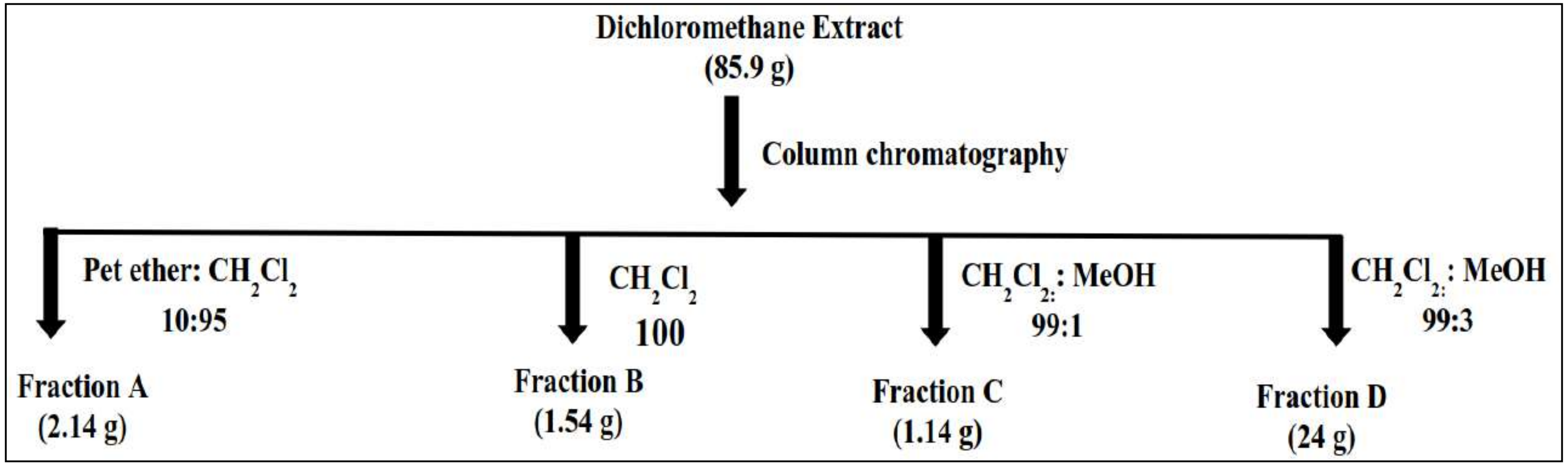
Inactive

Aqueous Extract

L. major
Amphotericin B= 3.14± 0.04 µg/mL, p-value < 0.0001
Pentamidine = 9.25± 0.05 µg/mL, p-value < 0.0001
Miltefosine= 10.4± 0.42 µg/mL, p-value < 0.0001

L. tropica
Amphotericin B= 3.16± 0.04 µg/mL, p-value < 0.0001
Pentamidine = 9.25± 0.05 µg/mL, p-value < 0.0001
Miltefosine= 17.4± 0.42 µg/mL, p-value < 0.0021

Fractionation of Dichloromethane Extract of *Physalis minima*



Fraction A	Fraction B	Fraction C	Fraction D
L. major, IC_{50} (µg/mL)= 6.67 ± 0.1	*L. major*, IC_{50} (µg/mL)= 9.95 ± 1.9	*L. major*, IC_{50} (µg/mL)= 6.3 ± 0.02	*L. major*, IC_{50} (µg/mL)= 6.37 ± 0.02
L. tropica, IC_{50} (µg/mL)= 26.5 ± 1.1	*L. tropica*, IC_{50} (µg/mL)= 6.41 ± 0.7	*L. tropica*, IC_{50} (µg/mL)= 6.34 ± 0.05	*L. tropica*, IC_{50} (µg/mL)= 6.37 ± 0.02

L. major
Amphotericin B= 3.14± 0.04 µg/mL, $p < 0.0001$
Pentamidine = 9.25± 0.05 µg/mL, $p < 0.0001$
Miltefosine= 10.4± 0.42 µg/mL, $p < 0.0001$

L. tropica
Amphotericin B= 3.16± 0.04 µg/mL, $p < 0.0001$
Pentamidine = 9.25± 0.05 µg/mL, $p < 0.0001$
Miltefosine= 17.4± 0.42 µg/mL, $p < 0.0021$

L. major
Amphotericin B= 3.14± 0.04 µg/mL, $p < 0.0001$
Pentamidine = 9.25± 0.05 µg/mL, $p < 0.8898$
Miltefosine= 10.4± 0.42 µg/mL, $p < 0.5084$

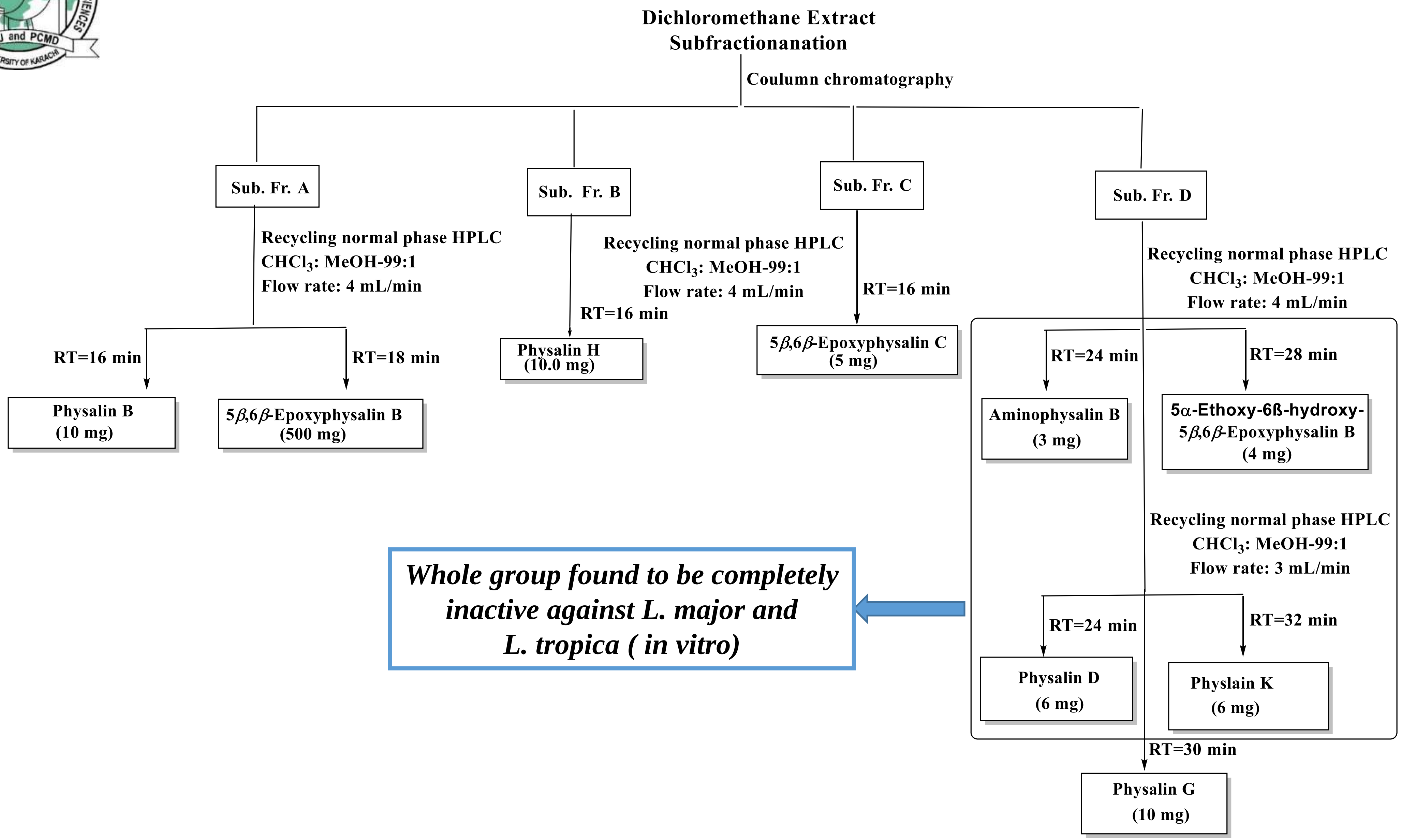
L. tropica
Amphotericin B= 3.16± 0.04 µg/mL, $p < 0.0001$
Pentamidine = 9.25± 0.05 µg/mL, $p < 0.0001$
Miltefosine= 17.4± 0.42 µg/mL, $p < 0.0021$

Fraction C and D

L. major
Amphotericin B= 3.14± 0.04 µg/mL, $p < 0.0001$
Pentamidine = 9.25± 0.05 µg/mL, $p < 0.0001$
Miltefosine= 10.4± 0.42 µg/mL, $p < 0.0001$

L. tropica
Amphotericin B= 3.16± 0.04 µg/mL, $p < 0.0001$
Pentamidine = 9.25± 0.05 µg/mL, $p < 0.0001$
Miltefosine= 17.4± 0.42 µg/mL, $p < 0.0021$

PURIFICATION OF PHYSALINS FROM DICHLOROMETHANE EXTRACT



Clinical Trials

Before treatment

After treatment

80% Methanolic Extract of Aerial Parts of *Physalis minima*

Before treatment

After treatment

Before treatment

After treatment

Before treatment

After treatment

Before treatment

After treatment

- Total Subjects: 100
- Follow up for 2 weeks
- 65.71% showed excellent recovery

Topical Formulation for the Treatment of Cutaneous Leishmaniais

Survey at Dadu, Juhi and other Villages

Topical Formulation for the Treatment of Cutaneous Leishmaniais

Local Treatment of Cutaneous Leishmaniais

US008287921B1

(12) **United States Patent**
Rahman et al.

(10) **Patent No.:** **US 8,287,921 B1**
(45) **Date of Patent:** **Oct. 16, 2012**

(54) **FORMULATIONS AGAINST CUTANEOUS LEISHMANIASIS**

(76) Inventors: **Attaur Rahman**, Karachi (PK); **Mohammad Iqbal Choudhary**, Karachi (PK); **Sammer Yousuf**, Karachi (PK); **Samreen Khan**, Karachi (PK); **Farooq Rahman Soomro**, Karachi (PK); **Shahida Perveen**, Karachi (PK)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/189,509**

(22) Filed: **Jul. 24, 2011**

(51) **Int. Cl.**
A01N 65/00 (2009.01)

(52) **U.S. Cl.** **424/725**
(58) **Field of Classification Search** .... None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2003/0175366 A1 * 9/2003 Pauly et al. 424/725

* cited by examiner

Primary Examiner — Michael Meller
(74) *Attorney, Agent, or Firm* — Sarfaraz K. Niazi

(57) **ABSTRACT**

Treatment of leishmaniasis in animals and humans using the methanolic extract of *Physalis minima* in petrolatum is described.

1 Claim, No Drawings

NO.DDG/VBD/DD/ 401/404 /2023
DIRECTORATE GENERAL
HEALTH SERVICES SINDH HYDERABAD
(E-mail: vbdhealth@sindhhealth.gov.pk)
DATED: 01st FEBRUARY 2023

To

The Professor Dr. M. Iqbal Chaudry
International Centre for Chemical and
Biological Sciences (HEJ & PCMD)
Karachi.

SUBJECT: SUPPORT REQUIRED REGARDING PROVISION OF OINTMENTS (COMPRISES OF 25% W/W ALLIUM SATIVAUM L, EXTRACT IN SOFT PARAFFIN) FOR THE TREATMENT OF CUTANEOUS LEISHMANIASIS CASES.

With reference to your kind support were provided in 2022 to Vector Borne Diseases, Directorate General Health Services Sindh Hyderabad regarding treatment of Cutaneous Leishmaniasis through ointments, which is highly appreciable. Currently we are expecting unusual rise of Cutaneous Leishmaniasis cases due to post floods situation.

In this context, you are requested to provide support 10000 jars (100g each) of topical ointments comprises of 25% w/w Allium sativaum L, extract in soft paraffin for the treatment of cutaneous leishmaniasis.

Your support in this regard will be highly appreciated.

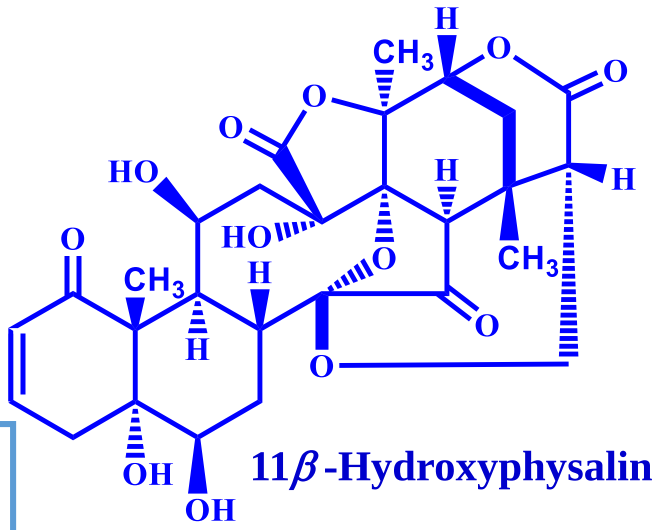
DEPUTY DIRECTOR GENERAL
HEALTH SERVICES SINDH (VBD)
HYDERABAD

Copy forwarded for information to:-
1- The Secretary Health Department, Government of Sindh, Karachi.
2- The Director General Health Services Sindh Hyderabad.
3- The P.S to Minister Health, Government of Sindh Karachi.
4- Master File

Antileishmanial Activity of Physalins

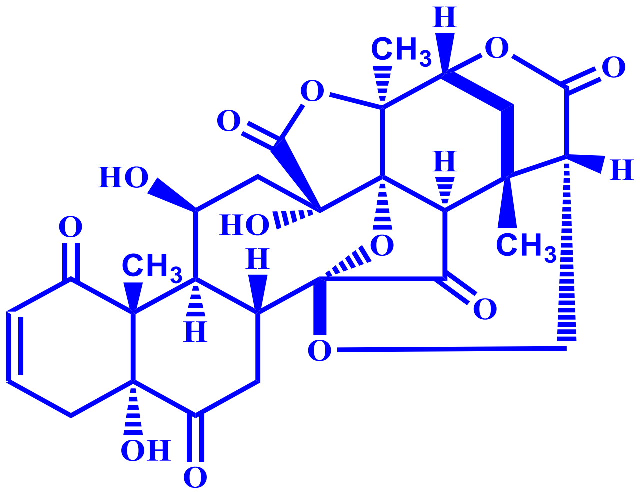
L. major
Amphotericin B= 3.39± 0.04 μM, $p < 0.0001$
Pentamidine = 27.20± 0.02 μM, $p < 0.0001$
Miltefosine= 25.55± 1.03 μM, $p < 0.0001$

L. tropica
Amphotericin B= 3.42± 0.04 μM, $p < 0.0001$
Pentamidine = 27.20± 0.02 μM, $p < 0.0001$
Miltefosine= 42.05± 1.03 μM, $p < 0.0001$



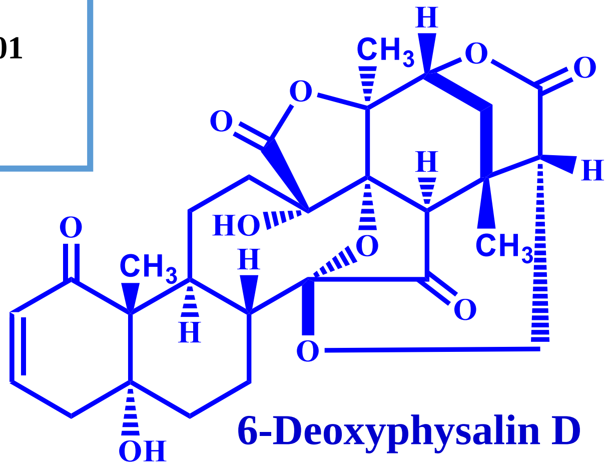
11β-Hydroxyphysalin D

L. major, IC_{50} (μM)= 0.92 ± 0.001



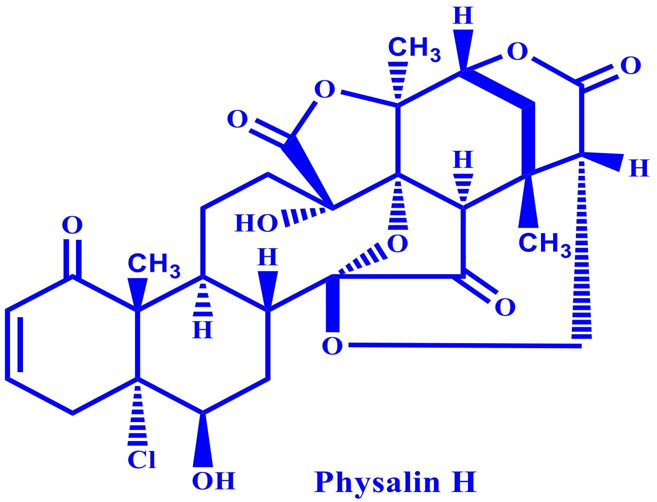
6-Oxo-11β-Hydroxyphysalin D

L. major, IC_{50} (μM)= 3.65 ± 0.07



6-Deoxyphysalin D

L. major, IC_{50} (μM)= 5.0 ± 0.01



Physalin H

L. major, IC_{50} (μM)= 3.34± 0.64

L. tropica, IC_{50} (μM)= 9.59 ± 0.27

Antileishmanial Activity of Physalins

L. major
Amphotericin B= 3.39± 0.04 μM, p < 0.0001
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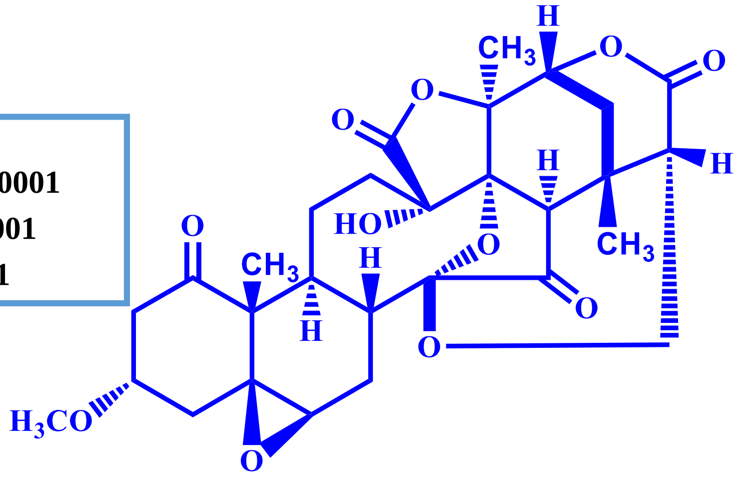
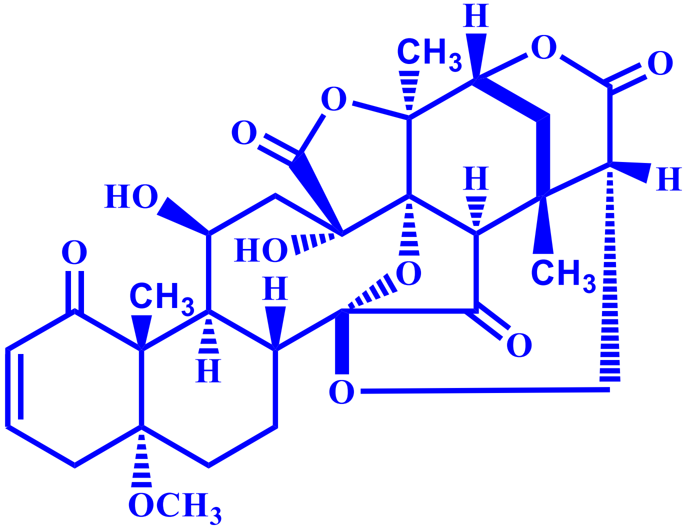
Miltefosine= 25.55± 1.03 μM, p < 0.0001



2,3-Dihydro-5*β*,6*b*-epoxy-3*β*-methoxy-physalin B

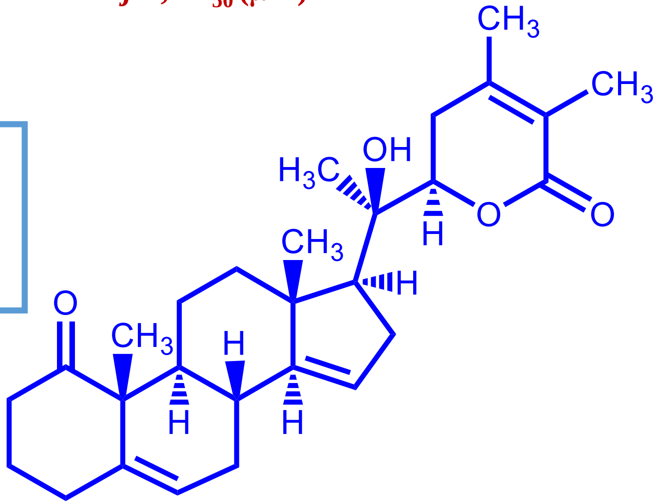
***L. major*, IC$_{50}$ (μM)= 19.5± 0.18**



6-Dehydroxy-11*β*-hydroxyphysalin I

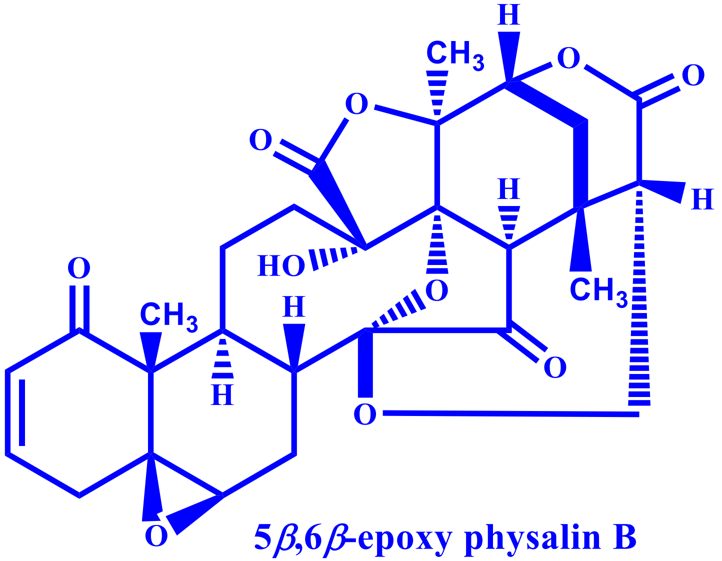
***L. major*, IC$_{50}$ (μM)= 4.86 ± 0.08**

L. tropica
Amphotericin B= 3.42± 0.04 μM, p < 0.0001
Pentamidine = 27.20± 0.02 μM, p < 0.0001
Miltefosine= 42.05± 1.03 μM, p < 0.0001



27-Hydroxy-1-oxo-witha-5,14,24-trienolide

***L. major*, IC$_{50}$ (μM)= 38.5 ± 1.05**



5*β*,6*β*-epoxy physalin B

***L. major*, IC$_{50}$ (μM)= 3.76 ± 0.85**

***L. tropica*, IC$_{50}$ (μM)= 18.53 ± 0.28**

Antileishmanial Activity of Physalins

L. major
Amphotericin B= 3.39± 0.04 µM, p < 0.0001
Pentamidine = 27.20± 0.02 µM, p < 0.0001
Miltefosine= 25.55± 1.03 µM, p < 0.0001

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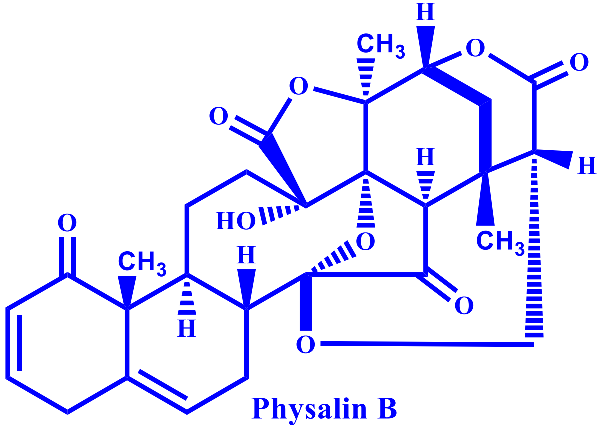
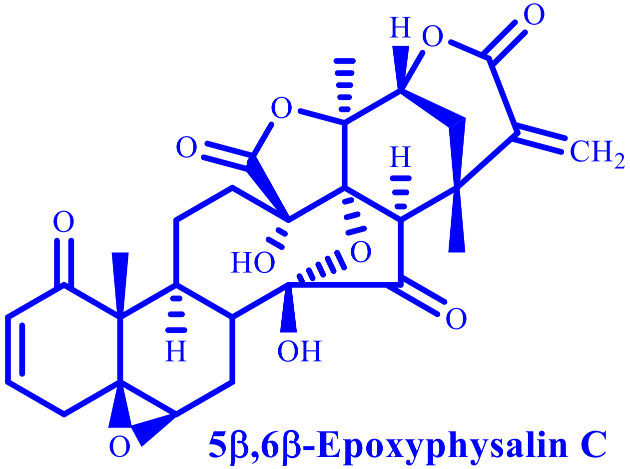
Amphotericin B= 3.42± 0.04 µM, p < 0.0001
Pentamidine = 27.20± 0.02 µM, p < 0.0001
Miltefosine= 42.05± 1.03 µM, p < 0.0001



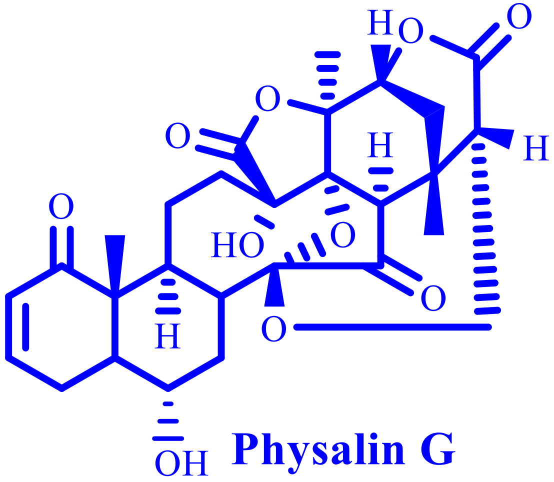
Physalin B

***L. major*, IC_{50} (µM)= 3.04 ± 1.12**
***L. tropica*, IC_{50} (µM)= 13.33 ± 0.09**



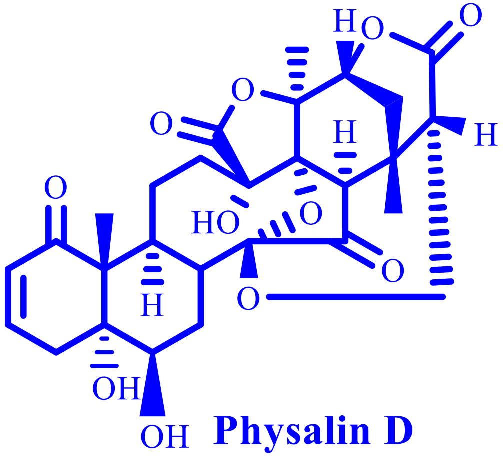
5β,6β-Epoxyphysalin C

***L. major*, IC_{50} (µM)= 84.79 ± 1.96**
***L. tropica*, IC_{50} (µM)= 23.76 ± 1.90**



Physalin G

***L. major*, IC_{50} (µM)= 52.28 ± 1.18**
***L. tropica*, IC_{50} (µM)= 19.09 ± 0.02**

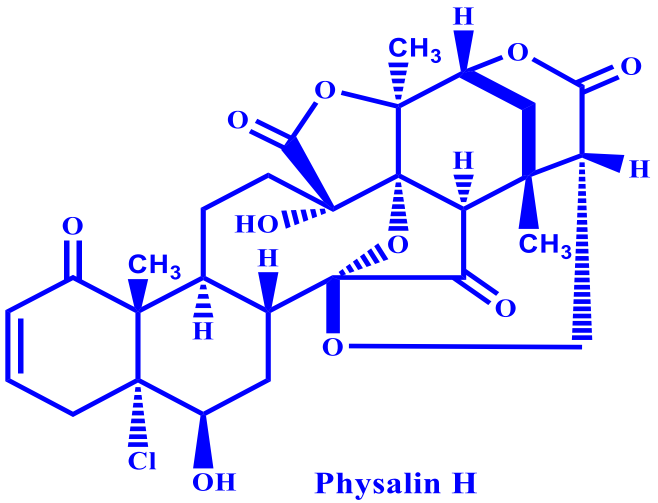


Physalin D

***L. major*, IC_{50} (µM)= Inactive**
***L. tropica*, IC_{50} (µM)= 55.24 ± 0.01**

Antileishmanial Activity of Physalins

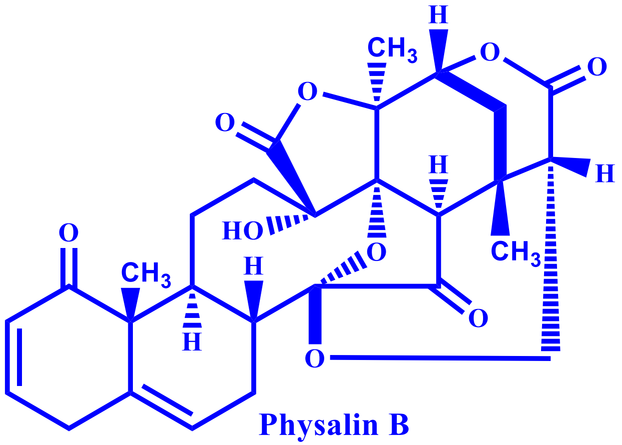
Macrophage assay to evaluate intracellular anti-leishmanial activity against amastigotes



Physalin H

L. major, IC_{50} (μM)= 3.34± 0.64

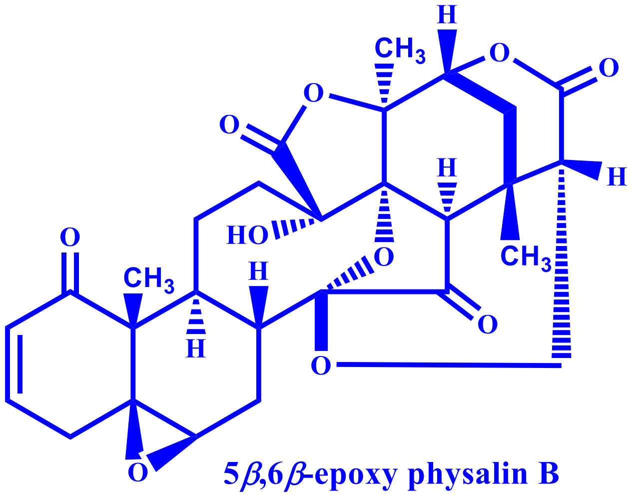
L. tropica, IC_{50} (μM)= 9.59 ± 0.27



Physalin B

L. tropica, IC_{50} (μM)= 13.33 ± 0.09

L. major, IC_{50} (μM)= 3.04 ± 1.12

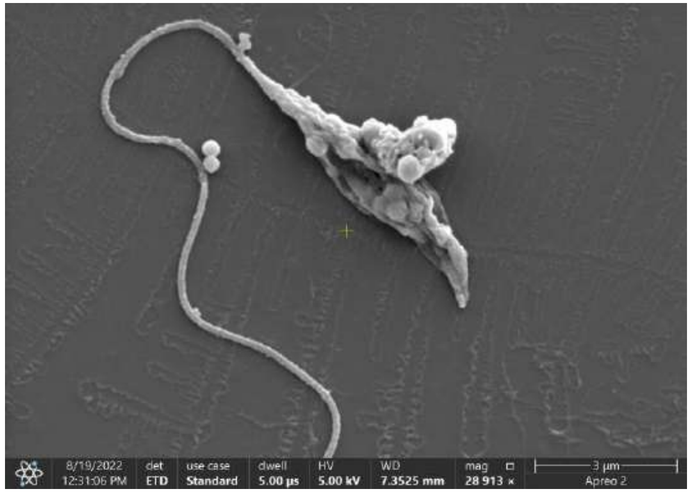


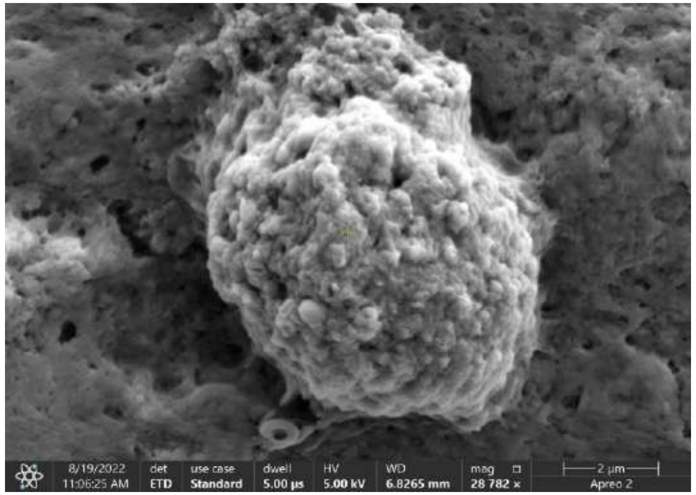
5*β*,6*β*-epoxy physalin B

L. major, IC_{50} (μM)= 3.76 ± 0.85

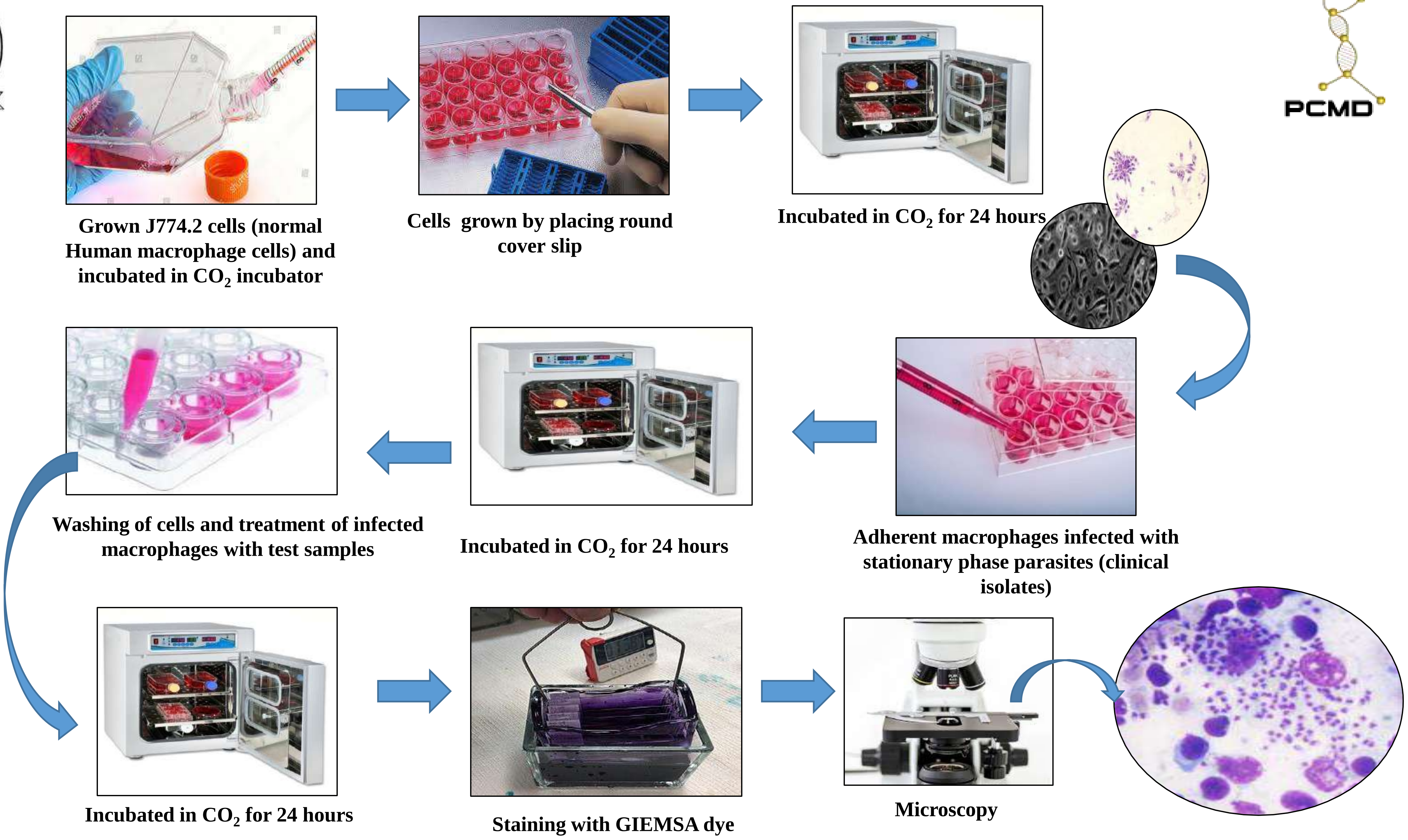
L. tropica, IC_{50} (μM)= 18.53 ± 0.28

Antileishmanial Activity of Physalins Against Amastigotes Stage of Parasite *via* Infected Macrophage Cell line Assay

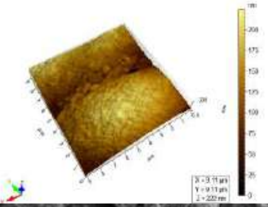
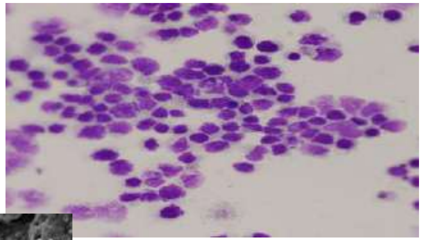
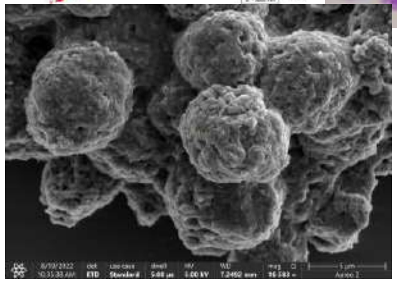




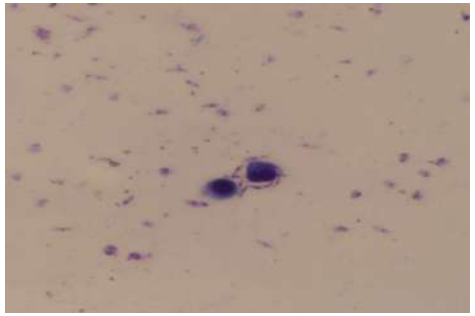
PROTOCOL SUMMARY



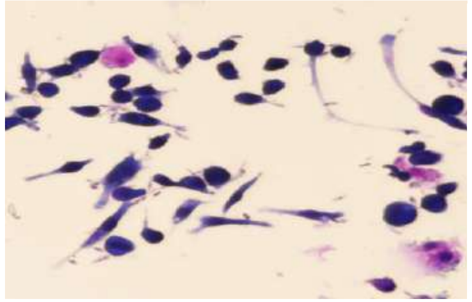
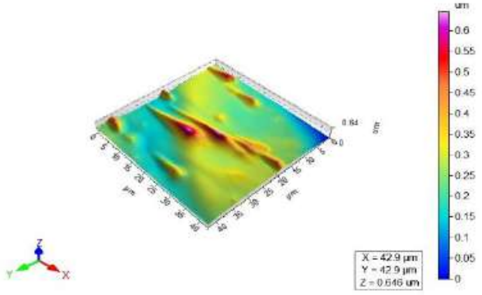
Images of Various Stages of Macrophage Assay (5% GIMSA Dye, AFM, and SEM)

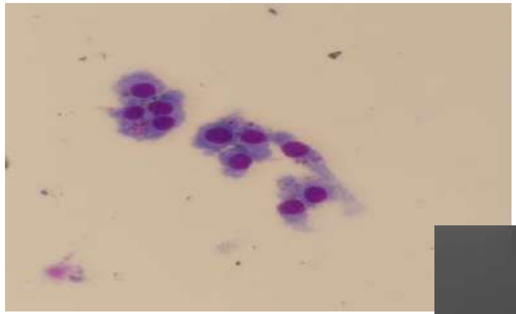
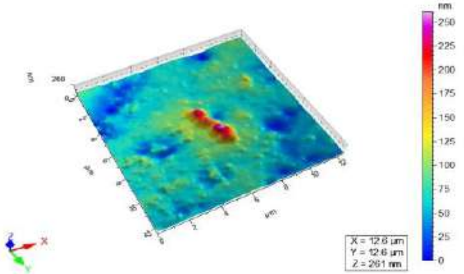
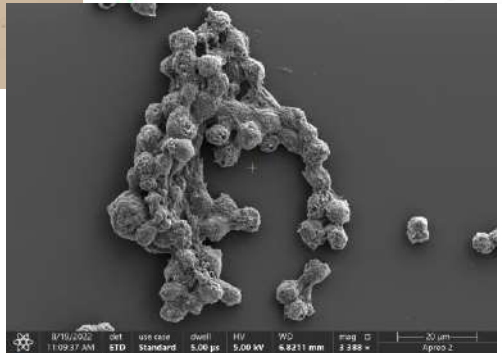
Normal Macrophages



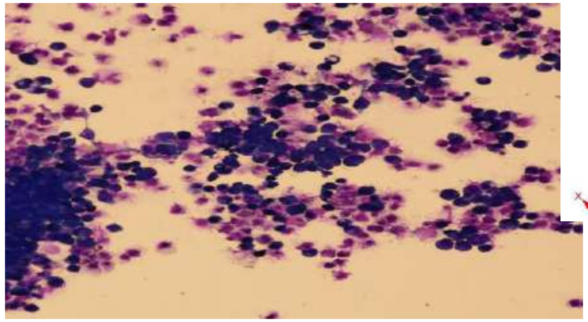
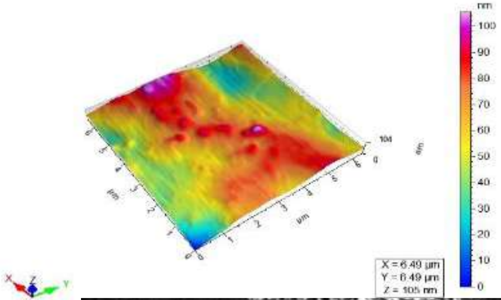
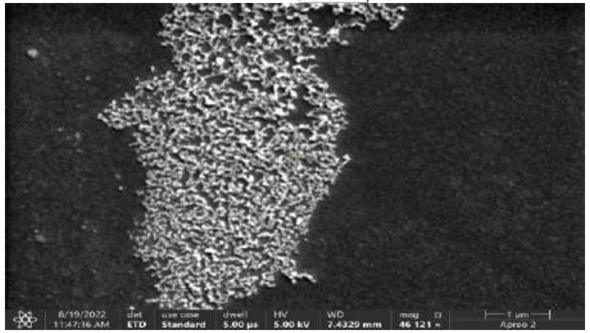
Attachment and engulfment of leishmania parasite inside macrophages

Engulfment of *Leishmania major* parasite inside macrophages by pseudo hype formation

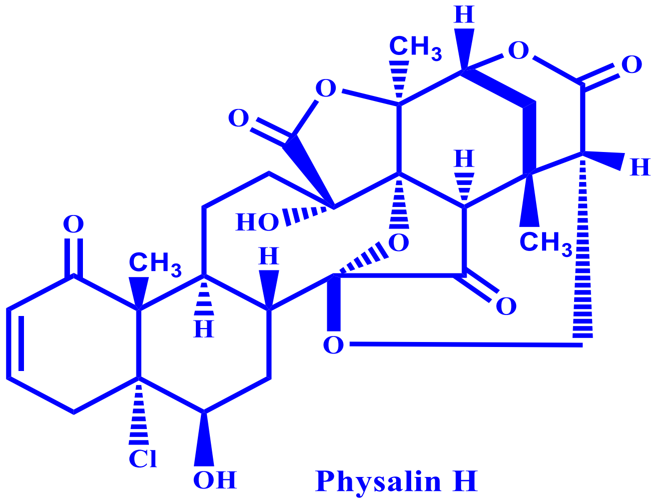




Amastigotes formation inside macrophages

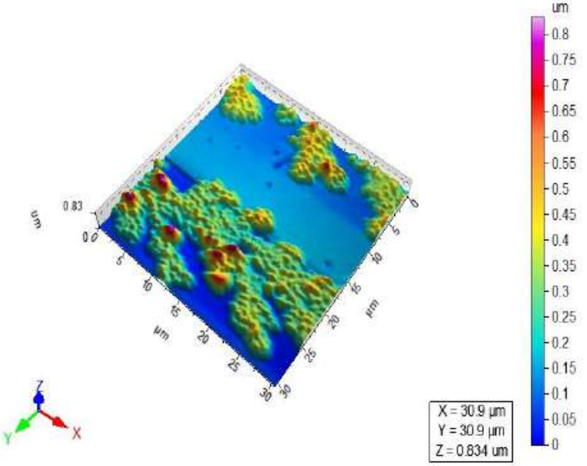




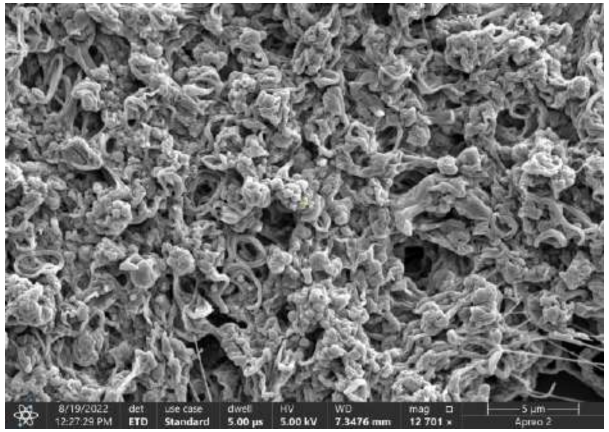
Effect of test compounds on macrophages. Light purple shows dead cells along with dark colored live cells of macrophages

ANTILEISHMANIAL ACTIVITY AGAINST AMASTIGOTES BY INFECTING MACROPHAGES CELL LINE

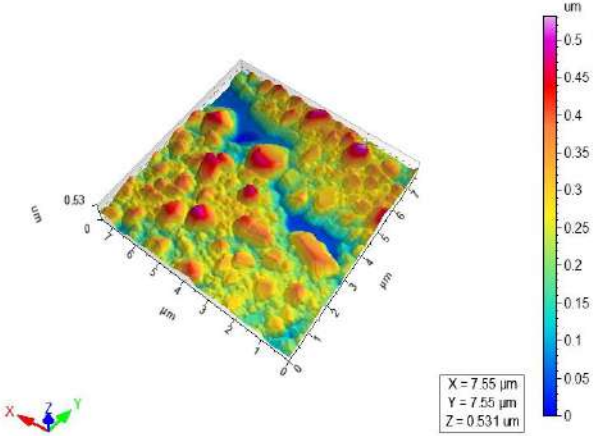


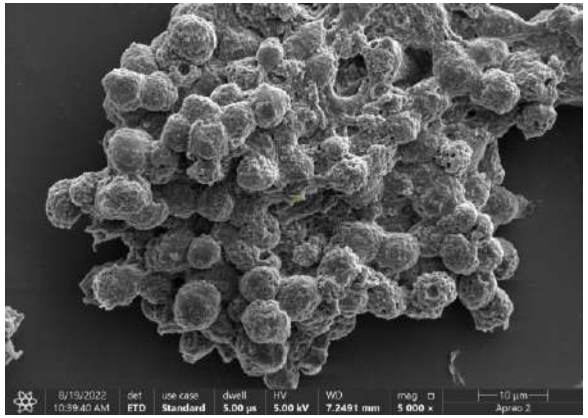
Physalin H





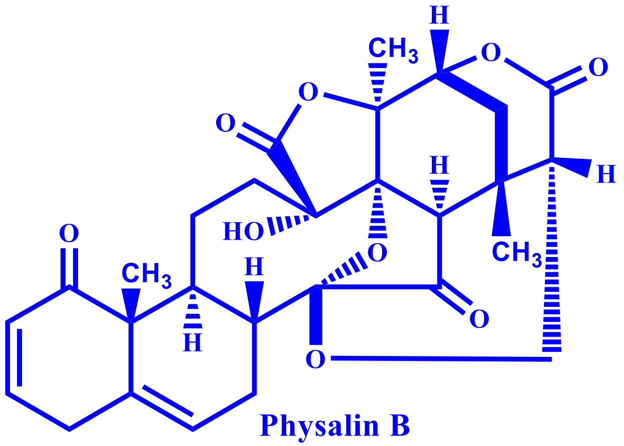
Infected macrophages with L. major (untreated)



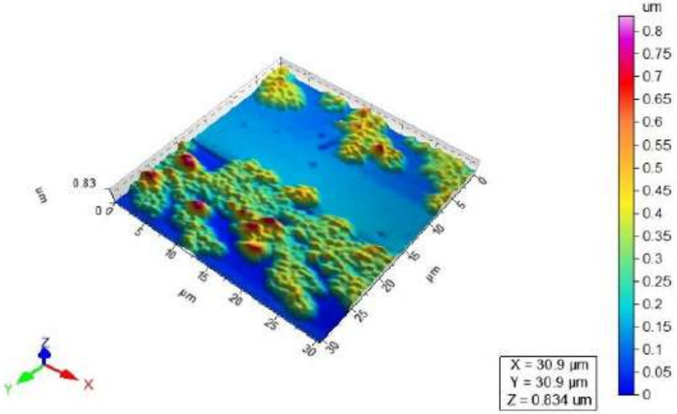


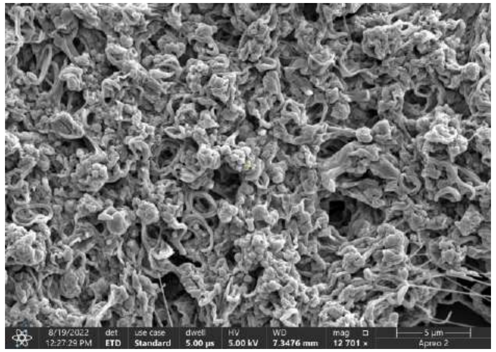
Infected macrophages with L. major (Treated)

ANTILEISHMANIAL ACTIVITY AGAINST AMASTIGOTES BY INFECTING MACROPHAGES

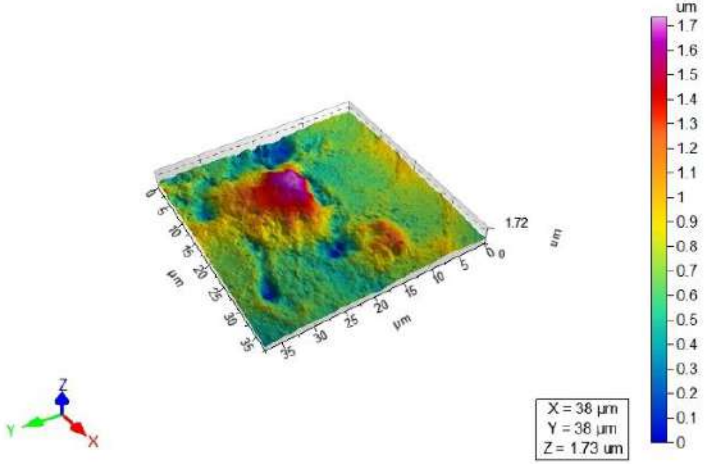


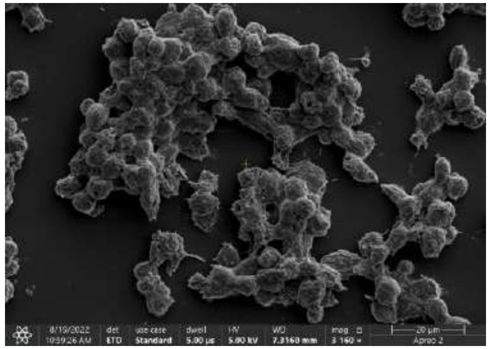
Physalin B





Infected macrophages with L. major (untreated)





Infected macrophages with L. major (Treated)

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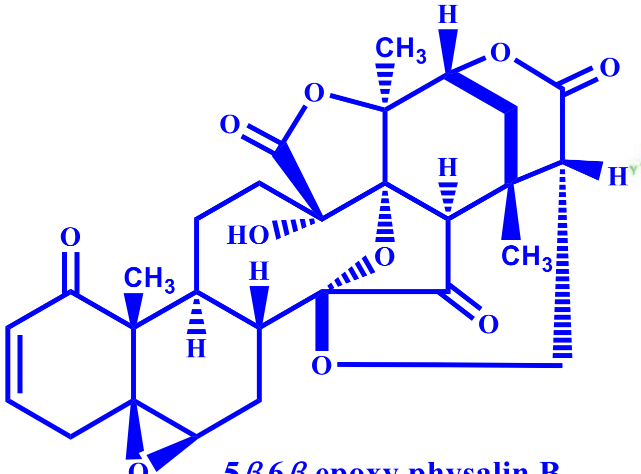
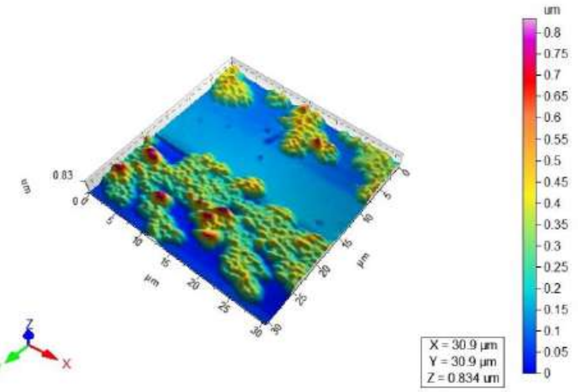
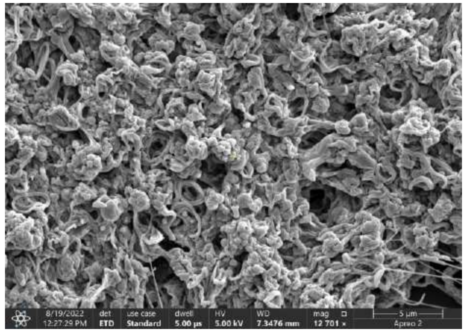
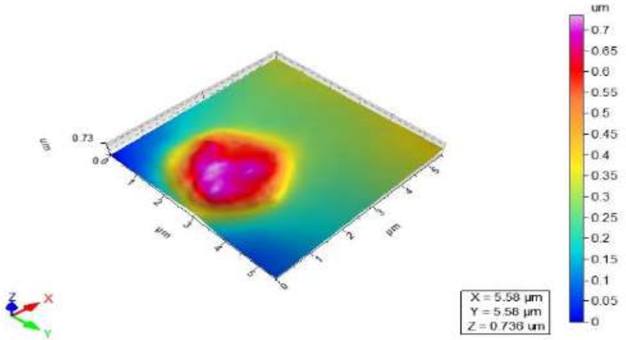


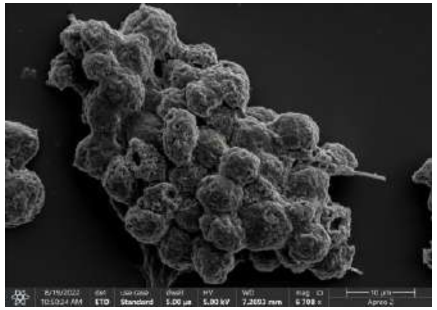
5β,6β-epoxy physalin B





Infected macrophages with L. major (untreated)



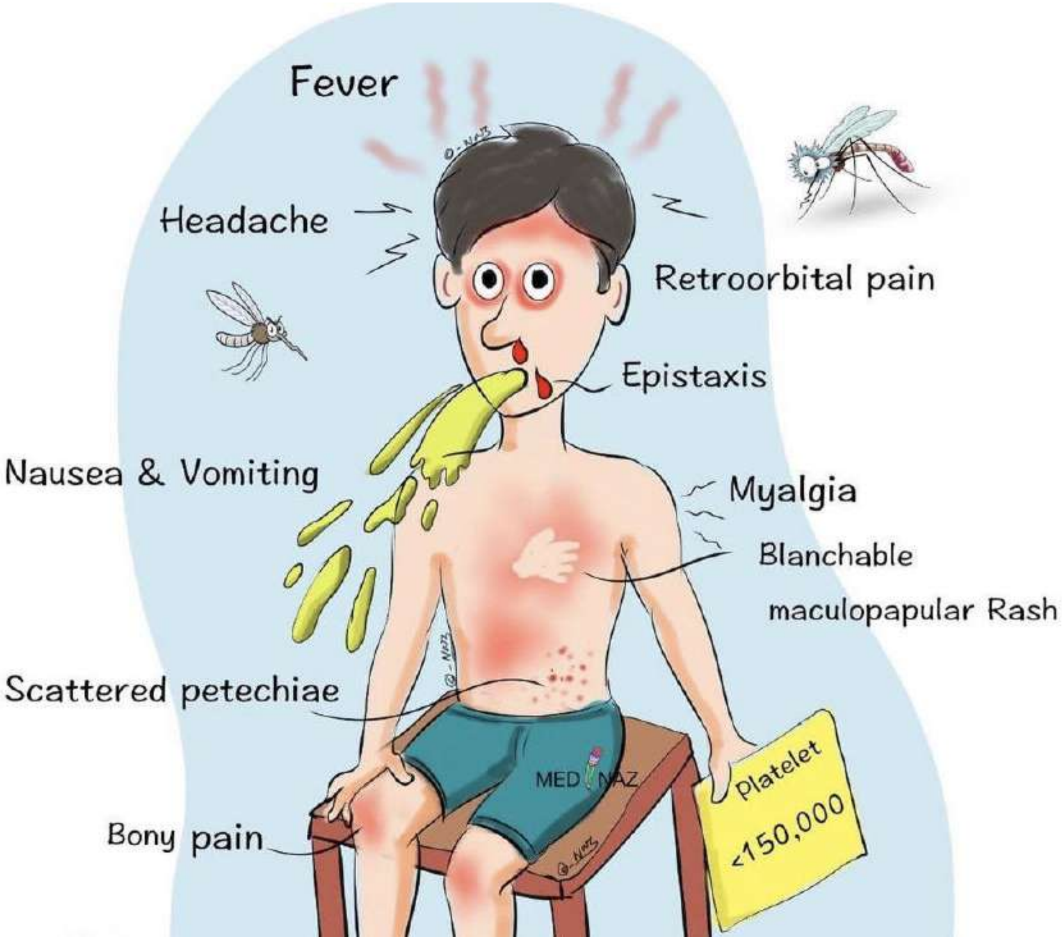


Infected macrophages with L. major (Treated)

Drug Repurposing

An approach to identify the new therapeutic indications of already approved drugs, for the treatment of both common and rare diseases. It potentially lowers the cost, and time required for drug discovery and development.

Identification of New Inhibitors of Non Structural Protein-5 (NS5) from Dengue Virus



Karachi reports over 6,000 confirmed dengue cases in September alone

Faiza Ilyas | Published October 1, 2022

A health worker carries out anti-dengue spray in Kharadar.—Online

KARACHI: As dengue fever claimed another life on Friday, the total number of cases from the mosquito-borne infection crossed over 6,000 mark in the metropolis in September.

PAKISTAN TOP STORIES

Dengue cases sharply increasing across Pakistan

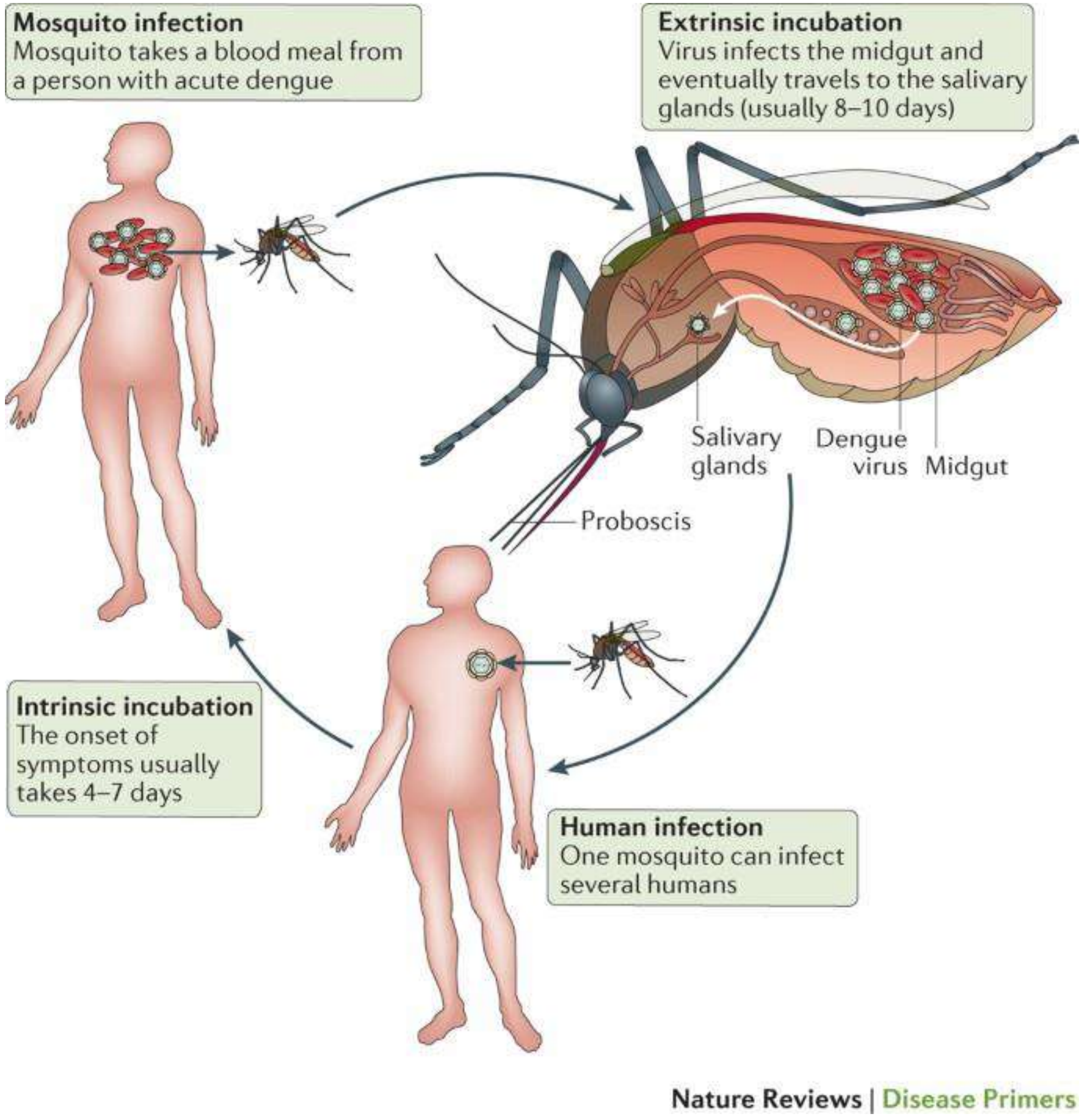
Web Desk
SEPTEMBER 12, 2022

0 Shares

Pakistan's major cities experienced a sharp increase in dengue cases. In the past 24 hours, 62 patients in Lahore received a dengue diagnosis, while 55 new cases were reported in Islamabad and 113 cases were confirmed by the Karachi Health Department.

Dengue Virus Infections

- Rapid spread of dengue virus has now become a major health problem worldwide, especially in tropical and sub-tropical regions.
- Nearly half of the human population is at the risk of getting infection.
- No vaccine developed so far. No treatment.
- Despite the recent advances, there is still an immense need for effective approaches towards drug discovery against dengue virus.
- According to a recent report (2022), a total of **78,554 cases of dengue**, including **194 deaths** have been reported in **Pakistan**. (WHO-2023)



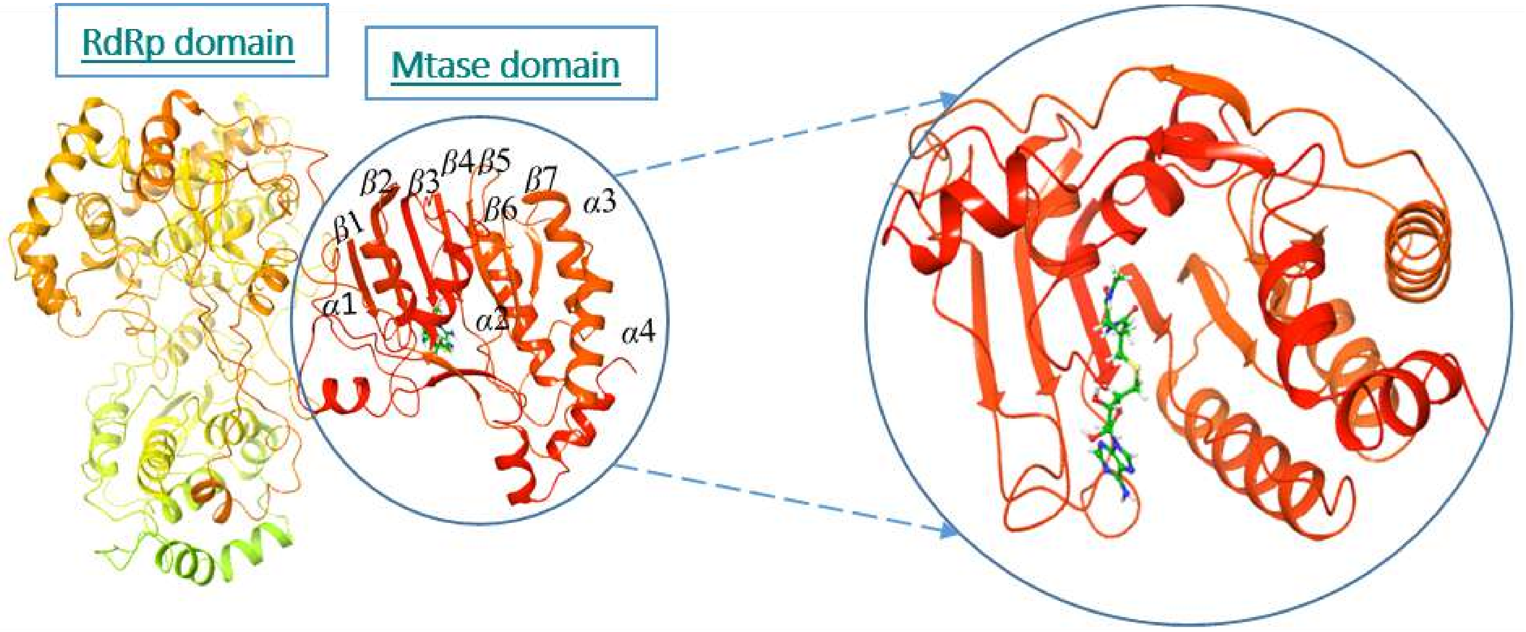
Nonstructural protein NS5- A validated drug target for Dengue Virus

Among the proteome of dengue virus, nonstructural protein NS5 is conserved across the *Flaviviridae* family.

Among all the nonstructural proteins, NS5 is the most important one which helps the virus to replicate, and protect against the host immune reaction. Due to highest homology among all the serotypes, NS5 is identified as a promising target for anti-DENV therapy.

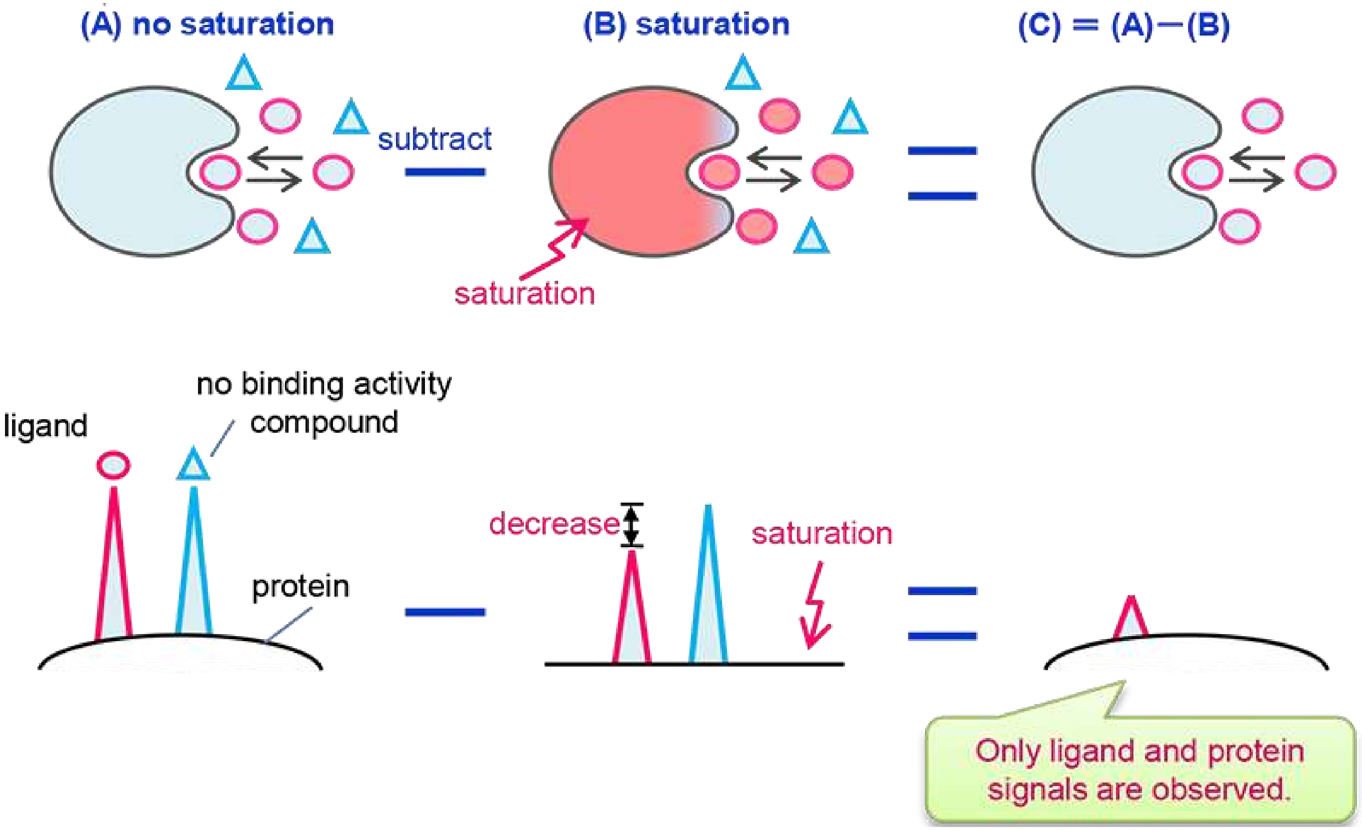
- NS5 is a monomeric 104.387 kDa protein , having methyl transferase (MTase) domain at N-terminal, while C-terminal harbors RNA-dependent RNA polymerase (RdRP) region.

- The catalytic domain of MTase containing seven β-sheets surrounded by four-helices.



Evaluation of drugs by biophysical method i.e. STD-NMR Spectroscopy

Saturation transfer difference (STD-NMR) is a robust technique for the analysis of protein-ligand interactions, as well as for the identification of binding epitope of a ligand when bound to its receptor protein.

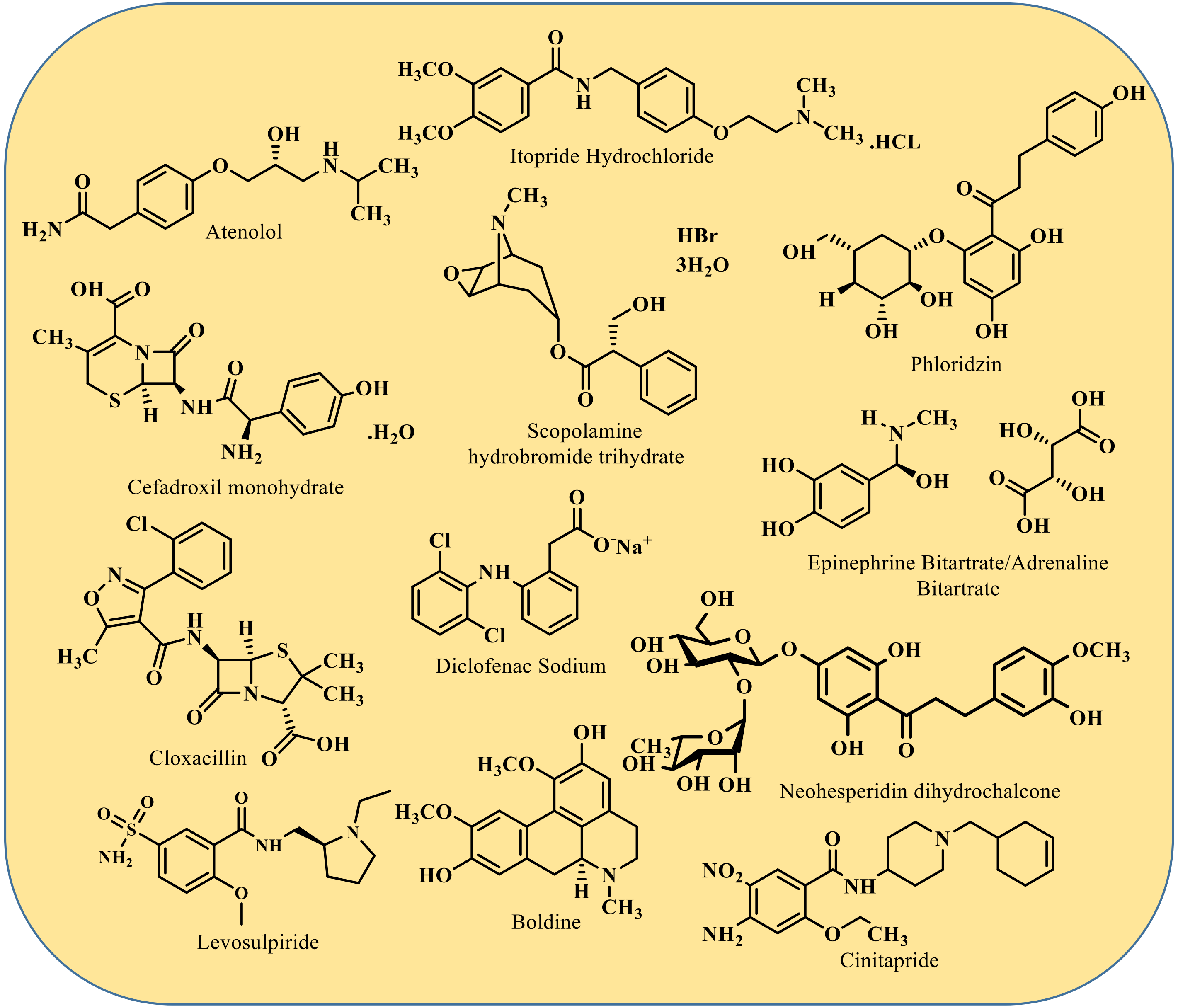


Outcomes of STD-NMR Spectroscopy

- **75 FDA approved drugs** (grouped into 15 mixtures) were checked for their ability to interact with NS5 protein.

- Identified ligands were further validated by molecular docking and simulation studies.

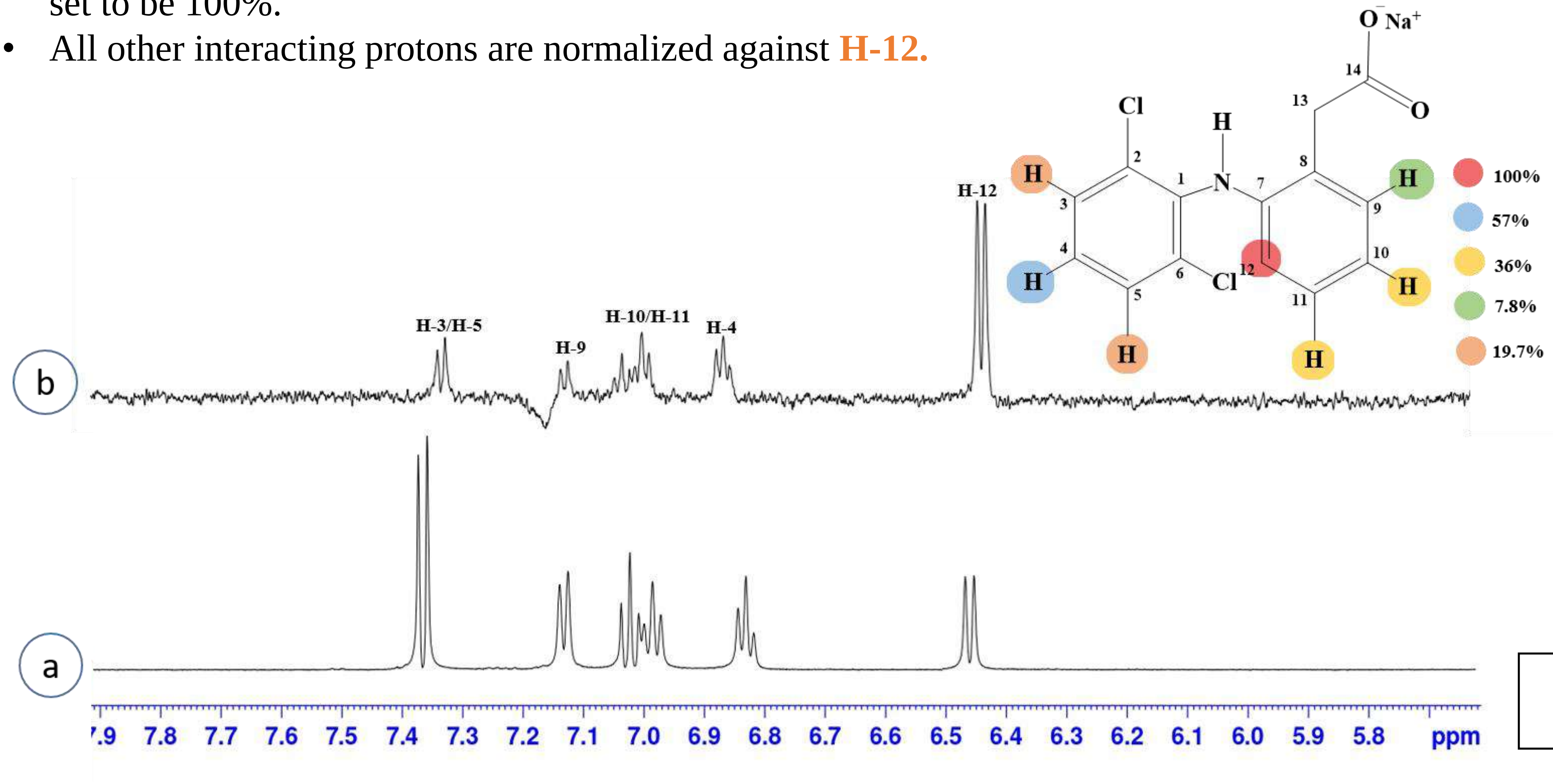
- 10 drugs were identified which could be the lead candidates to be further studied as potential antiviral agents.



STD-NMR of Diclofenac sodium

NSAID,

- H-12 of compound **5** received the maximum saturation of STD integral value, set to be 100%.
- All other interacting protons are normalized against H-12.

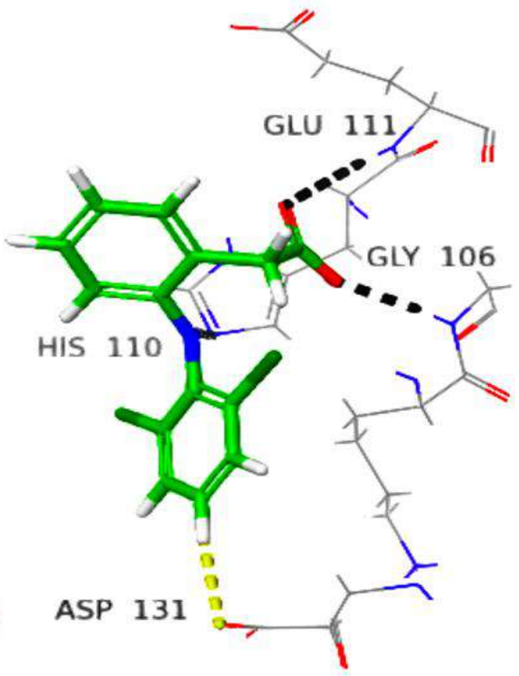


Difference Spectrum of Diclofenac with and without protein

^{1}H Spectrum of Diclofenac

Molecular docking and simulation studies on Diclofenac sodium

● Hydrogen bond
● Aromatic hydrogen bond

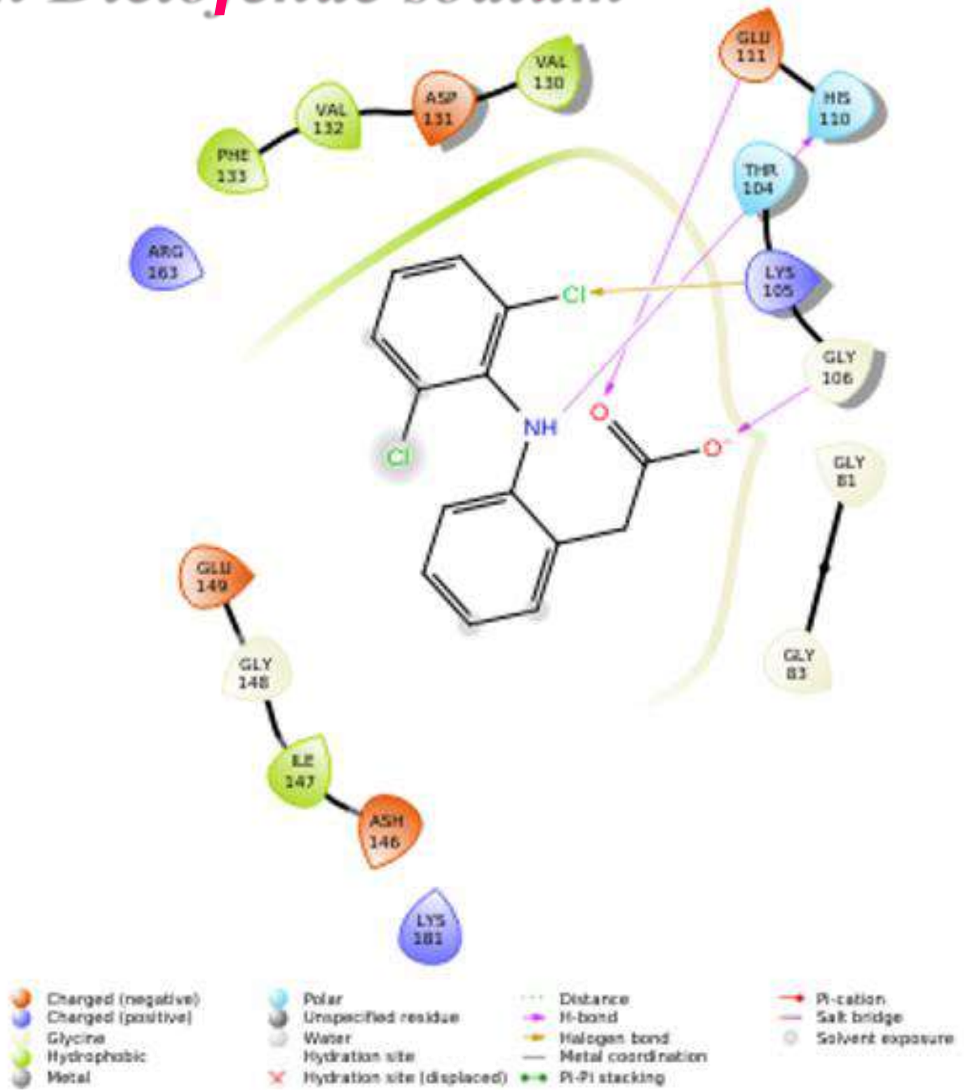


a

3D Protein-ligand interaction

Docking score -4.7

b



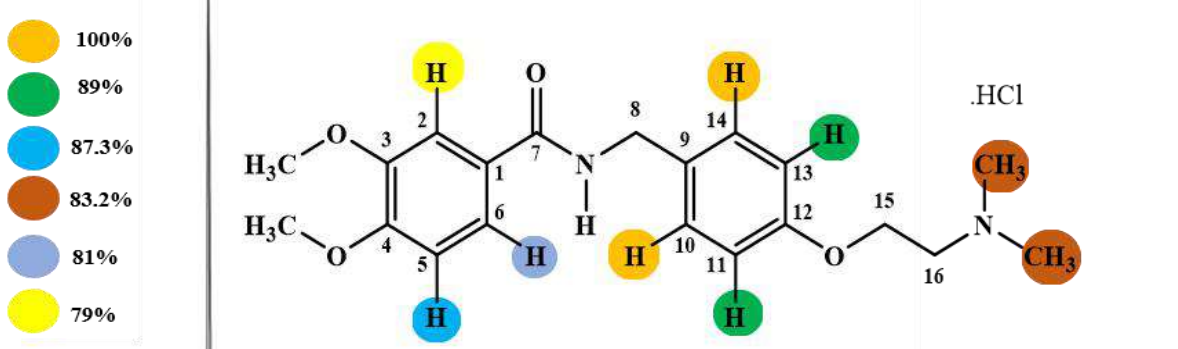
2D Protein-ligand interaction

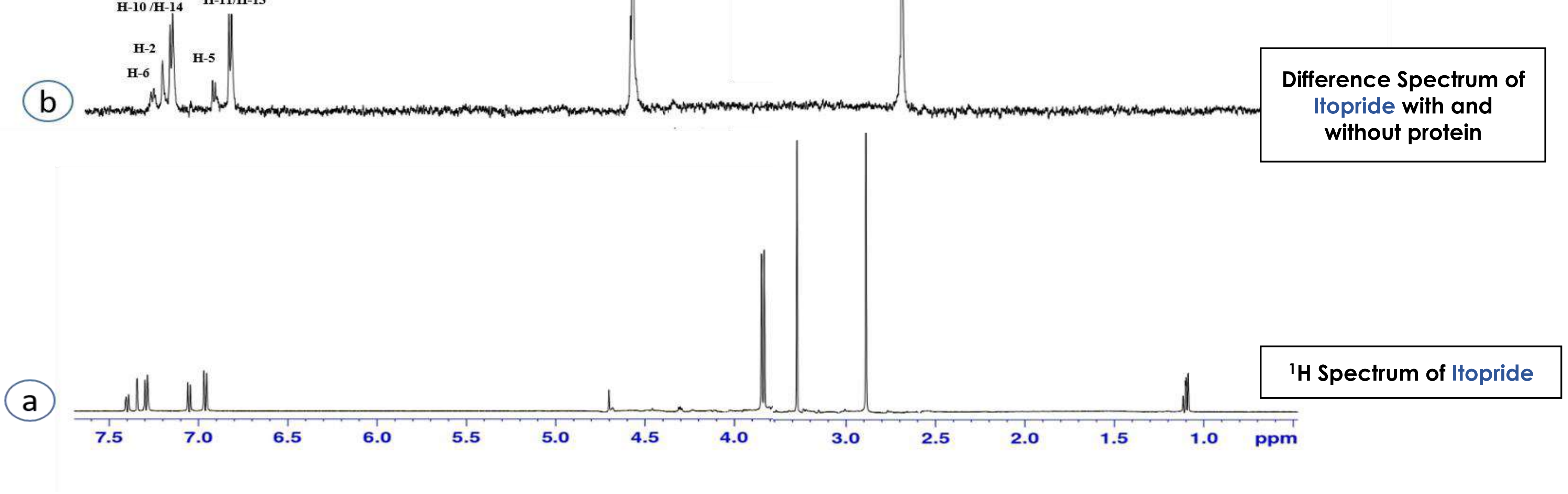
Diclofenac sodium showed hydrogen bond interactions with Glu111 and Gly106, and aromatic hydrogen bond intercation with Asp131 of NS5 polymerase enzyme of dengue virus.

STD-NMR of Itopride

Itopride is an acetylcholine esterase inhibitor and dopamine D2 receptor antagonist used to treat symptoms of functional dyspepsia such as nausea and vomiting

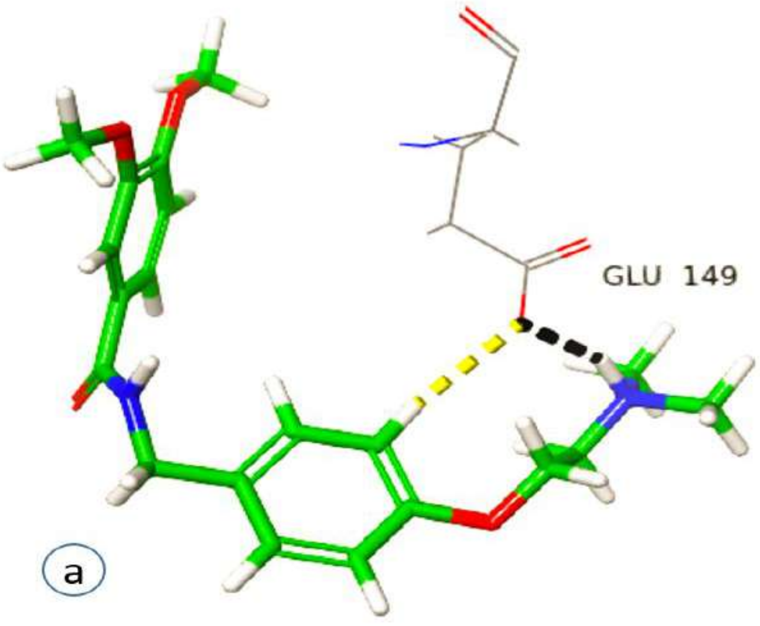
- H-10/H-14 with the integral value 100% had achieved maximum interactions.
- H-11/H-13 have displayed 89% saturation.
- H-5 and H-6 received 87% and 81% saturation, respectively. Terminal methyl protons had achieved 83.2% saturation relative to maximum integral.
- H-2 received 79% saturation.



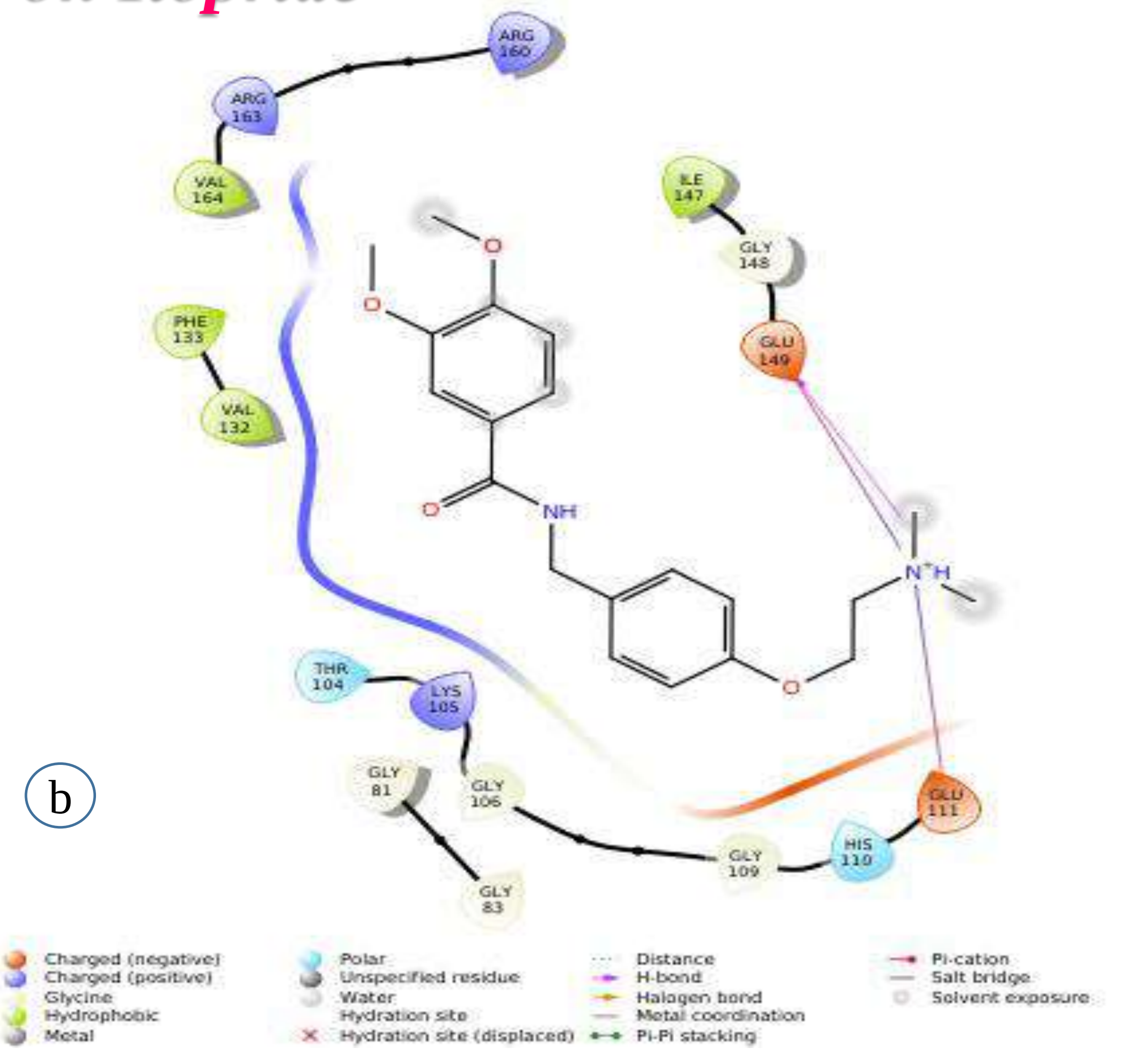


Molecular docking and simulation studies on Itopride

- Hydrogen bond
- aromatic hydrogen bond



Docking score -3.8

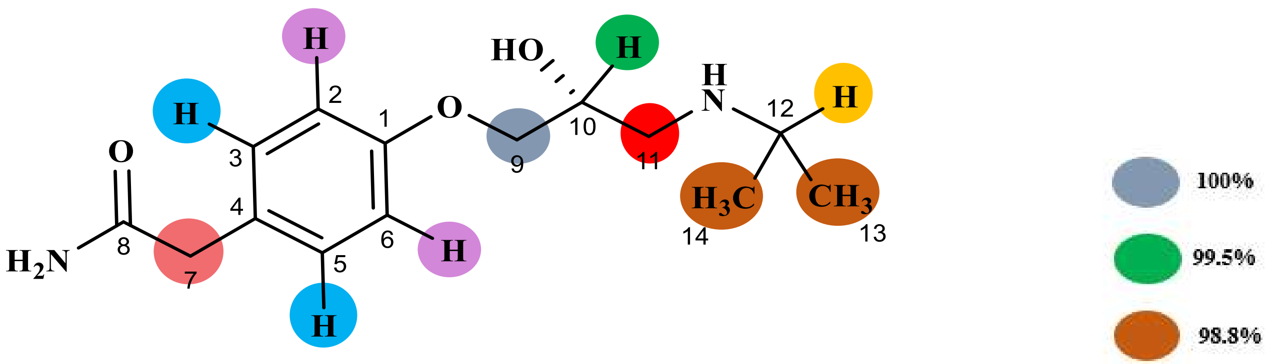


2D Protein-ligand interaction

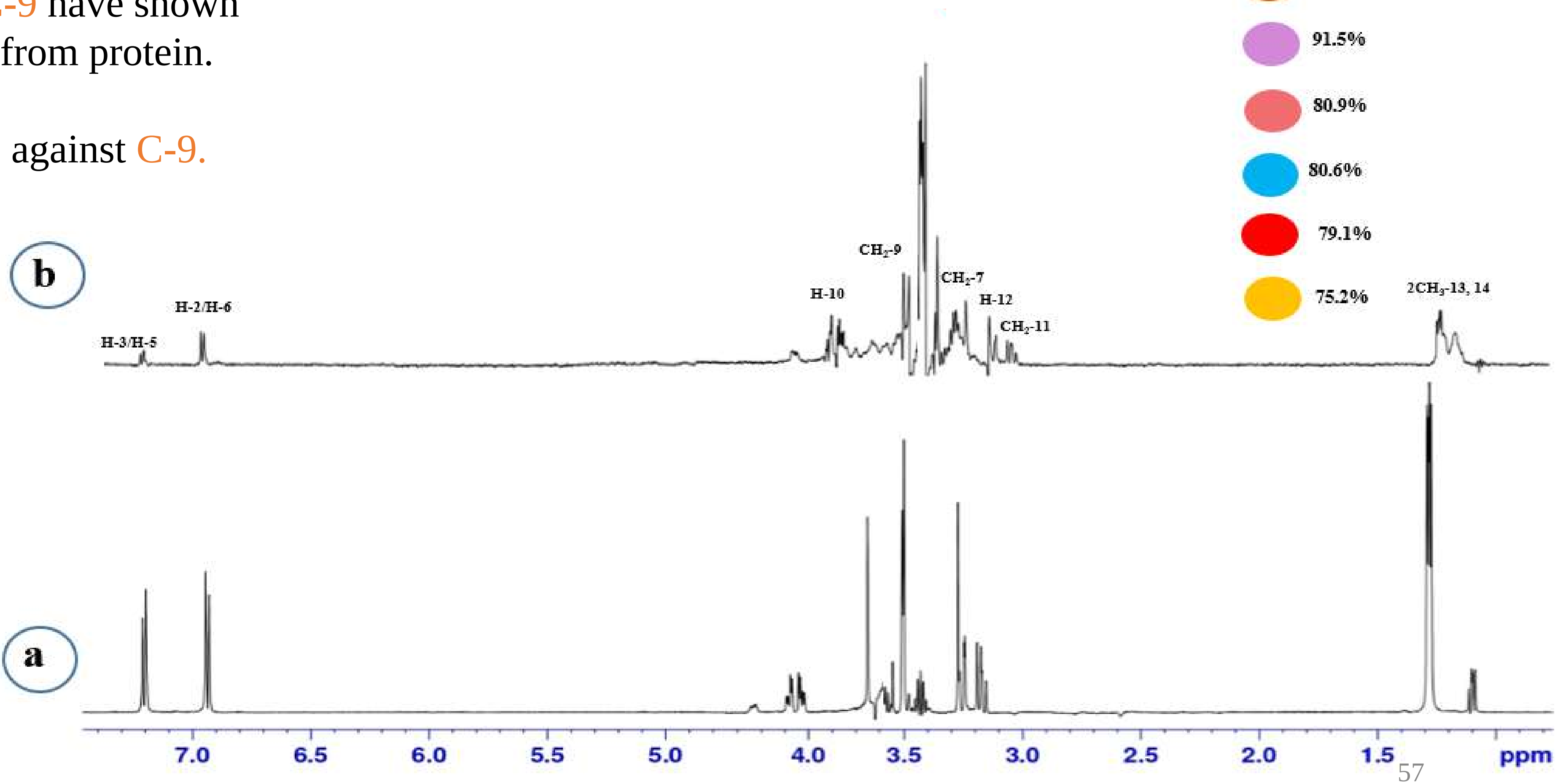
Itopride showed hydrogen bonding and aromatic hydrogen bonding interaction with Glu149 of NS5 polymerase enzyme of dengue virus.

STD-NMR of Atenolol

- **Atenolol is a beta blocker medication primarily used to treat high blood pressure and heart-associated chest pain.**
- Aliphatic protons of CH_2 at C-9 have shown maximum (100%) saturation from protein.
- Rest of proton was normalize against C-9.



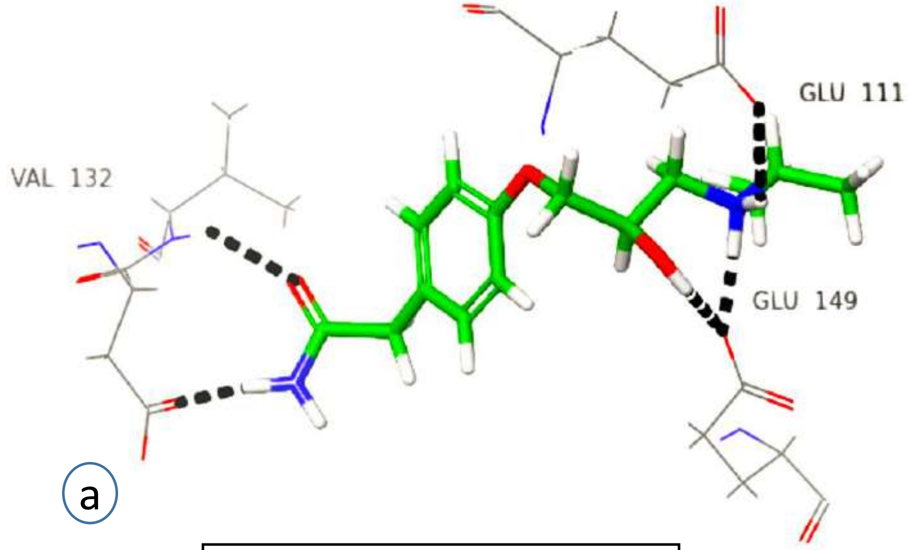
Difference Spectrum of Atenolol with and without protein



[1]H Spectrum of Atenolol

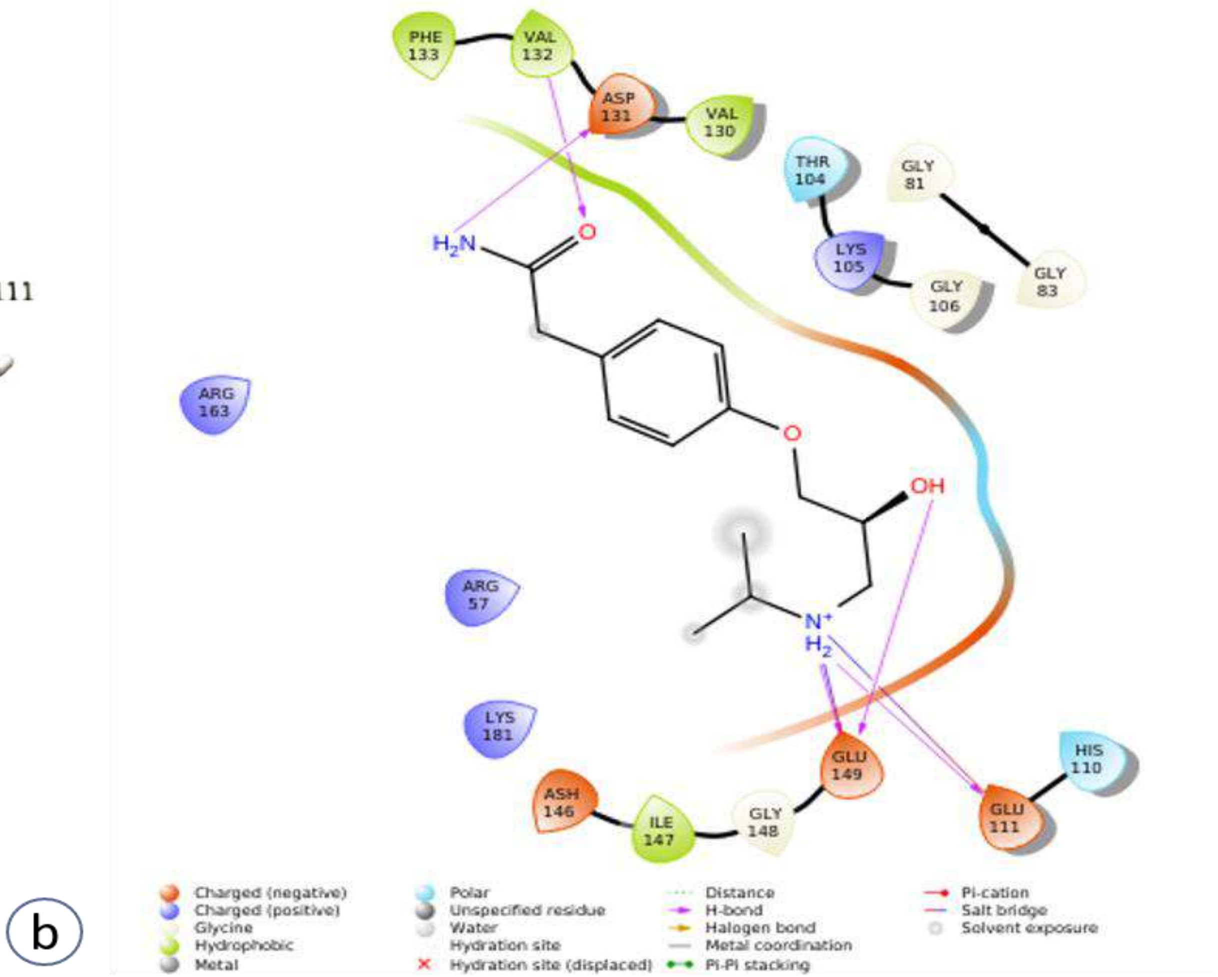
Molecular docking and simulation studies on Atenolol

- Hydrogen bond



3D Protein-ligand interaction

Docking score -4.3



Atenolol showed hydrogen bond interactions with Glu149, Glu111, and Val132 of NS5 polymerase enzyme of dengue virus.

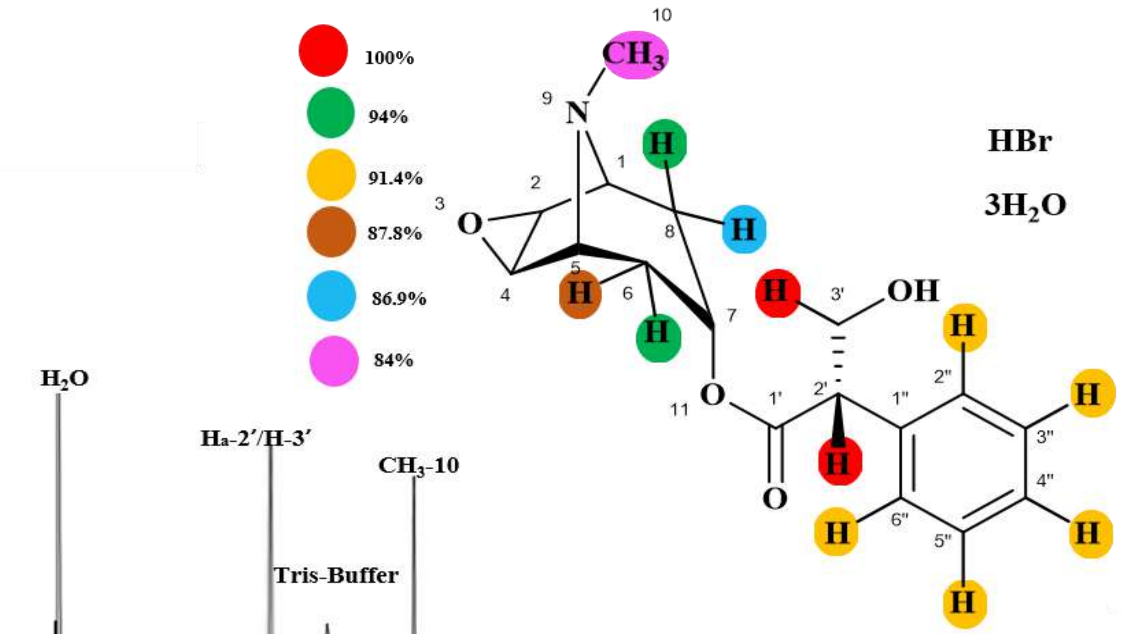
2D Protein-ligand interaction

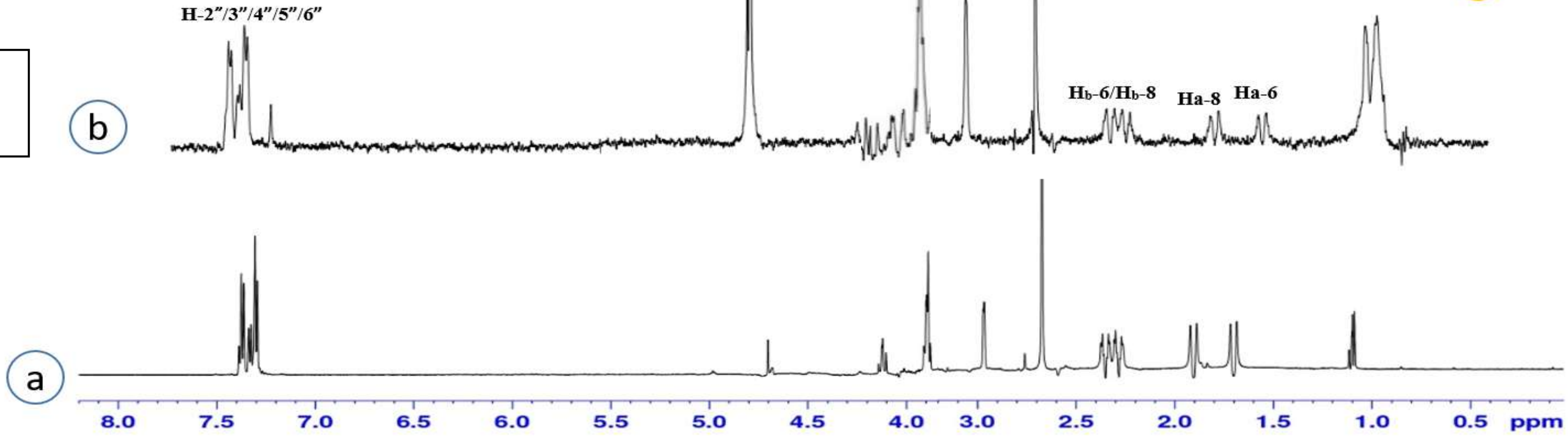
STD-NMR of Scopolamine

- **Scopolamine works by blocking the effects of acetylcholine on the central nervous system. It is used to prevent nausea and vomiting caused by motion sickness or medications used during surgery.**

- Aliphatic protons **H-2′/H-3′** had received a maximum saturation of relative STD integral value, set to be 100%.

- All other interacting protons are normalized against **H-2′/H-3′.**

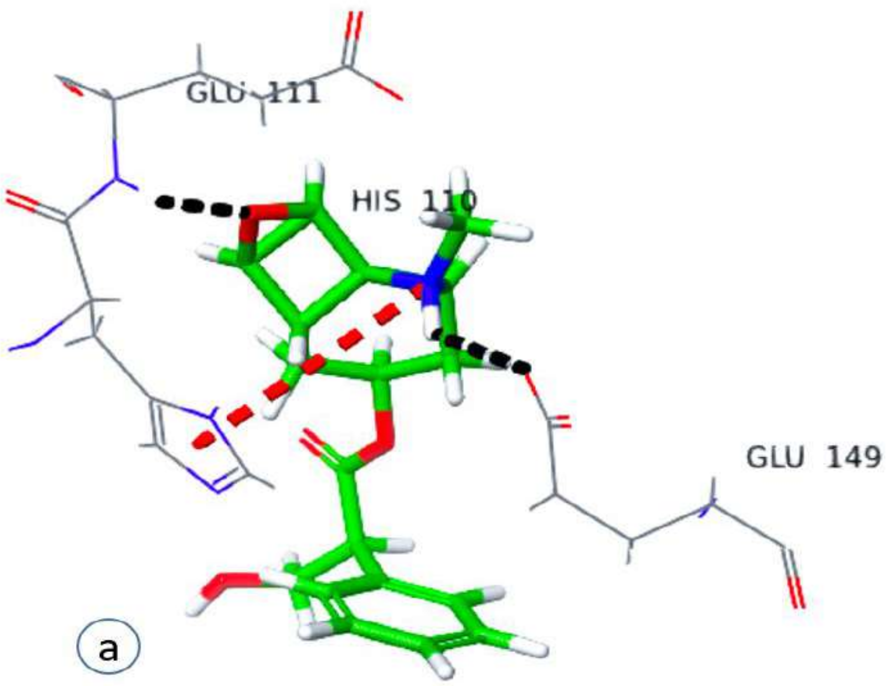




Difference Spectrum of Scopolamine with and without protein

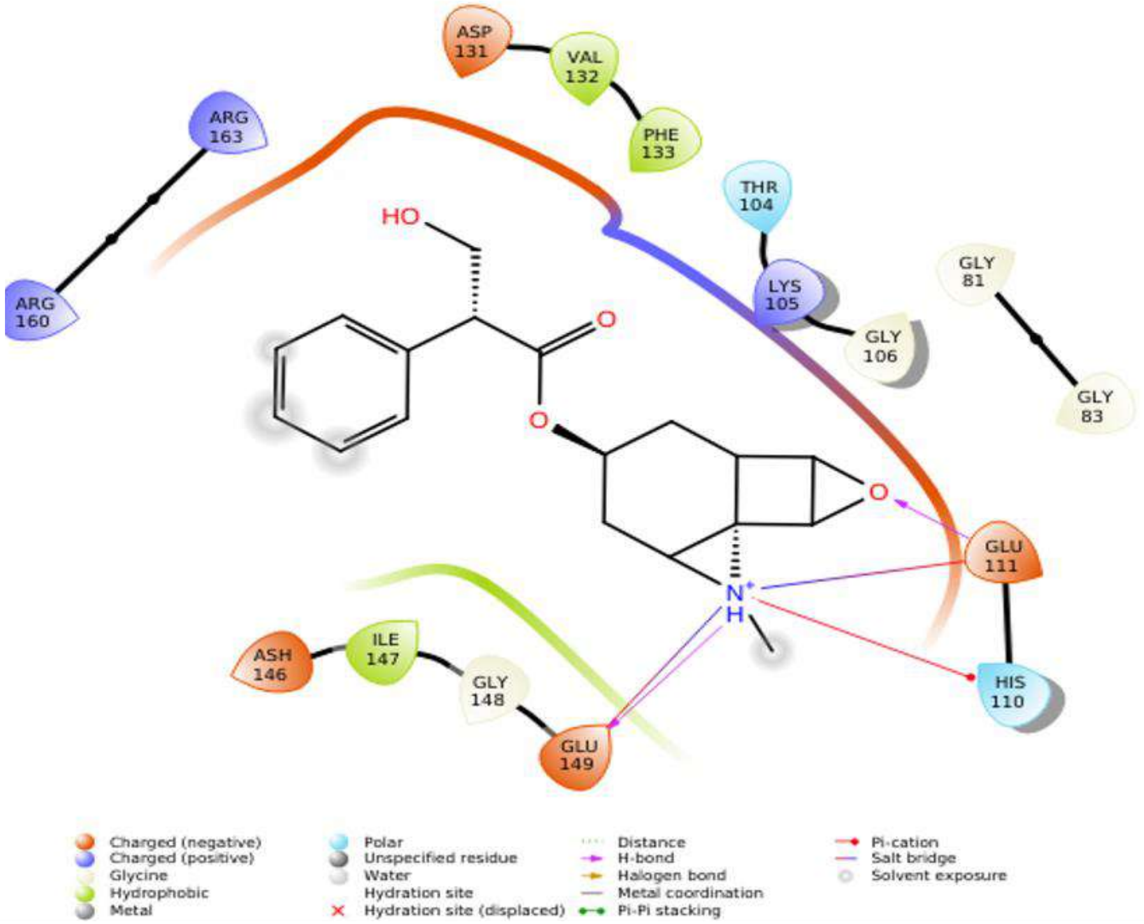
[1]H Spectrum of Scopolamine

Molecular docking and simulation studies on Scopolamine



- Hydrogen bond
- π cation interaction

Docking score -4.2

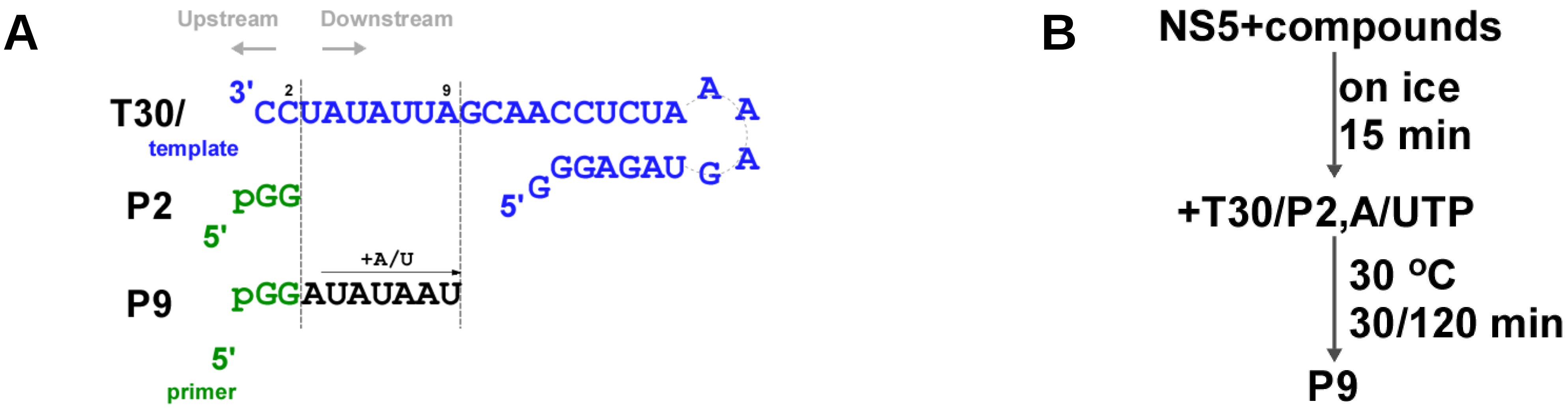


Scopolamine showed hydrogen bond interactions with Glu111 and Glu149, and π cation interaction with His 110 of NS5 polymerase enzyme of dengue virus.

2D Protein-ligand interaction

Diclofenac sodium effectively inhibits the activity of dengue virus NS5 polymerase

Protocol for polymerase inhibitory activity

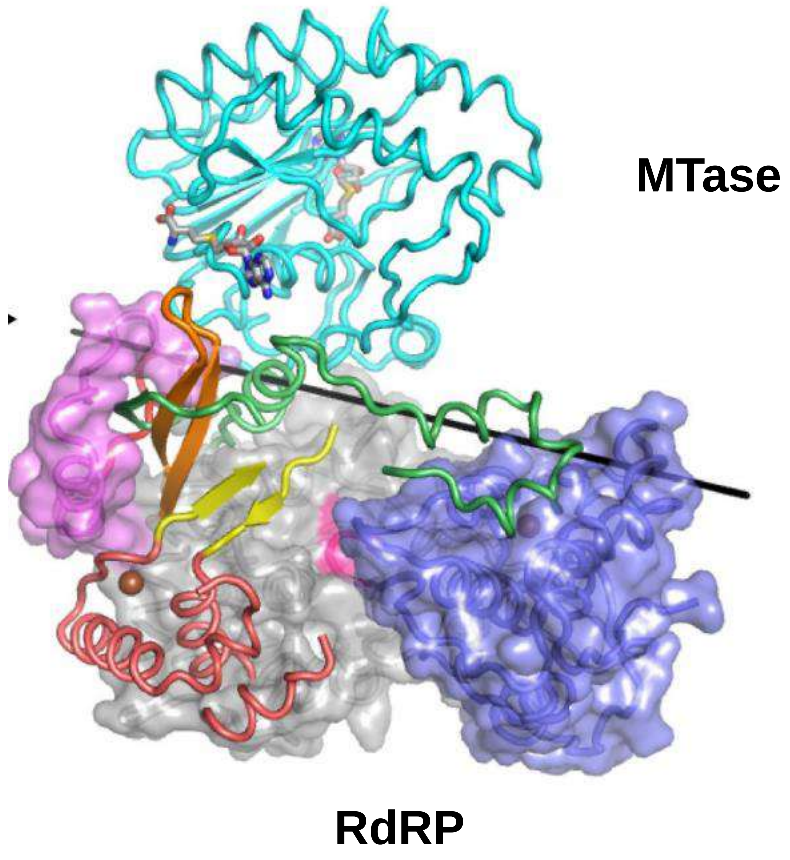


A: A diagram of construct T30/P2 used in NTP-driven polymerase reactions to generate 9-mer products. T30: RNA template; P2: dinucleotide primer.

B: 6 μM protein was incubated with different concentrations of drugs in assay buffer (50 mM Tris-HCl pH 7.5, 5 mM $MgCl_2$, 5 mM dithiothreitol) on ice for 15 min. The reaction was started by the addition of 4 μM RNA template, 300 μM ATP, and 300 μM UTP in a final reaction volume of 20 μL. After incubation at 30 °C for various durations, the reaction was stopped by adding 2× STOP solution.

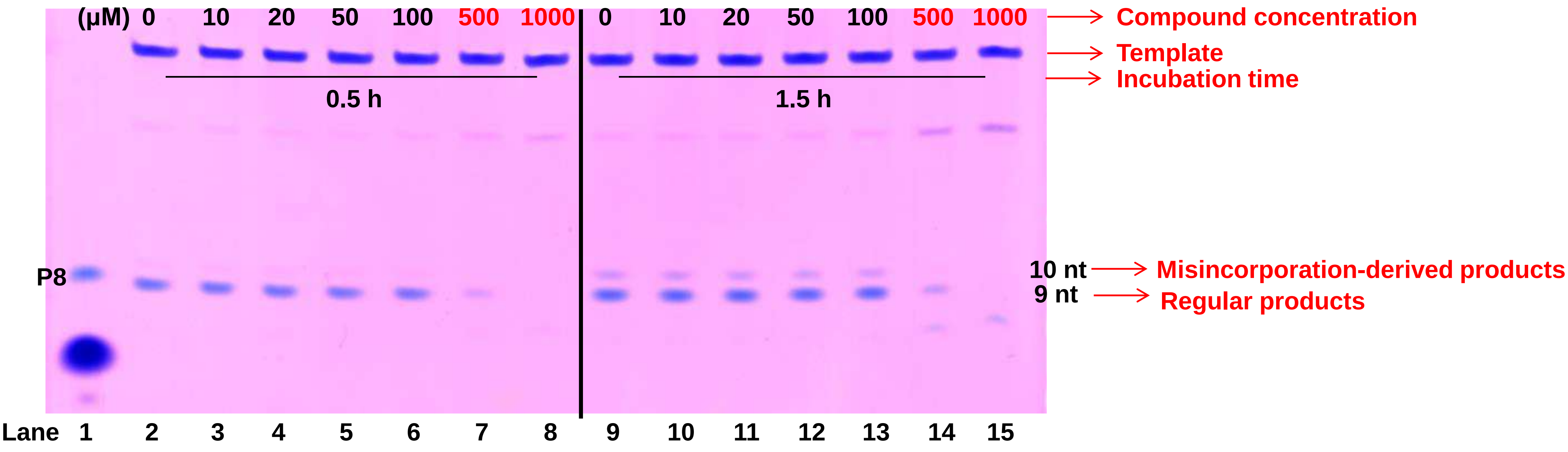
RNA Polymerase inhibitory activity

The full-length protein of NS5 was used in the above activity tests. Flavivirus NS5 is a fusion of an S-adenosyl-l-methionine (SAM)-dependent methyltransferase (MTase).



Wu, Jiqin et al. *PLoS Pathogens* vol. 16(5):e1008484. 1 May. 2020,

Inhibition of the polymerase activity by diclofenac sodium



This compound has an inhibitory effect when provided at 500 μM or beyond.

What we have been able to achieve recently ?

- **Identify nature based- drug leads and herbal formulations for medicinal plants (Anti-Lesihmanial, Anti-epileptic, Anti-leishmanial, Anti-Parkinson's, etc). These drug leads are in different phases of development.**
- **Produce bioactive chemical space through bio-catalytic methods with enhanced pharmacokinetic properties.**
- **We focused on many neglected diseases, such as Dengue hemorrhagic fever, by drug repurposing.**

ACKNOWLEDGMENTS

Prof. Dr. Atta-ur-Rahman FRS Our Teacher

Development of Anti-Leishmanial Agents

- **Prof. Dr. Sammer Yousuf**
- **Dr. Azam Jah Samdani**
- **Dr. Farooq Soomro**
- **Mr. Samreen**
- **Ms. Sobia Ghani**

Drug Repurposing against Dengue Virus

Prof. Dr. Atia-tul-Wahab
Prof. Dr. Peng Gong
(Construct provided)
Mr. Asmat Ullah
Mr. Abdul Mateen

Financial Support:

- **The Searle Company Pakistan**
- **Higher Education Commission, Pakistan**
- **Pakistan Academy of Sciences**
- **Searle Pharmaceutical Company Pakistan**
- **GCRF-NTD UK**

Financial Support

SEARLE

HIGHER EDUCATION COMMISSION

PAKISTAN ACADEMY OF SCIENCES

A Global Network for Neglected Tropical Diseases
Chagas disease | Leishmaniasis

https://ntd-network.org

COMSTECH

(OIC's Ministerial Standing Committee on Scientific and Technological Cooperation)

Genesis and Governance

Established in 1981

Chaired by The President
and
Co-Chaired by The Prime Minister

Organizational Structure

COMSTECH works with all member states and plays its due role under:

General Assembly

Executive Committee

Coordinator General

COMSTECH Secretariat

COMSTECH's GENERAL ASSEMBLY

- ❑Ministers in Charge S&T
- ❑Secretary General OIC
- ❑President IsDB
- ❑Observer States
- ❑OIC-15 Dialogue Platform
- ❑Relevant OIC Organizations
- ❑Muslim Communities endorsed by OIC
- ❑Collaborating International Organizations
- ❑Relevant UN and its Organizations

Strong Network-Real Strength of

COMSTECH

DAUGHTER ORGANISATIONS

PARTNERS

OIC-GS

COMCEC

ICESCO

IOFS

SESRIC

OIC-CERT

IAS

ORGANISATIONS

ISNET INWRDAM INOC INTROM INIT CINVU INSTP INN

COMSTECH Inter-Islamic Networks

MAJOR PROGRAMS

- Largest Research Training Fellowship Programs (IsDB, ICGEB, IOFS)
- COMSTECH Health and S&T Programs (IsDB, OIC-GS, LRBT)
- COMSTECH Research Projects Support Programs (IFS, TWAS, UNESCO, ICGEB)
- COMSTECH Consortium of Excellence Program
- COMSTECH – IOFS Food Security Initiatives
- COMSTECH's Country Specific Programs (Palestine, Yemen, Nigeria, Sudan, and Somalia)
- COMSTECH Forum on Environment and Ecosystem Restoration (CFEER)

COMSTECH Research Fellowships

- **500 Scholarships and Fellowships for Palestine (CCoE, PICA)**
- **Virology and Vaccine Training Fellowships (BioFarma, Indonesia)**
- **Fellowships for Muslim Minorities (IsDB)**
- **Technician Training Program (IsDB)**
- **Fellowships for LDC-Africa (IsDB)**
- **Fellowships for Women Researchers (IsDB)**
- **"Science in Exile Fellowships" for Refugee scientists (UNESCO, TWAS)**
- **Biotechnology Research Training Initiatives for Africa (ICBEB)**

CAPACITY BUILDING PROGRAMMES

- **Reverse Linkages Program for institutional strengthening**
- **COMSTECH-CCoE Yemen Program for Capacity Building in Public Health, Health Research, and Biomedical Technology**
- **Country specific programs with Nigeria, Sudan, and Somalia**
- **IOFS-COMSTECH Fellowships for Research/Training in Food Security for Afghanistan and others.**
- **COMSTECH – COMCEC project on Agriculture – 2023**
- **Training on Clinical Trials – Uganda, and Egypt**
- **Pakistan- Türkiye- Kazakhstan Youth Forums on Biotechnology**

COMSTECH's Top Priority
Africa Health and S&T Programs

HEALTH FOR AFRICA PROGRAM

- **Two-year training of Ophthalmologists from Africa (Pakistan Medical Commission)**
- **Cataract Surgery Campaigns (Surgeries, Trainings, Equipment Repair) in LDC-OIC Africa**

  Niger Nov 2021, Feb 2022
  Chad January 2023
  Uganda March 2023

- **Repair & maintenance of biomedical/ophthalmology equipment**
- **Over 400 Cataract Surgeries & Post Op examination in each campaign**
- **Training Workshops for doctors and paramedics**

HEALTH FOR AFRICA PROGRAM

- **Training Workshops in Cancer Care: Burkina Faso, Niger, and Sudan.**

- **Training Workshops in Neurology/Neuro-critical Care: Senegal, Guinea-Bissau, and Uganda**

S&T Education and Research Institutions Building in Africa

- **Establishment of MS computer science program and labs at the University of Gambia**
- **PNAC Accredited Halal Products Testing Laboratory at the IUIU, Uganda**
- **Citrus Value Added Product Technology Transfer for Nigeria**
- **Faculties of Engineering and Science at N DJamena University, Chad**

Partners of the COMSTECH Forum on Environment and Ecosystem Restoration (CFEER)

POTSDAM INSTITUTE
FOR CLIMATE IMPACT RESEARCH

CERTE
مركز بحوث وتكنولوجيّات المياه

TIRDO

UN
environment
programme

United Nations
Convention to Combat
Desertification

COMSTECH

الجمعيّة العِلميّة المَلكيّة
Royal Scientific Society
For Jordan since 1970 • في خدمة الوطن منذ ١٩٧٠

ICARDA
Science for resilient livelihoods in dry areas

Songhaï
L'AFRIQUE RELEVE LA TÊTE! AFRICA STANDS UP!

CILSS

UTG

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
CSIR
• GHANA •

UN
environment
programme
International Ecosystem Management Partnership
国际生态系统管理伙伴计划
UNEP-IEMP

Belantara
FOUNDATION

University of
The Gambia

ICESCO

SAHEL
COALITION

AIN SHAMS UNIVERSITY
FACULTY OF AGRICULTURE

COMSTECH Action Plan for “Preventing Food Crisis in the Sahel“ (July 2022)

- Concept approved by partners
- The aim is to develop a COMSTECH Framework to assist the Sahel countries in addressing challenges of food insecurity.
- COMSTECH program partners CILSS, ICESCO, and IOFS.

Cooperation Agreement between **COMSTECH** & Permanent Inter-State Committee for Drought Control in the Sahel **(CILSS)**

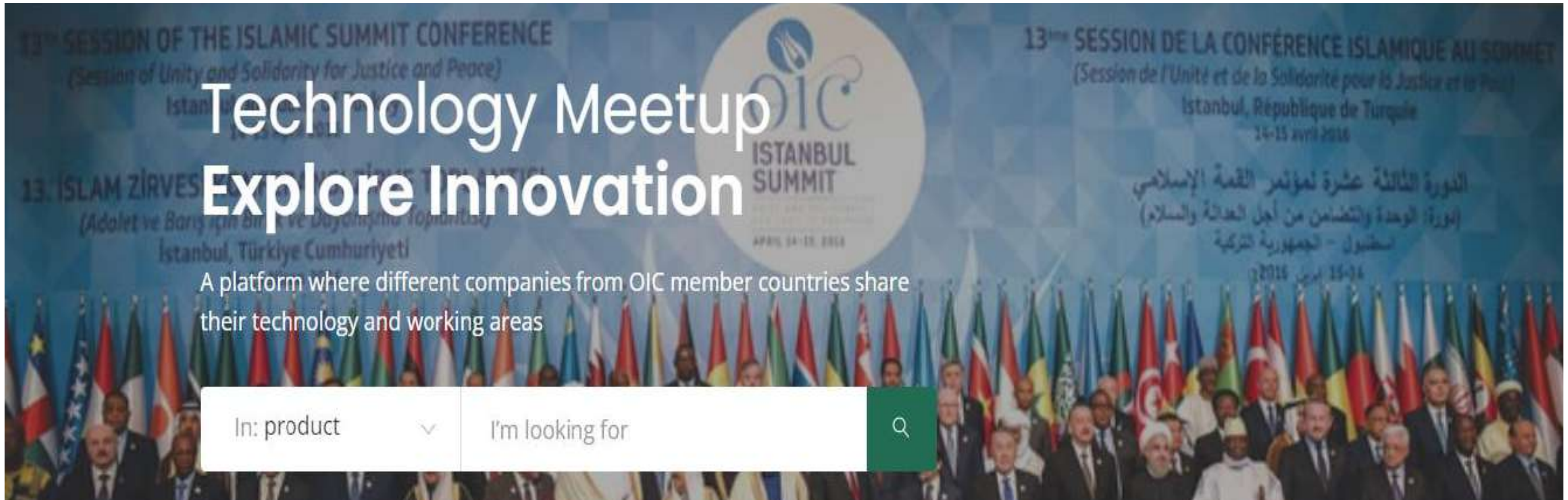
- MoU signed in August, 2022.
- CILSS is an international organization based in Ouagadougou, Burkina Faso, and covers 17 countries in West Africa.
- 12 OIC members: countries are members of CILSS

- Benin
- Burkina Faso
- Chad
- Côte d’Ivoire
- Gambia
- Guinea
- Guinea Bissau
- Mali
- Mauritania
- Niger
- Nigeria
- Senegal
- Sierra Leone
- Togo

COMSTECH-OIC Technology and Innovation Portal

The COMSTECH-OIC Technology and Innovation Portal is a digital information platform to showcase the prowess of scientists, innovators, and product developers from the OIC world. The portal provides a platform to help exchange information about the emerging and existent technologies, originating from the OIC Member Countries. This will result in intra-OIC interactions, and business engagements.

The portal also provides a platform for companies/organizations/ R&D institutions to showcase their products/services to reach out to potential end users, investors, etc. This portal has the potential to bring meaningful change to the lives of millions of people across the OIC Member Countries, by giving researchers, technologists, innovators, and entrepreneurs the opportunity to exchange information about emerging technologies, and their applications.



COMSTECH Program for Celebrating Muslims in Science

(In collaboration of International Turkic Academy, and Host Countries)

- **Global Al-Farabi Forum, Islamabad 2020**
- **Iqbal Forum, Almaty 2022**
- **The Global Forum Babur-Balasagyn, Bishkek 2023**
- **Al-Biruni Forum, Tashkent 2023**

COMSTECH Key Programs for 2023

- **OIC-15 Dialogue Platform Ministerial Meeting (Kazakhstan, OIC-GS, COMSTECH)**
- **COMSTECH General Assembly (Islamabad, Pakistan)**
- **Third Youth Forum for Biotechnology (Kazakhstan)**
- **Kazan IPR and S&T Policy Trainings for OIC**
- **Launching of COMSTECH-IsDB-Pakistan Fellowship Program**
- **COMSTECH-Pakistan Technology Expos (Cybersecurity, Agritech, E-health, Climate Change)**
- **COMSTECH Training Programs for the Managers of Science Technology Park and Incubation Centers (Government of Pakistan, Perdis Technology Park. Bilkent Tech Park)**
- **Skill Development Programs in E-gaming, E-Commerce, IoT, Blockchain, Data Science, etc (Government of Pakistan)**

Exhibition of COVID Related Technologies

AI and IoT Products Exhibition

SOME GLIMPSES OF RECENT MEETINGS

Thank you very much

Halal Products Biomolecular Science and Healthy Life

Ali A. Moosavi-Movahedi FIAS
Institute of Biochemistry and Biophysics,
University of Tehran, Iran

Abstract

Today, Halal products are placed in the framework of science, and scientific parameters can be measured for them. The insights of science in halal products can be studied by different disciplines such as biochemistry, biophysics, and bioinformatics. From a biological point of view, the common relationship between halal products and human health is supposed. One of the angles is the biophysical look on protein functions in halal and non-Halal foods. Protein is molecular machine for our life and the rule proposed as protein structure and function relationship.
Myoglobin is an oxygen-carrying protein in muscle that is found in meat. In this work, the Halal and non-Halal myoglobins were purified from slaughtered sheep's and the thermal profiles were measured by differential scanning calorimetry (DSC) for both proteins. Thermal profile of protein by DSC is the identification of protein structure. In this research, the structures of both myoglobins are completely different via DSC, therefore their functions should be different. Functional parameters for aggregation, digestibility, unbalanced free radicals of two types of myoglobins were measured and shown non-Halal case for aforementioned parameters were increased several times that of Halal case.
It is important to note that diabetes, especially type 2, is not only a disease of sugar, but also a disease of stress. The molecular definition of stress means the induction of unbalanced free radicals. Therefore, the use of stressful foods increases the possibility of diabetes or any type of industrial diseases, which should be careful. Therefore, lifestyle based on science and reason is one of the most important general knowledge for humanity and society, which should be searched from lifestyles of different nations.

Keywords: Halal and non-Halal foods, Scientific measurement, DSC, Biochemistry, Biophysics, Free radicals, Diabetes.

بسم الله الرحمن الرحيم

Halal Products Biomolecular Sciences and Healthy Life

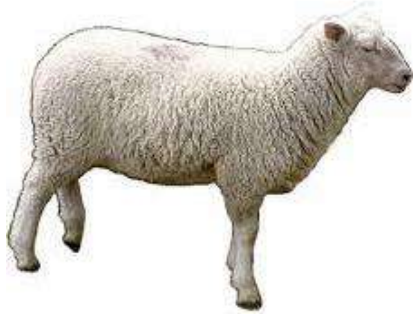
Ali A. Moosavi-Movahedi, FTWAS, FIAS

Institute of Biochemistry and Biophysics (IBB),
UNESCO Chair on Interdisciplinary Research in Diabetes (UCIRD),
University of Tehran, Tehran, Iran
Web: ibb.ut.ac.ir/~moosavi

BCL
Biophysical Chemistry Laboratory
IBB, University of Tehran

Halal Science and Correleation to Proteins as Molecular Machines

- Today, Halal products are placed in the framework of science, and scientific parameters can be measured for them. The insights of science in Halal products can be studied by different disciplines such as biochemistry, biophysics, and bioinformatics. From a biological point of view, the common relationship between Halal products and human health is supposed. One of the angles is the biophysical outlook on protein functions in Halal and non-Halal foods. Protein is molecular machine for our life and the main rule proposed as protein structure function relationship.

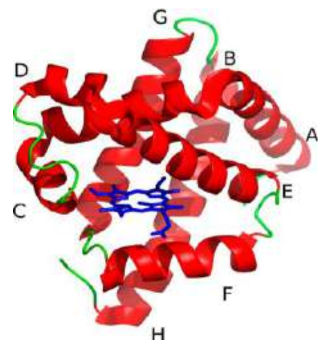


Non Halal slaughtering

Halal slaughtering

Less bleeding

More bleeding

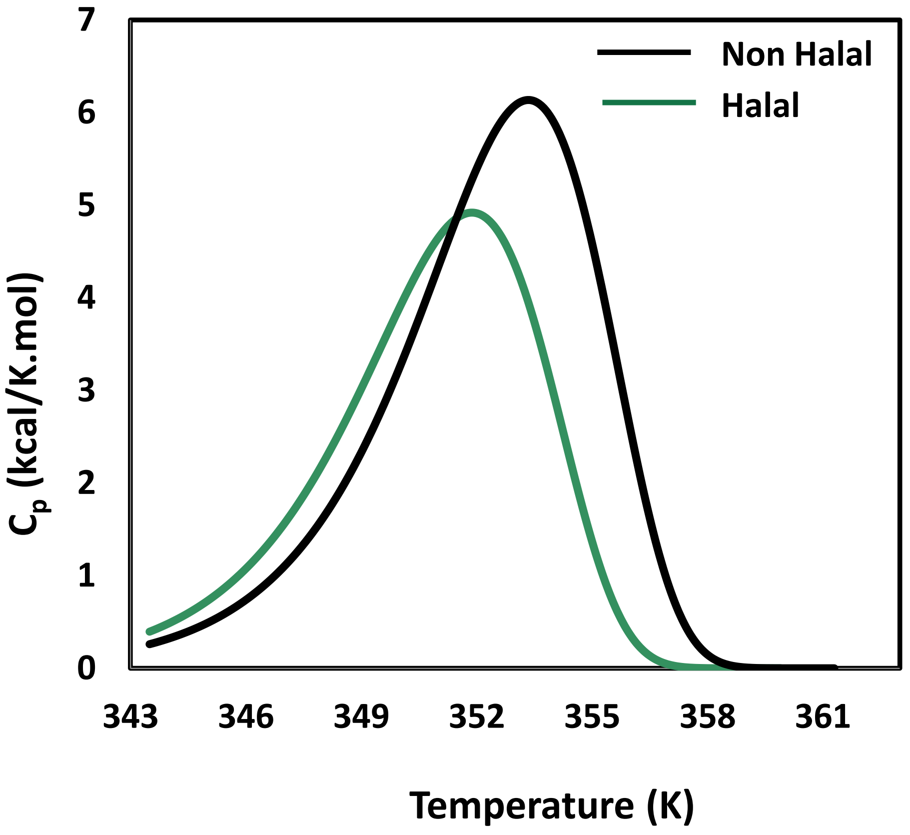


Extraction of Myoglobin as an indicator of meat proteins

Difference in Halal and Non-Halal Myoglobins

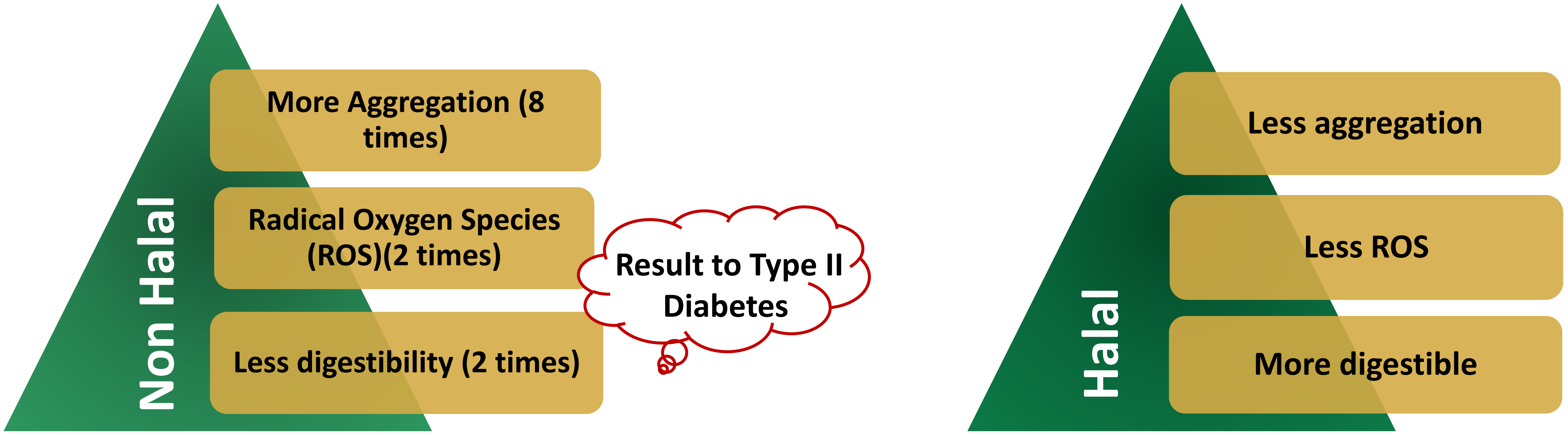
Myoglobin is an oxygen-carrying protein in muscle that is found in meat. In this work, the Halal and non-Halal myoglobins were purified from slaughtered sheep’s and the thermal profiles were measured by differential scanning calorimetry (DSC) for both proteins. Thermal profile of protein by DSC is the identification of protein structure.

Cp and anesthesia degree



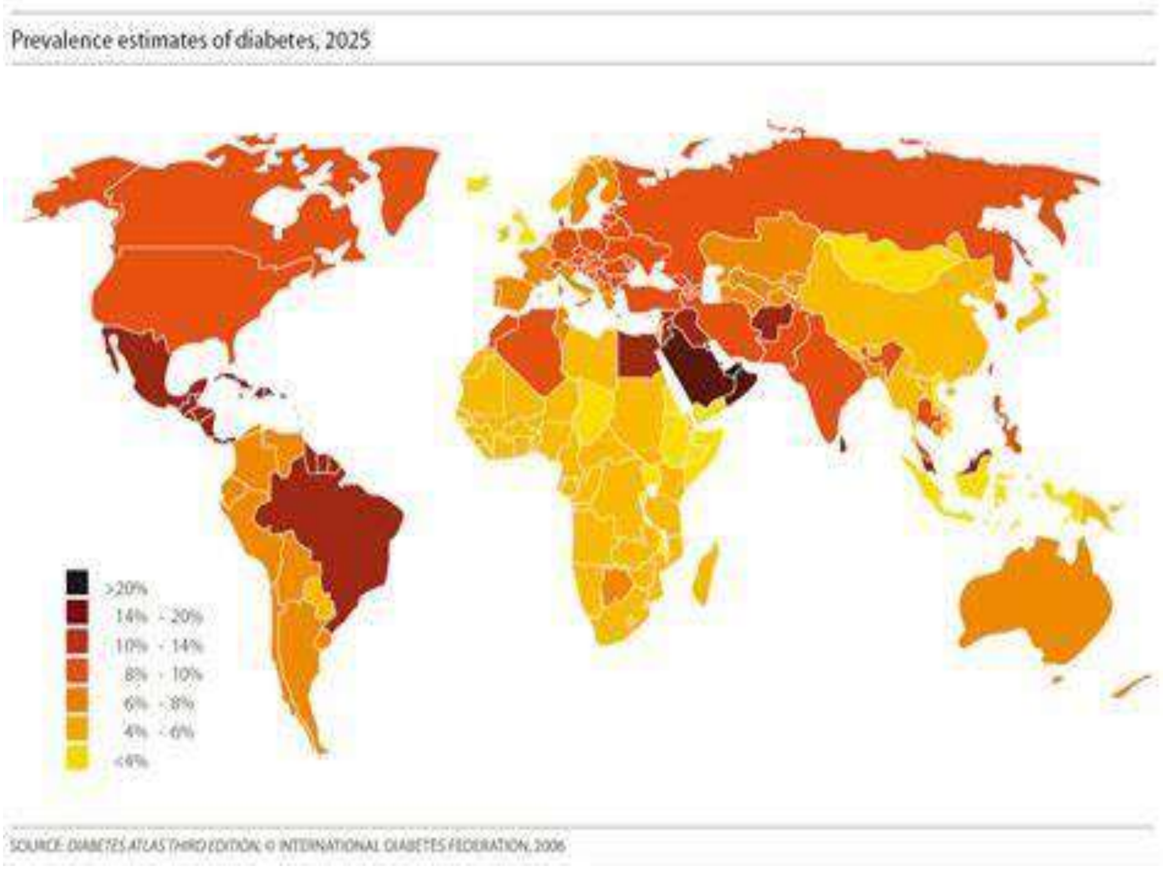
Protein Sturcture Function Relationship

In this research, the structures of both myoglobins are completely different via DSC, therefore their functions should be different. Functional parameters for aggregation, digestibility, unbalanced free radicals (stress) of two types of myoglobins were measured and shown non-Halal case for aforementioned parameters were increased relative to Halal case.



Radical Oxygen Species and Diabetes World Map

It is important to note that diabetes, especially type 2, is not only a disease of sugar, but also a disease of stress. The molecular definition of stress means the induction of unbalanced free radicals. Therefore, the use of stressful foods and stressful habit increases the possibility of diabetes or any type of industrial diseases, which should be careful.



Lifestyle based on Science and Wisdom

Lifestyle based on science and reason is one of the most important general knowledge for humanity and society.

Lifestyle such as:

- Halal Meat-Myoglobin oxygenation in muscles
- Good Sleep-Melatonin (Night)
- Happiness- Serotonin (Day)

  Have a happy day, sleep well at night
- Satisfaction-Oxytocin

  Forgiveness, exercise induced oxytocin

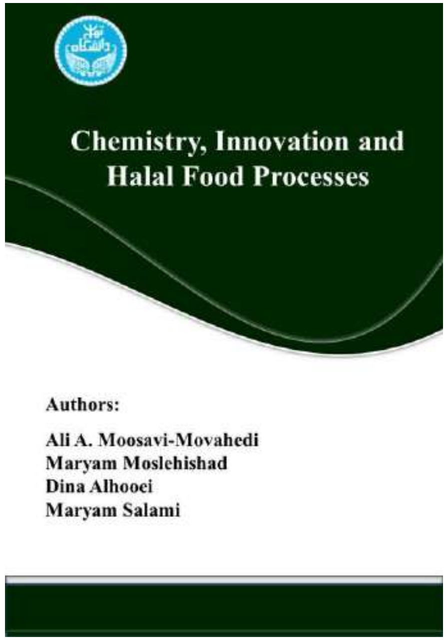
Molecular Lifestyle

Molecules play important and vital roles in our life, we get them from our lifestyle and good deeds. They are made in our body and called reward molecules. We can coin in this conference the terminology named "Molecular Lifestyle". Hope I can write a book in this term in near future.

Man Metabolism as Chemical Reactor

Man metabolism is resemble to chemical reactor, molecules are the vital vibrate of our life, let's know and respect them as a reward vital molecules.

The End



Halal products have a different molecular mechanism from non-Halal products. The biomolecular structure of Halal products (less stressful) play the important roles in human health and well-being.

DRUG RESEARCH THROUGH NATURE - FROM LAB TO PATENT

ILKAY ERDOGAN ORHAN FIAS
Dean, Faculty of Pharmacy, Gazi University, Ankara
Principal Member, Turkish Academy of Sciences (TÜBA), Türkiye

ABSTRACT

Great biodiversity of nature with enormous number of plants, animals, marine organisms, and microorganisms has so far offered a prodigious role in discovery of new drug molecules and also served for therapeutic purposes to mankind since ancient cultures. As well-known, a lot of modern medications took their roots from aged traditional medicinal systems such as Chinese traditional medicine, Ayurvedic medicine, Unani medicine, Kampo medicine, etc. Due to progresses in chemistry over centuries, it gives the impression that natural medicines were misplaced, but it is now very obvious that they are again attractive targets for drug discovery and research. Because many clinically available drugs, *e.g.* quinine, aspirin, tubocurarine, taxol, artemisinin, exenatide, statins, ivermectin, metformin, acyclovir, etc. have been discovered in organisms such as microorganisms, macrofungi, insects, animal venoms, plants as well as marine organisms. In our far-reaching search and screening *via* primarily Turkish flora, which consists of roughly 12.000 plant taxa being the richest flora in whole Europe continent, we have been able to report quite promising natural molecules with substantial enzyme inhibitory activity by *in vitro* and *in silico* tools against cholinesterase, tyrosinase, elastase, collagenase, xanthine oxidase, lipoxygenase, etc as well as cell culture and *in vivo* experiments.

In this talk, eminence of biodiversity in drug R&D will be emphasized also pointing out in part to the findings from our research group.

Drug Research Through Nature - From Lab to Patent

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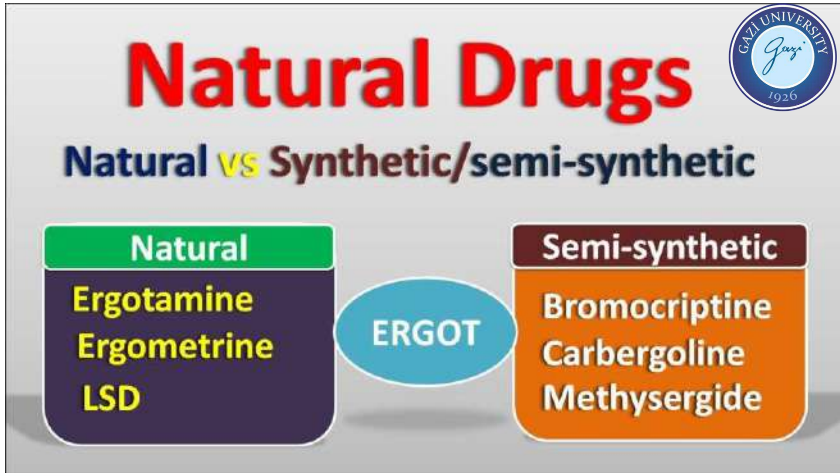
Principal Member of Turkish Academy of Sciences (TÜBA)

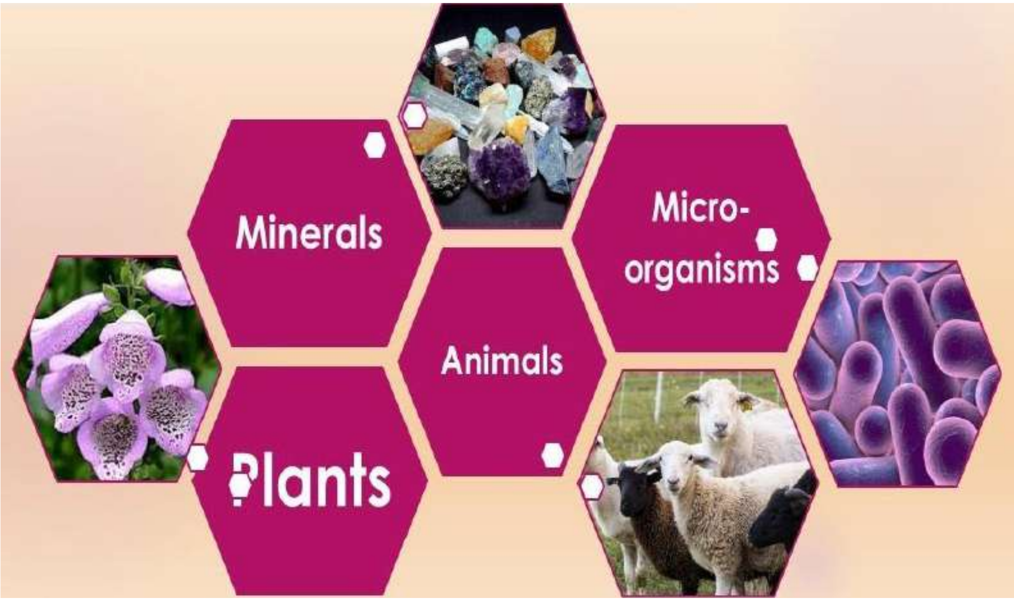
Fellow of Islamic World Academy of Sciences (IAS)

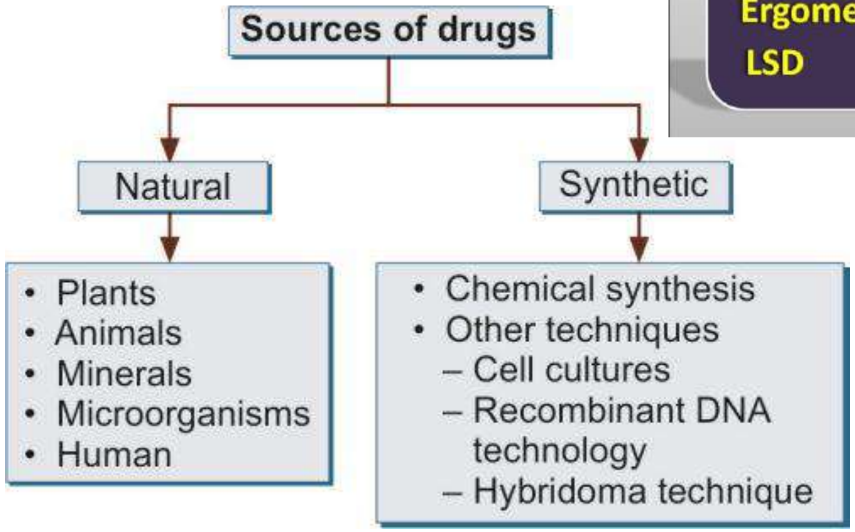




Drug Research Through Nature







aspirin
Salix alba

morphine
Papaver somniferum

echinacea
Echinacea purpurea

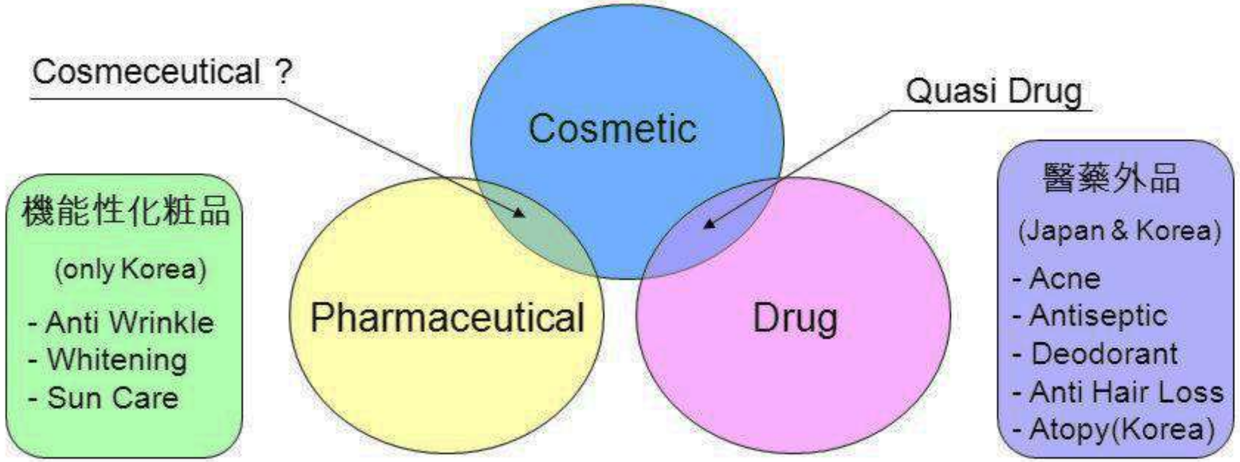
ginkgo
Ginkgo biloba

Cosmetics/Cosmeceuticals/Cosmedicals

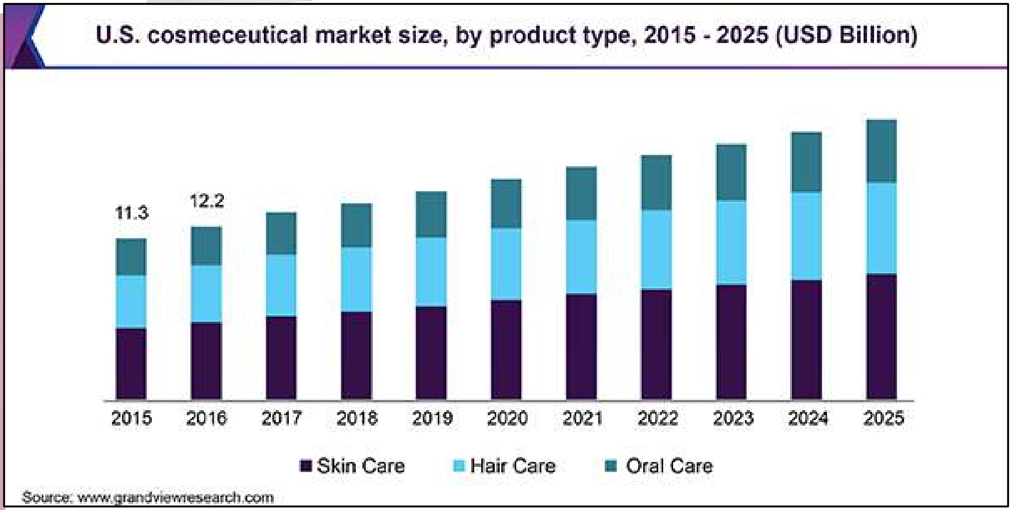
Cosmeceuticals

Cosmeceuticals represent the marriage of cosmetics and pharmaceuticals

Cosmeceuticals are cosmetic products with biologically active ingredients purporting to have medical or drug-like benefits.



Medical Cosmetics (Cosmedicals) / Doctor Cosmetics



However, according to the United States Food and Drug Administration (FDA), the Food,Drug, and Cosmetic Act "does not recognize any such category as "cosmeceuticals." A product can be a drug, a cosmetic, or a combination of both, but the term "cosmeceutical" has no meaning under the law" (☞ wikipedia)

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Consumer and cosmetic industry

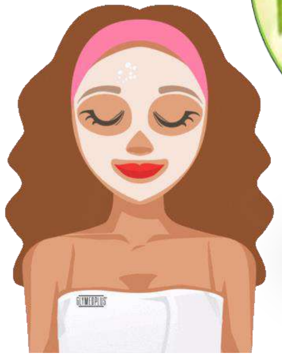
Cosmeceuticals

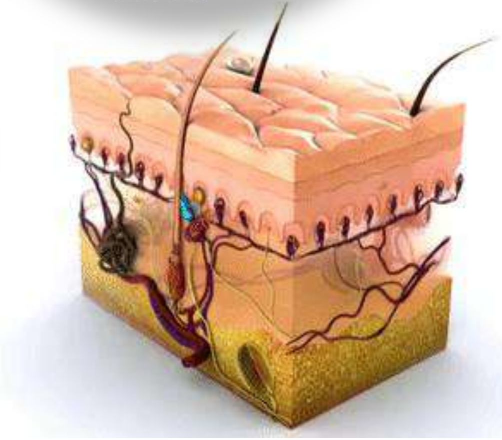
Efficacy

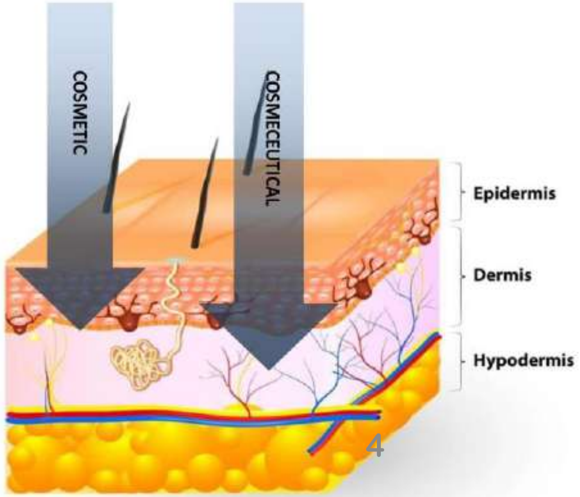
Natural & sustainable sources

Products at the borderline between cosmetics and pharmaceuticals

Safety







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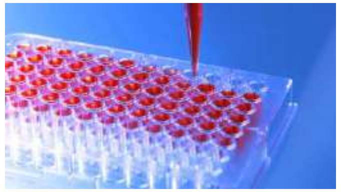
Work Flow in Our Laboratory



Traditional medicine data / random screening

Plant Collection

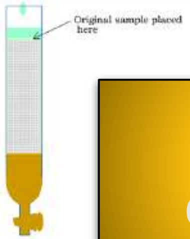
Extraction

Screening by enzyme inhibition assays (*in vitro* methods)

Active fraction(s)

Screening by enzyme inhibition assays (*in vitro* methods)

Activity-Guided Fractionation



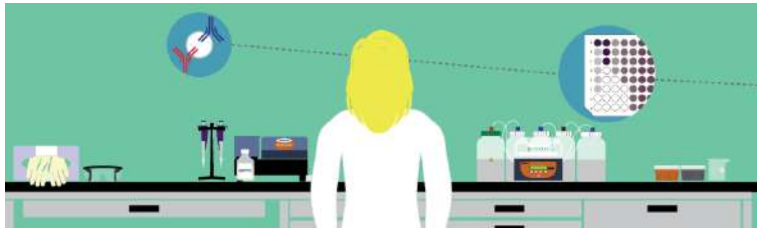
Active extract(s)

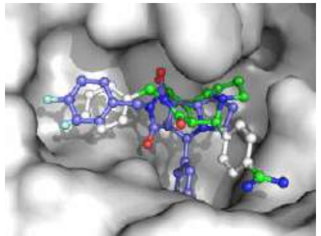
Active Compound(s)

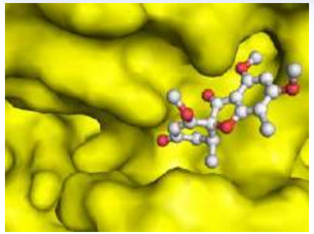
Screening by enzyme inhibition / cell culture assays

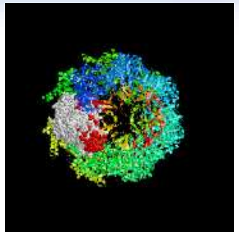
Molecular docking assays (*in silico* methods)

Phytochemical analysis









Enzyme Inhibition Assays for Skin Aging/Bleaching

Tyrosinase

Collagenase

Elastase

Lipoxygenase

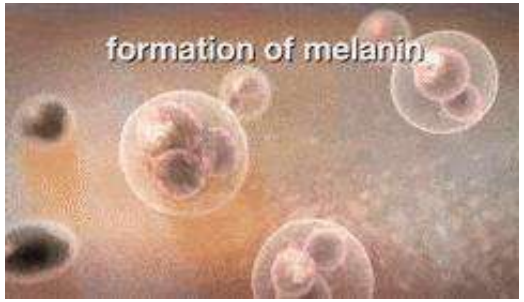
Plant extracts/Pure compounds

↓

Activity-guided fractionation

↓

Cosmetic formulations



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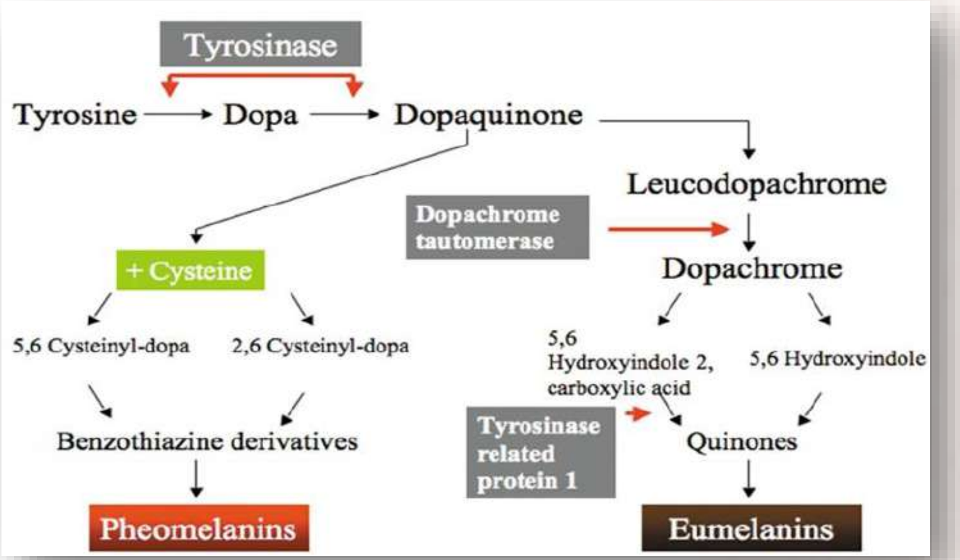
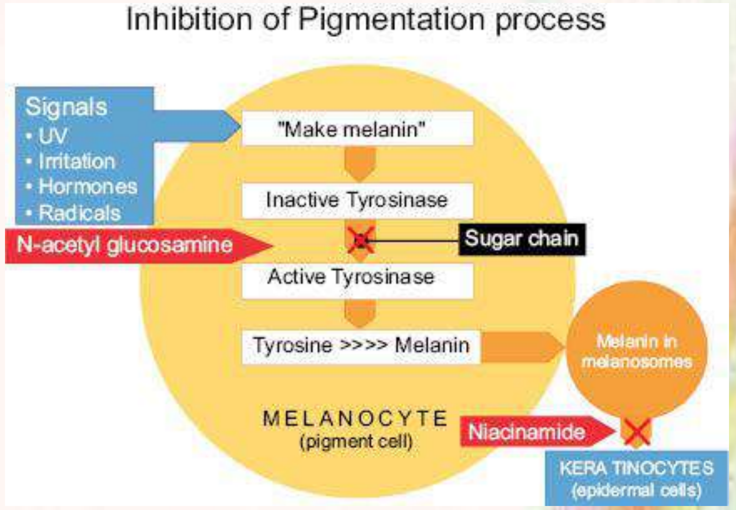
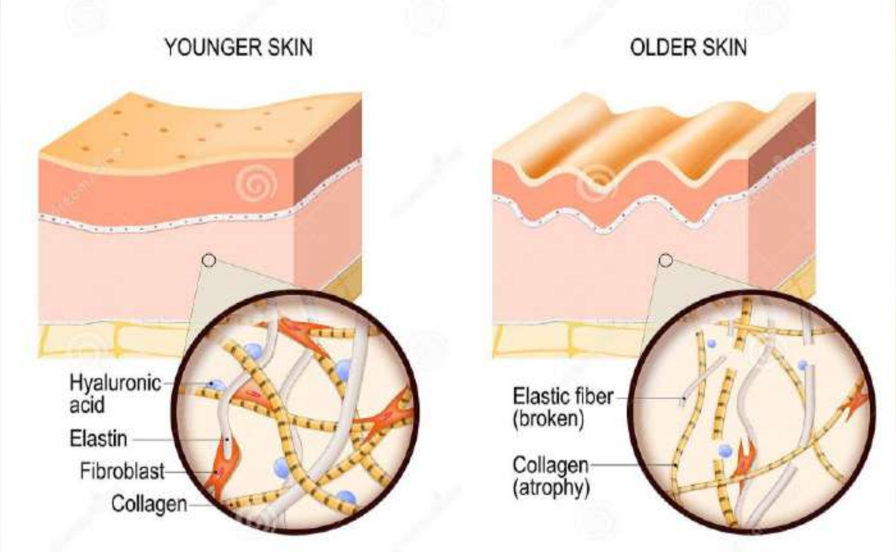
DEPIGMENTING AGENTS

- -Hydroquinone
- -Arbutin
- -Ascorbic acid
- -Alfa-Kojic acid
- -Tretionin







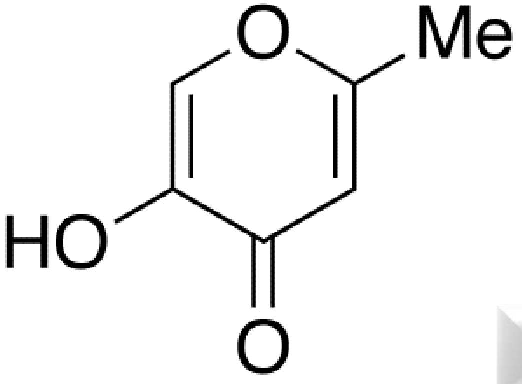
Tyrosinase Inhibition

TÜRK PATENT

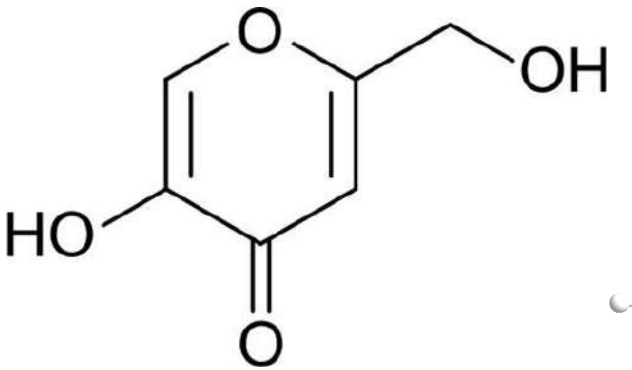
TÜRK PATENT VE MARKA KURUMU

HACETTEPE

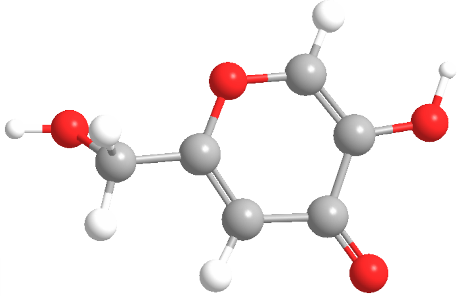
kj KOJİ kozmetik



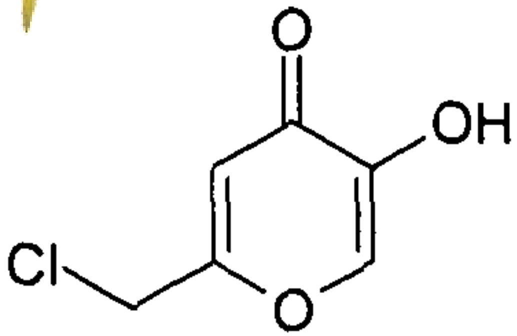
Allomaltol



Alpha-Kojic acid



Fungal metabolite derived from *Acetobacter Aspergillus*, and *Penicillium*



Chlorokojic acid

125 derivatives

Kojylmethyl Dichlorobenzyl Piperazine

US009975884B2

(12) **United States Patent**
Aytemir et al.

(10) **Patent No.:** **US 9,975,884 B2**
(45) **Date of Patent:** **May 22, 2018**

(54) **KOJIC ACID-DERIVED MANNICH BASES WITH BIOLOGICAL EFFECT**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days. days.

Database Registry [Online] Chemical Abstracts Service; Columbus, Ohio; US; Aug. 28, 2011 (Aug. 28, 2011); XP002760857; Database accession No. 1324084-63-0 RN 1324084-63-0.
Burdock, G. A., et al., "Evaluation of Health Aspects of Kojic Acid in Food", Regulatory Toxicology and Pharmacology, 2001, vol. 33, pp. 80-101.
Kim, D. H., et al., "Development of 5-[(3-Aminopropyl)phosphinooxy]-2-(hydroxymethyl)-4H-pyran-4-one as a Novel Whitening Agent", Chem. Pharm. Bull, 2003, vol. 51, pp. 113-116.
Brtko, J., et al., "Kojic Acid and its Derivatives: History and Present State of Art", Cent. Eur. J. Publ. Health, 2004, 12 suppl. , pp. S16-S18.
Bentley, R., "From miso, saké and shoyu to cosmetics: a century of science for kojic acid", Nat. Prod. Rep., 2006, vol. 23, pp. 1046-1062.
Uchino, K., et al., "Kojic Acid as an Anti-speck Agent", Agric. Biol. Chem., 1988, vol. 52, No. 10, pp. 2609-2610.
Noh, Jin-Mi, et al. "Kojic Acid—Tripeptide Amide as a New Tyrosinase Inhibitor", PeptideScience, 2007, vol. 88, No. 2, pp. 300-307.

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Swissreg extract - EP patents

Extract and status	: 25.10.2019
Publication number	: 03310778
Publication of application	: 25.04.2018
Grant date	: 17.07.2019
Application number	: 16732363
Filing date	: 17.05.2016

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Vertretungsübernahme – DE 60 2016 017 022.1
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MANNICHBASEN AUS KOJISÄURE MIT BIOLOGISCHER WIRKUNG
Aytemir, Mutlu, Ankara, TR; Erdogan Orhan, Ilkay, Ankara, TR; Karakaya, Gulsah, Ankara, TR; Ozcelik, Berrin, Ankara, TR; Senol, Fatma Sezer, Ankara, TR

4. Oktober 2019

Ihr Zeichen: DE 60 2016 017 022.1
Unser Zeichen: EP3310778

TÜRK PATENT
TÜRK PATENT VE MARKA KURUMU

İNCELEMELİ PATENT

No: TR 2015 07653 B

Buluş Başlığı

Biyolojik etkili kojik asit türevi mannich bazları.

Başvuru sahibi

MUTLU AYTEMİR
BERRİN ÖZÇELİK
İLKAY ERDOĞAN ORHAN
GÜLŞAH KARAKAYA
SEZER ŞENOL

Bu patent, 6769 sayılı Sınai Mülkiyet Kanununun Geçici 1 nci maddesi uyarınca Mülga 551 sayılı Patent Haklarının Korunması Hakkında Kanun Hükmünde Kararname kapsamında 22/06/2015 tarihinden itibaren 20 yıl süre ile korunmak üzere 21/11/2017 tarihinde incelemeli olarak verilmiştir.

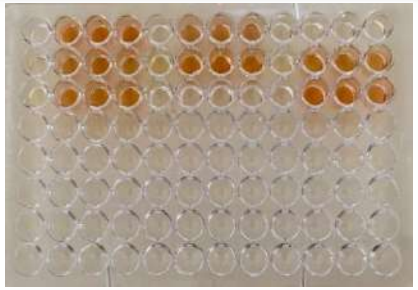
Prof. Dr. Habip ASAN
Başkan

ILKAY ERDOGAN ORHAN

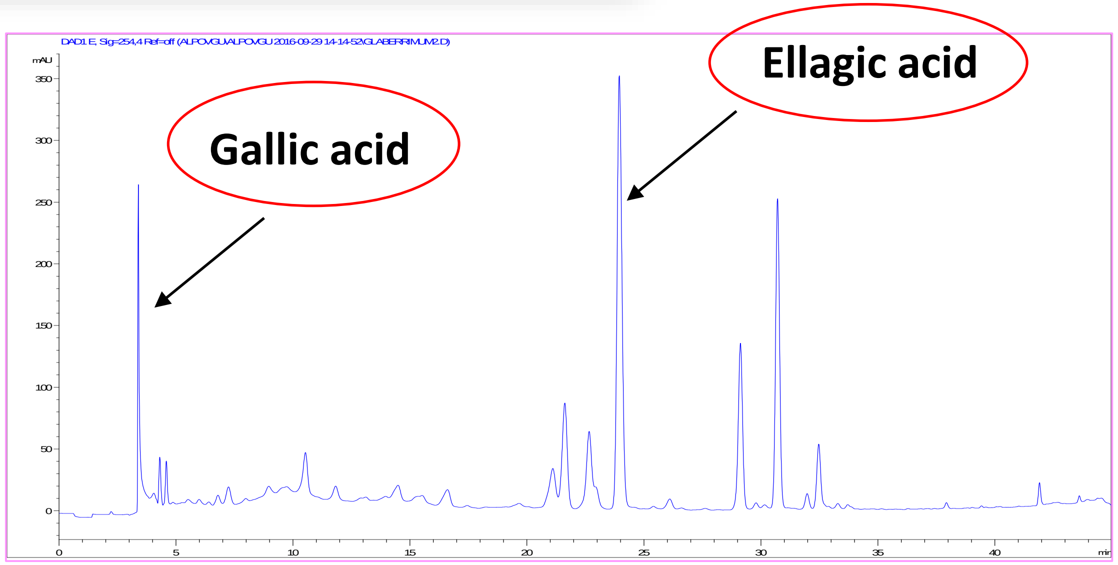
Silver Medal
"International Scientific Invention Fair" 2017 (ISIF-2017) - Istanbul

Kojylmethyl dichlorobenzyl piperazine

Tyrosinase Inhibition by *Geranium glaberrimum* L.



GG – 31.41 ± 1.11%



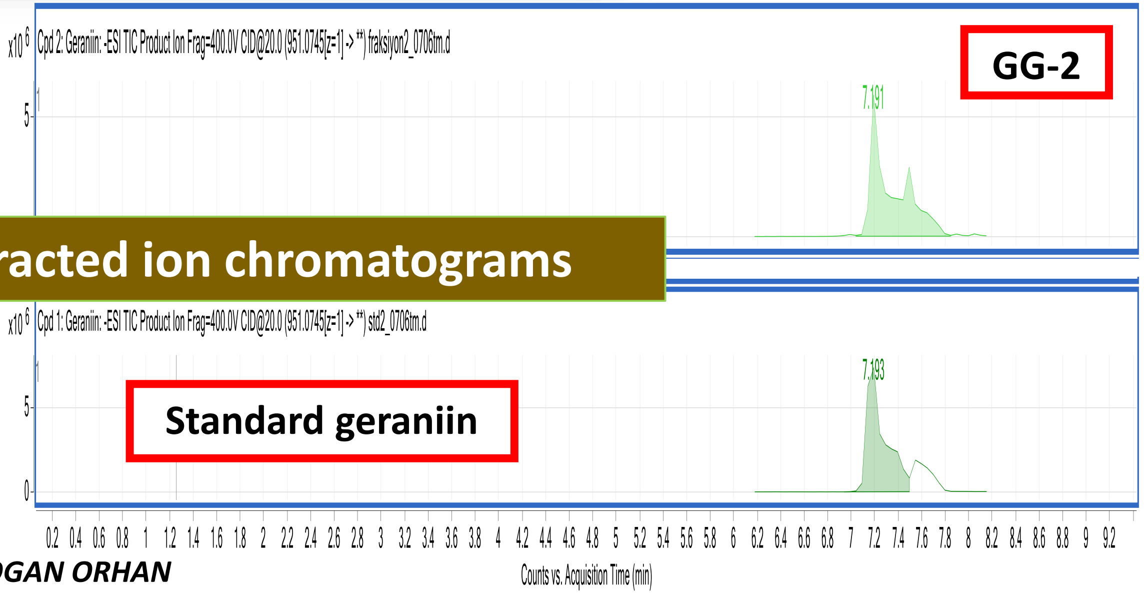
Fractionation by HPLC

GG-1	GG-2	GG-3	GG-4	GG-5	GG-6

The most active fraction

LC-Q-TOF analysis

Extracted ion chromatograms



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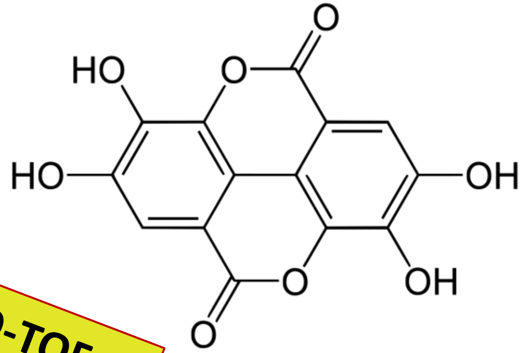
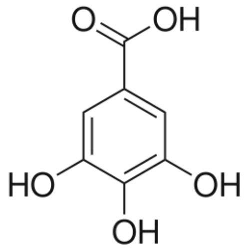
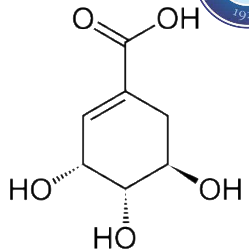
Fractions	Tyrosinase inhibition (Inhibition% ± S.D.)
GG-1	22,36 ± 2,14
GG-2	51,79 ± 3,84
GG-3	29,57 ± 2,45
GG-4	16,32 ± 0,37
GG-5	22,87 ± 3,87
GG-6	19,01 ± 1,89
α-Kojic acid[b]	90,10 ± 0,98

LC-Q-TOF analysis







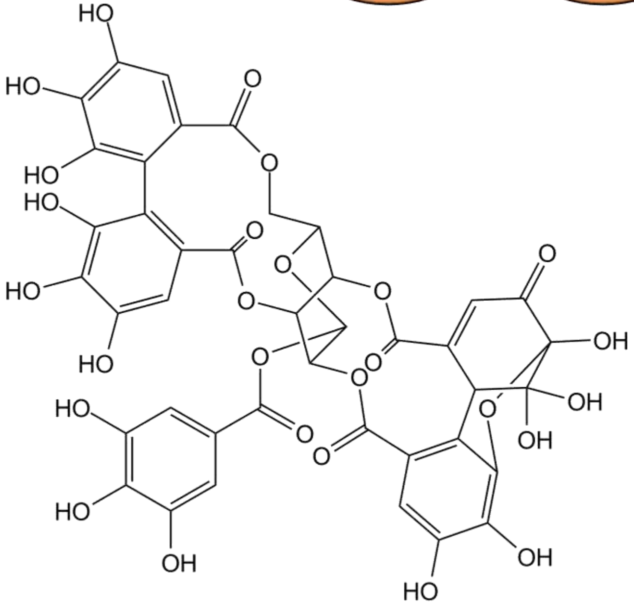
Elagic acid

Geraniin

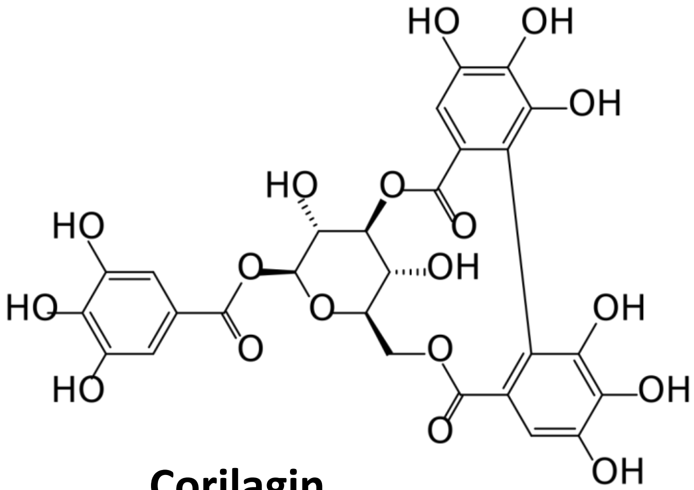
Corilagin

Gallic acid

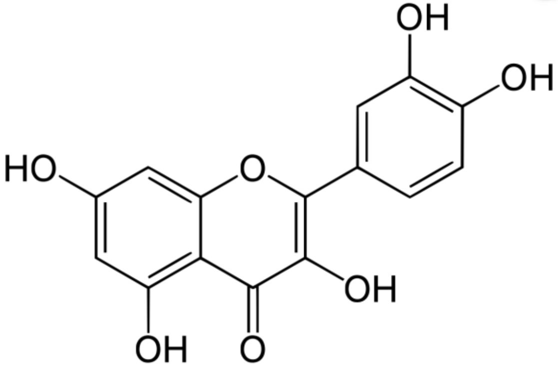
Quinic acid



Geraniin



Corilagin



Quercetin

(74.77 ± 0.26%)

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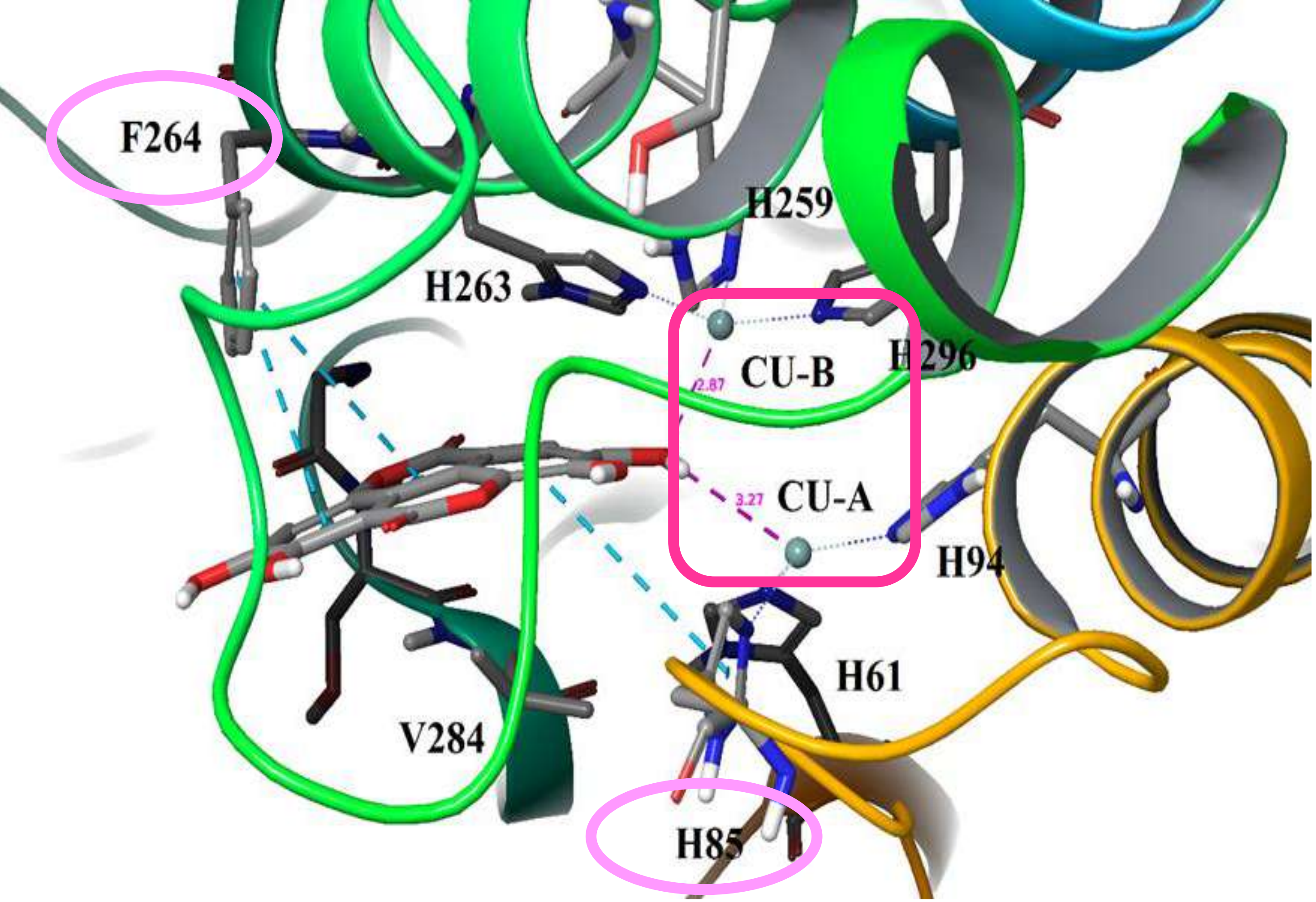
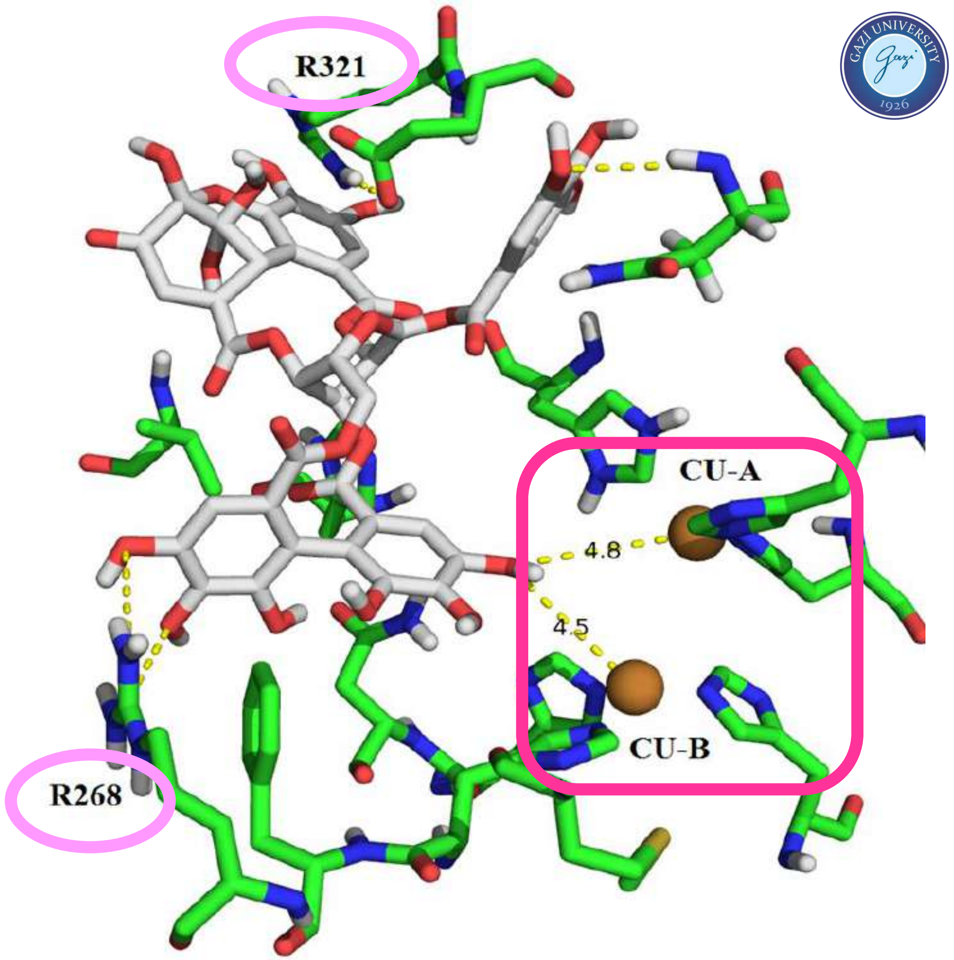


Elagic acid - tyrosinase interactions

- Aromatic π-π interactions with Phe264 and His85
- OH group – H bonding with CuA & CuB



Geraniin- tyrosinase interaction

- H bondings with Asn81, His85, Val248, Asn260, Arg268, Arg321 and Glu322
- OH group – H bonding with CuA & CuB - 4-5 Å
- Hydrophobic interactions with Val248, Phe264 and Glu322

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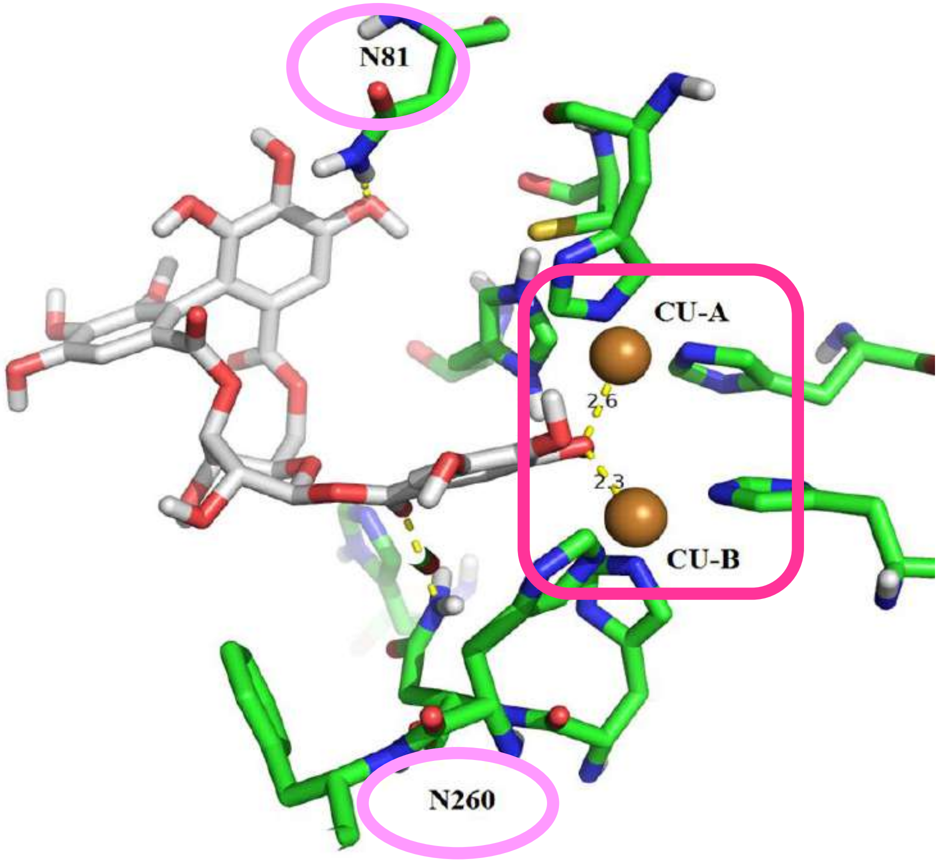
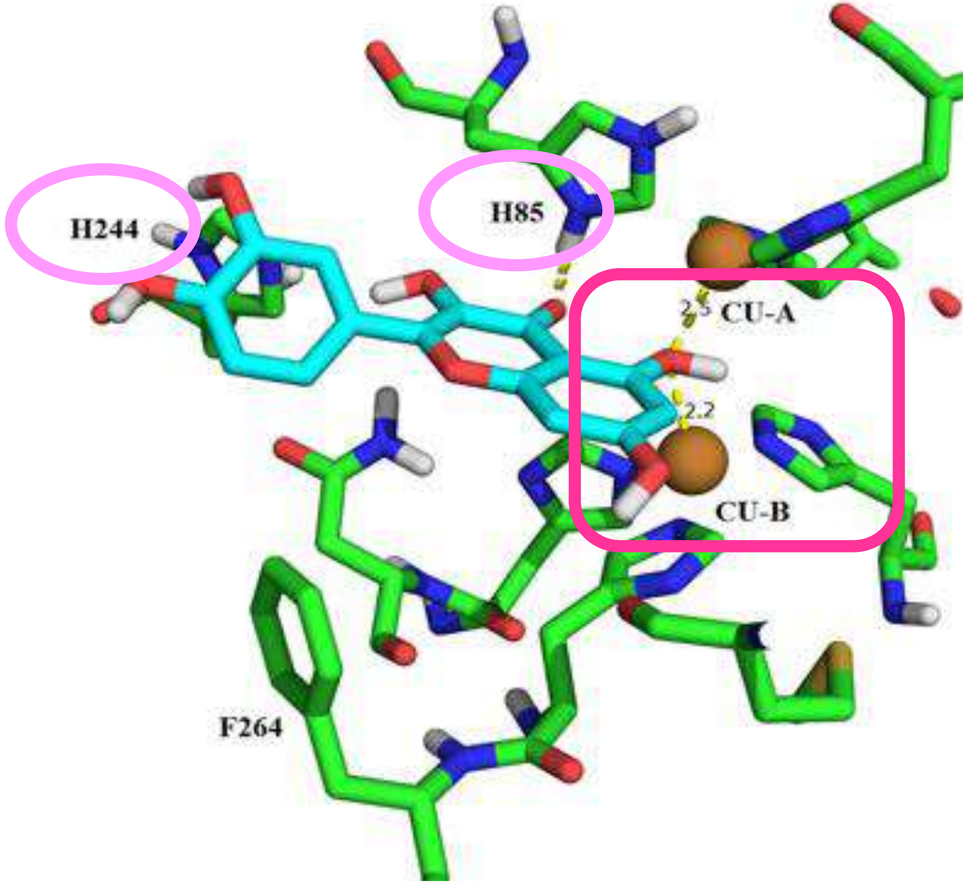


Corilagine- tyrosinase interaction

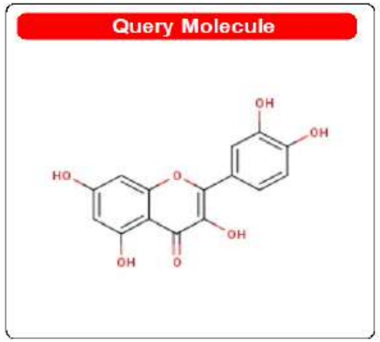
- H bondings with ASN81, Cys83, His85, Asn260 and Met280
- Ligation with CuA & CuB – less than 3 Å

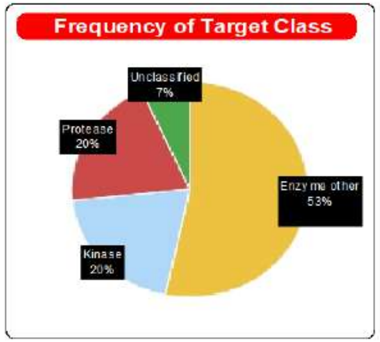


Quercetin- tyrosinase interaction

- H bondings with His85, His244, Asn260, Met280 and Ser282
- Ligation with CuA & CuB – less than 3 Å

Swiss Prediction Program



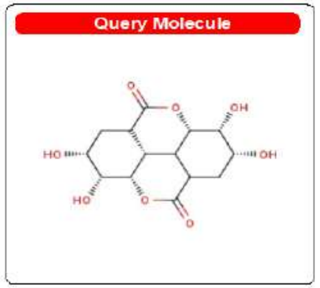


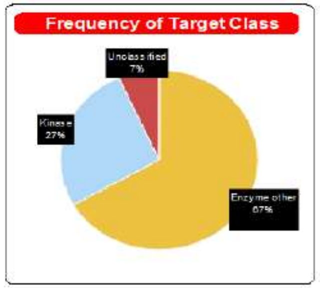
Target	Uniprot ID	Gene code	ChEMBL ID	Probability	# sim. cmpds (3D / 2D)	Target Class
Carbonic anhydrase 12	O43570	CA12	CHEMBL3242		3 / 5	Enzyme
Epidermal growth factor receptor	P00533	EGFR	CHEMBL203		6 / 28	Tyr Kinase
Carbonic anhydrase 1	P00915	CA1	CHEMBL261		10 / 7	Enzyme
Carbonic anhydrase 2	P00918	CA2	CHEMBL205		10 / 7	Enzyme
Phospholipase A2	P04054	PLA2G1B	CHEMBL4426		1 / 1	Enzyme
Receptor tyrosine-protein kinase erbB-2 (by homology)	P04626	ERBB2	CHEMBL1824		6 / 28	Tyr Kinase
Myeloperoxidase	P05164	MPO	CHEMBL2439		1 / 1	Enzyme
Cytochrome P450 1A2 (by homology)	P05177	CYP1A2	CHEMBL3356		8 / 13	Enzyme
Cyclin-dependent kinase 1	P06493	CDK1	CHEMBL308		3 / 27	Ser_Thr Kinase
Carbonic anhydrase 3	P07451	CA3	CHEMBL2885		10 / 7	Enzyme
Alpha-trypsin chain 1	P07477	PRSS1	CHEMBL209		1 / 2	Serine Protease
PEX	P08253	MMP2	CHEMBL333		5 / 2	Metallo Protease
Stromelysin-1	P08254	MMP3	CHEMBL283		3 / 2	Metallo Protease
Arachidonate 5-lipoxygenase	P09917	ALOX5	CHEMBL215		10 / 52	Enzyme
Microtubule-associated protein tau	P10636	MAPT	CHEMBL1293224		25 / 77	Unclassified

PASS Program

P_a [a]	P_i [b]	Biological activity
0,588	0,003	Skin whitener
0,538	0,003	Antioxidant
0,729	0,002	Astrengant
0,525	0,003	15-Lipoxigenase inhibitor
0,262	0,003	12-Lipoxigenase inhibitor
0,258	0,005	5-Lipoxigenase inhibitor
0,527	0,042	Oxygen scavenger
0,811	0,003	Free radical scavenger

Swiss Prediction Program





Target	Uniprot ID	Gene code	ChEMBL ID	Probability	# sim. cmpds (3D / 2D)	Target Class
Cytidine deaminase	P32320	CDA	CHEMBL4502		17 / 0	Enzyme
Thymidine kinase, cytosolic	P04183	TK1	CHEMBL2883		14 / 0	Enzyme
Adenosylhomocysteinase	P23526	AHCY	CHEMBL2664		50 / 0	Enzyme
Putative adenosylhomocysteinase 2 (by homology)	O43865	AHCYL1			48 / 0	Enzyme
Putative adenosylhomocysteinase 3 (by homology)	Q96HN2	AHCYL2			48 / 0	Enzyme
Adenosine deaminase	P00813	ADA	CHEMBL1910		11 / 0	Enzyme
Thymidine phosphorylase	P19971	TYMP	CHEMBL3106		1 / 0	Enzyme
Adenosine kinase	P55263	ADK	CHEMBL3589		41 / 0	Enzyme
Casein kinase II subunit alpha	P68400	CSNK2A1	CHEMBL3629		1 / 0	Ser_Thr Kinase
Dual specificity tyrosine-phosphorylation-regulated kinase 1A (by homology)	Q13627	DYRK1A	CHEMBL2292		1 / 0	Ser_Thr_Tyr Kinase
Casein kinase II subunit alpha' (by homology)	P19784	CSNK2A2	CHEMBL4070		1 / 0	Ser_Thr Kinase
Casein kinase II subunit alpha 3 (by homology)	Q8NEV1	CSNK2A3			1 / 0	Ser_Thr Kinase
Deoxycytidine kinase	P27707	DCK	CHEMBL2447		6 / 0	Enzyme
Deoxyguanosine kinase, mitochondrial (by homology)	Q16854	DGUOK	CHEMBL5997		6 / 0	Enzyme
Microtubule-associated protein tau	P10636	MAPT	CHEMBL1293224		13 / 0	Unclassified

PASS Program

P_a [a]	P_i [b]	Biological activity
0,265	0,014	Skin whitener
0,699	0,004	Antioxidant
0,680	0,009	Oxygene scavenger
0,596	0,006	Free radical scavenger
0,556	0,009	Pankreatic elastase inhibitor
0,332	0,009	Melanin inhibitor
0,507	0,012	Non-steroidal anti-inflammatuary

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Faz	Bileşen	% (w/w)
A	Aqua	62,25
A	Carbomer	0,40
A	Microcare[a]	1,00
A	Glycerin	5,00
A	Dimethicone	2,00
B	Butyrospermum parkii butter	4,00
B	Glyceril stearate	3,75
B	Stearyl alcohol	4,00
B	Tocopheryl acetate	0,50
B	Suncat[b]	3,00
B	Polysorbate20	4,00
B	Simmondsia chinensis seed oil	2,00
C	Orgasol nylon[c]	4,00
C	*Geranium glaberrimum* EtOH extract	2,00
C	Olea europaea fruit oil	1,00
C	Valvance Look 100[d]	0,50
C	Perfume	0,30
	Total	100,00

TÜRK PATENT

PATENT BAŞVURU FORMU P201

1. BAŞVURU BİLGİSİ

Başvuru Şekli/Ana Başvuru Numarası	Yeni Başvuru
Erken Yayın Talebi	Var
Buluş Başlığı	LEKE AÇICI BİTKİSEL KOZMETİK FORMÜLASYONU
Türkçe Çeviri Süre Talebi	Yok
Referans No	
Patent Sınıfı	A61K,
Tarifname Dili	TUR
Tarifname	5 Sayfa
İstem	9 Adet
Özet	1 Sayfa
Resim	1 Sayfa
Genetik Kaynak	HAYIR
Kamu Desteği	HAYIR

Skin-bleaching cream formulation

2. BAŞVURU SAHİBİ

Adı-Soyadı/Unvanı	GAZİ ÜNİVERSİTESİ		
Adres	Gazi Üniversitesi Rektörlüğü Teknikokullar Ankara TÜRKİYE		
Uyruğu	TÜRKİYE	**Sahip Türü**	Tüzel
TC Kimlik/Vergi Numarası	3890038275	**Sahip Profili**	Üniversite
TPE Sahip Numarası	5186535		

3. BULUŞ SAHİBİ

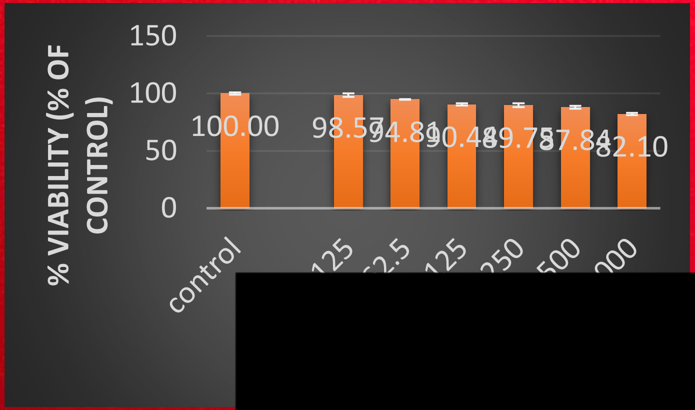
Adı-Soyadı	İLKAY ERDOĞAN ORHAN
Adres	Gazi Üniversitesi Eczacılık Fakültesi Farmasötik Kognozi Abd 06330 Etiler TÜRKİYE

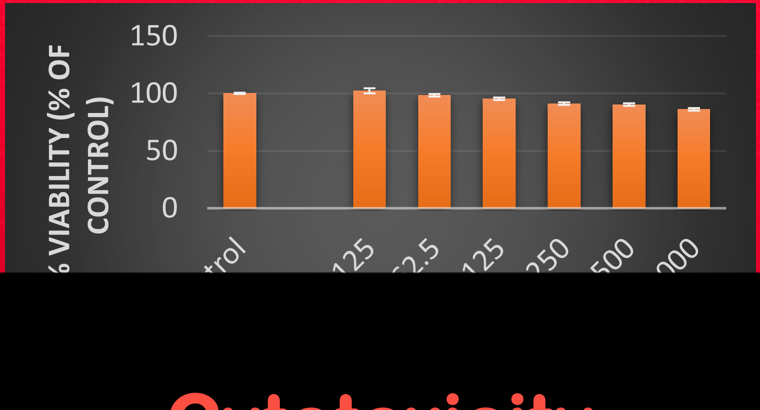
Active Extracts for Skin Aging

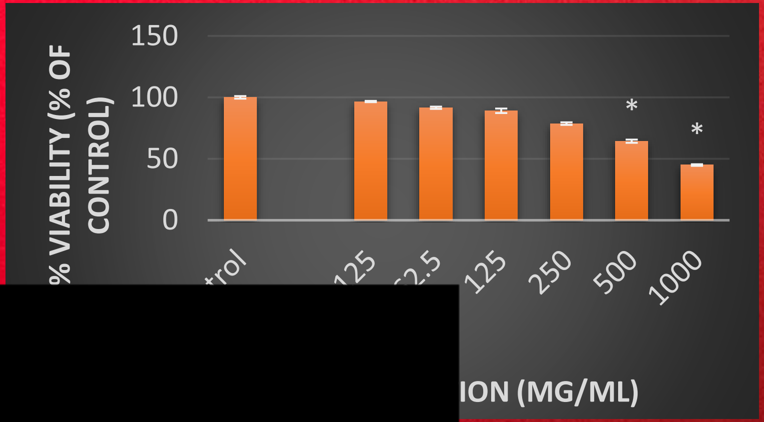
Plant	Part	Tyrosinase	Elastase	Collagenase
Cotinus coggyria	Pedicel	61.97 ± 1.80	3.01 ± 1.18	55.30 ± 4.68
	Leaf	64.43 ± 2.80	51.76 ± 2.33	-
Pistacia vera	Pericarpium	6.75 ± 1.92	64.33 ± 1.83	50.33 ± 4.68
Garcinia mangostana	Pericarpium	52.55 ± 0.40	36.50 ± 3.43	52.99 ± 2.63
Vitis vinifera	Seed	27.70 ± 2.55	70.74 ± 1.19	59.79 ± 2.88




Viability of fibroblast using MTT assay





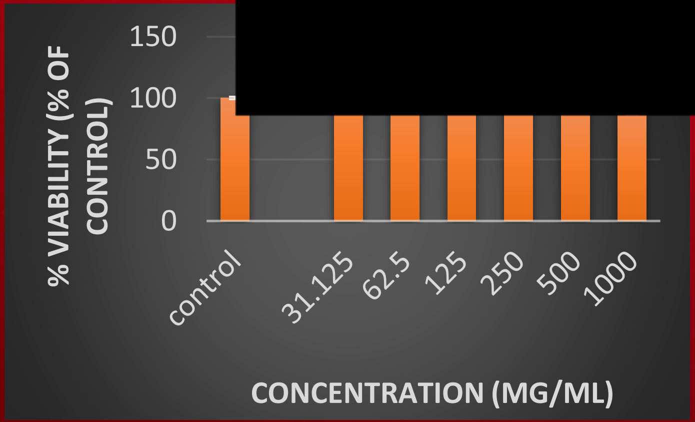


Cotinus cc

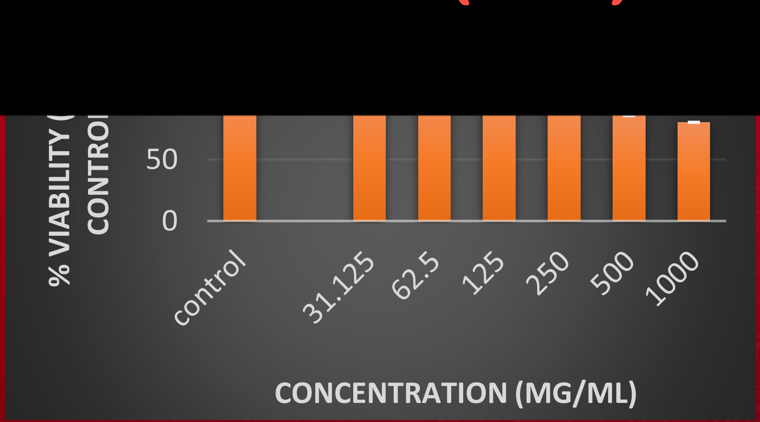
pium extract

Cytotoxicity

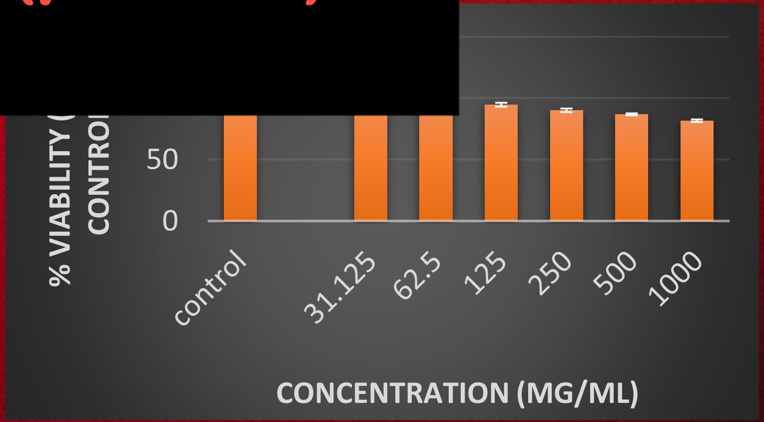
PV > GM ≈ VV≈ PL ≈ CC (leaf) ≈ CC (pedicel)



Garcinia mangostana pericarpium extract



Vitis vinifera seed extract



Propolis extract

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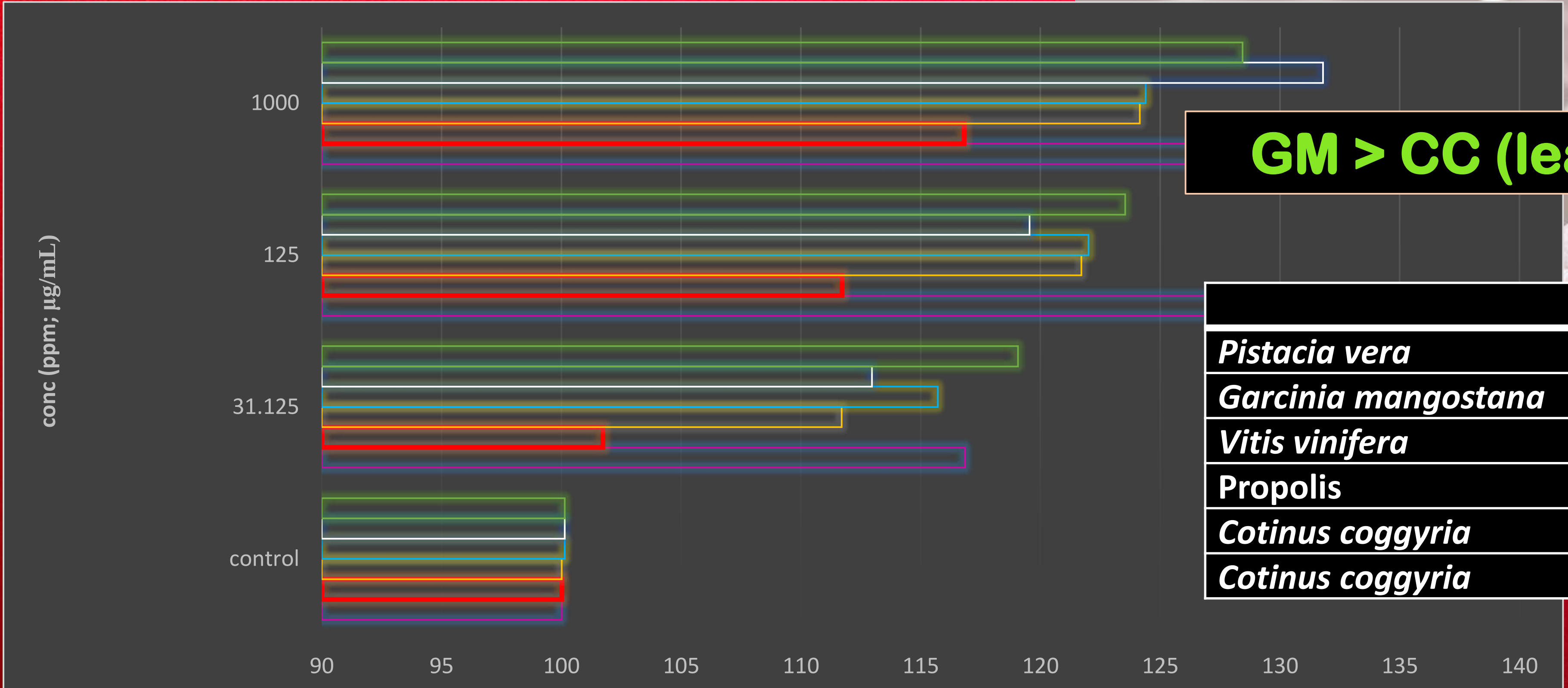
Collagen content using fibroblast & colorimetric method



	control	31.125	125	1000
CC(Folium)	100.1431008	119.0694934	123.5403817	128.4435477
CC(pedi)	100.1431008	112.9688799	119.5509874	131.8021707
PL	100.1431008	115.7220332	122.0089789	124.3875833
Vv	100.018243	111.7034746	121.7105225	124.1455956
PV (31.125, 125, 250 ppm)	100.018243	101.7349909	111.7209662	116.8130791
GM	100.018243	116.8587855	127.7277226	136.7555962

Collagen content (% of control)

GM > CC (leaf) ≈ CC (pedicel) > PL

		Tested conc.
Pistacia vera	PV	0-250 ppm
Garcinia mangostana	GM	0-1000 ppm
Vitis vinifera	Vv	
Propolis	PL	
Cotinus coggyria	CC (leaf)	
Cotinus coggyria	CC (pedicel)	

PV can enhance collagen synthesis in fibroblasts, however, the concentrations used was limited due to its cytotoxicity at high concentrations (greater than 500 ppm).

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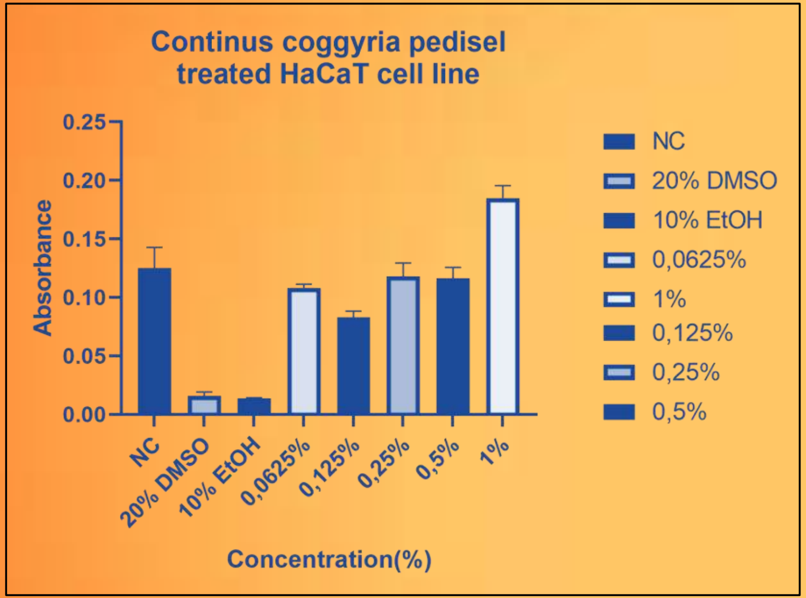
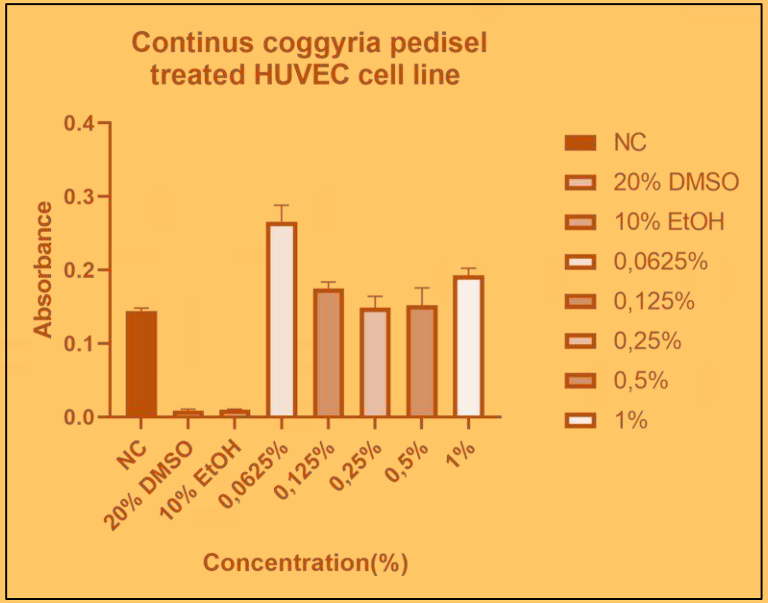
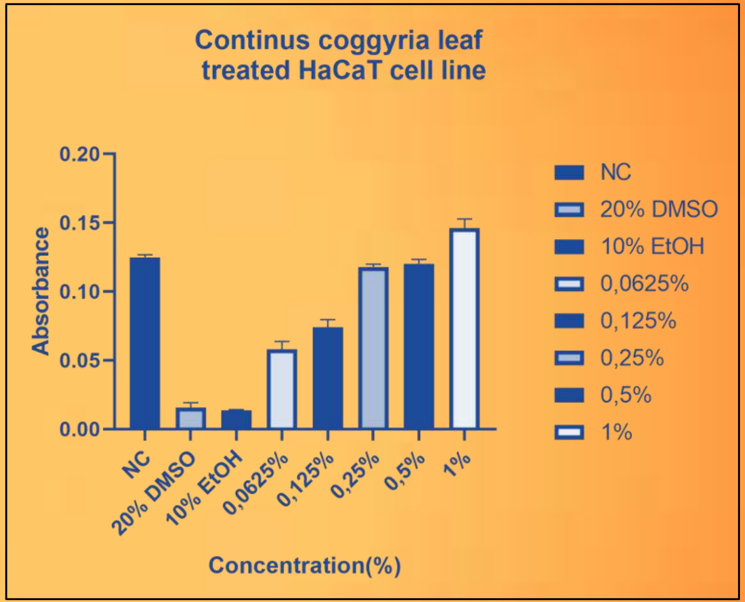
Cell culture studies





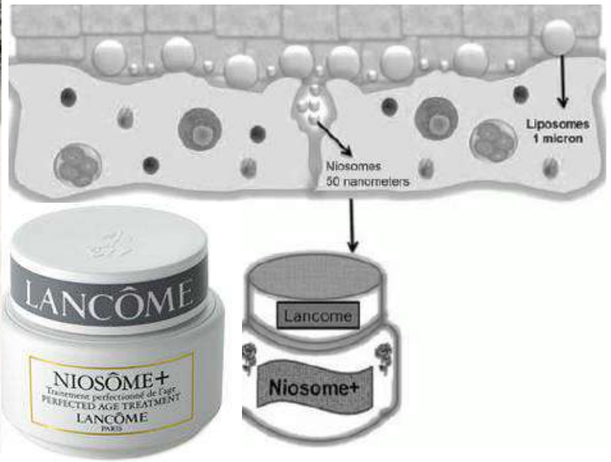


Niosome formulations

Extract	Dry extract	Niosomes
Garcinia mangostana (pericarp) EtOH extract	5,8940 g	Yes
Pistacia vera (pericarp) EtOH extract	3,0245 g	Yes
Vitis vinifera (semen) EtOh extract	1,5304 g	Yes
Propolis	5,1838 g	Yes
Cotinus coggyria (pedicel) EtOH extract	5,0370 g	Yes
Cotinu coggyria (folium) EtOH extract	5,1697 g	Yes
Niosome control formulation		Yes

NIOSOME FORMULATIONS

using Span 80 and cholesterol



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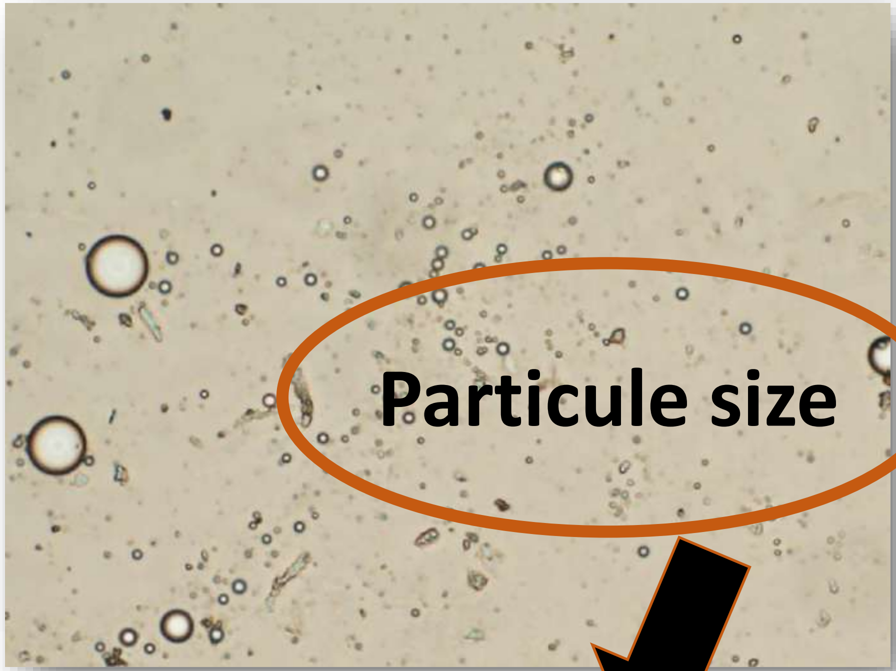
Niosome formulations



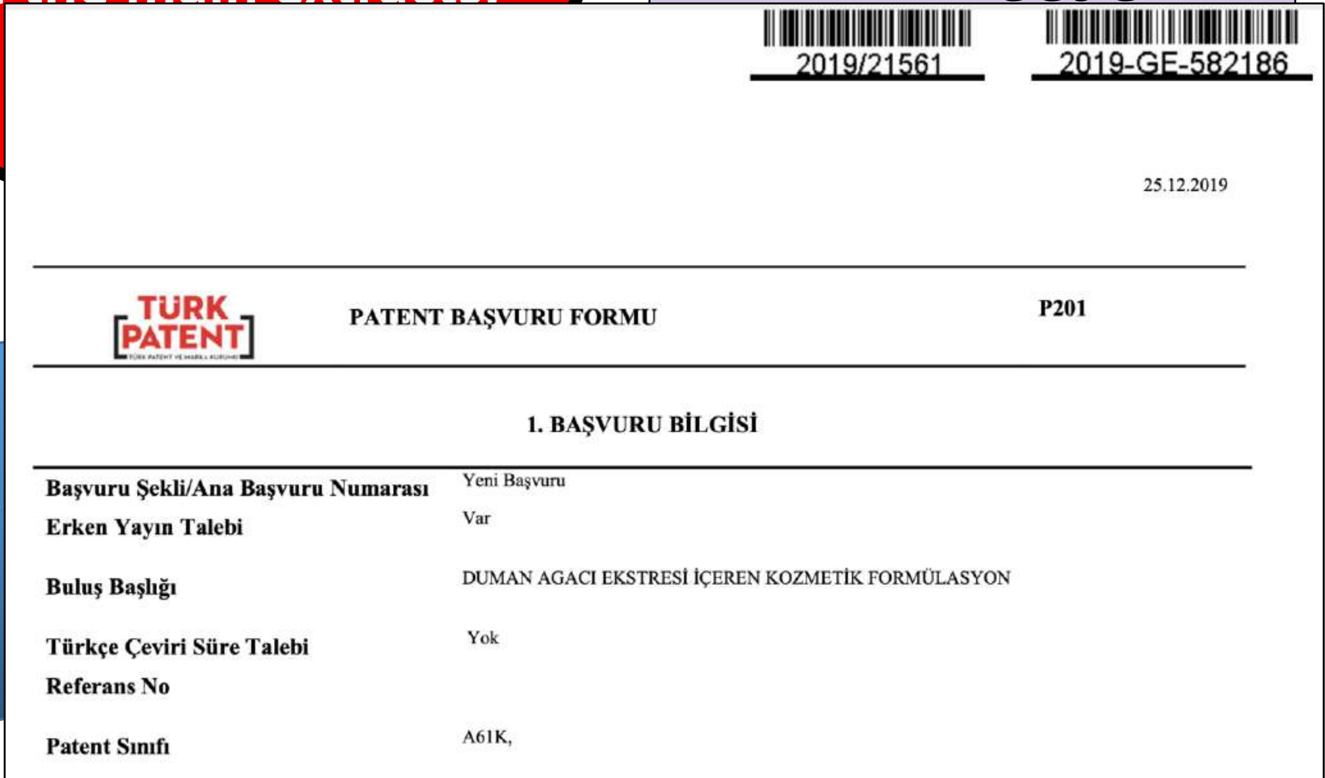
Malvern particle size analyzer

Inhibition against collagenase, elastase, and tyrosinase was lower than the main extracts.

adsi
Austrian Drug Screening Institute

Anti-aging emulgel formulation with *Cotinus coggygria*

NAN



2019/21561 2019-GE-582186

25.12.2019

TÜRK PATENT

PATENT BAŞVURU FORMU P201

1. BAŞVURU BİLGİSİ

Başvuru Şekli/Ana Başvuru Numarası	Yeni Başvuru
Erken Yayın Talebi	Var
Buluş Başlığı	DUMAN AGACI EKSTRESİ İÇEREN KOZMETİK FORMÜLASYON
Türkçe Çeviri Süre Talebi	Yok
Referans No	
Patent Sınıfı	A61K,

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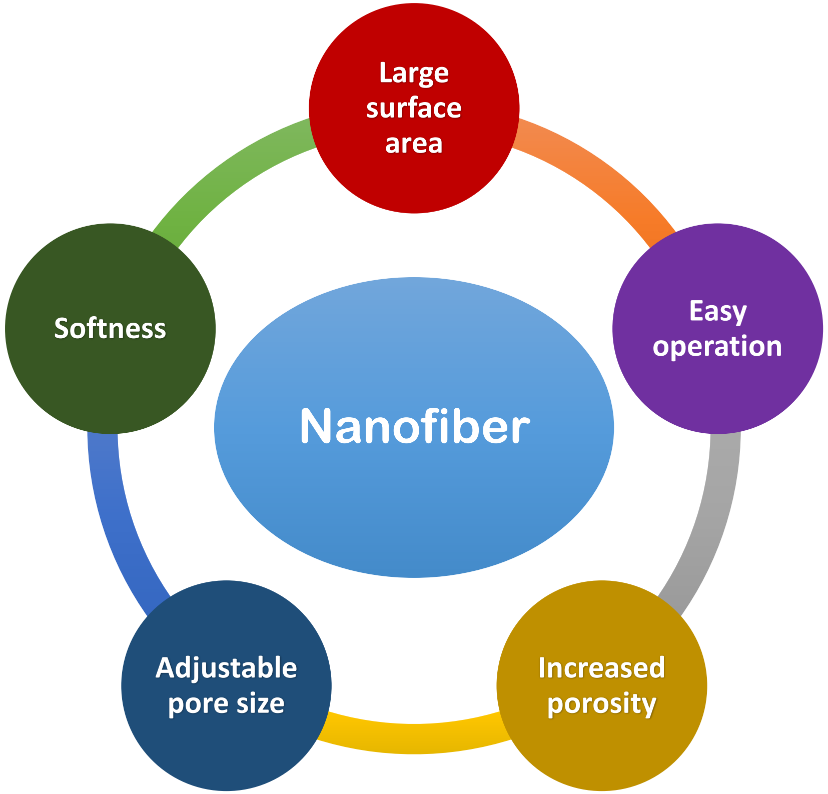
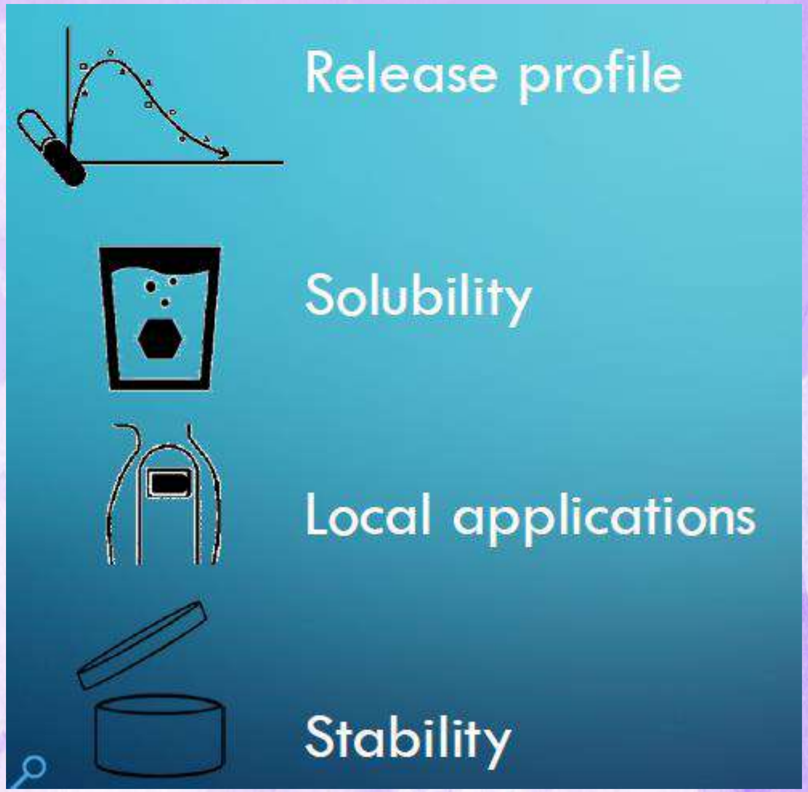
Nanofibers

Nanofibers have gained significant attention recently due to its wide applications in pharmaceutical area.

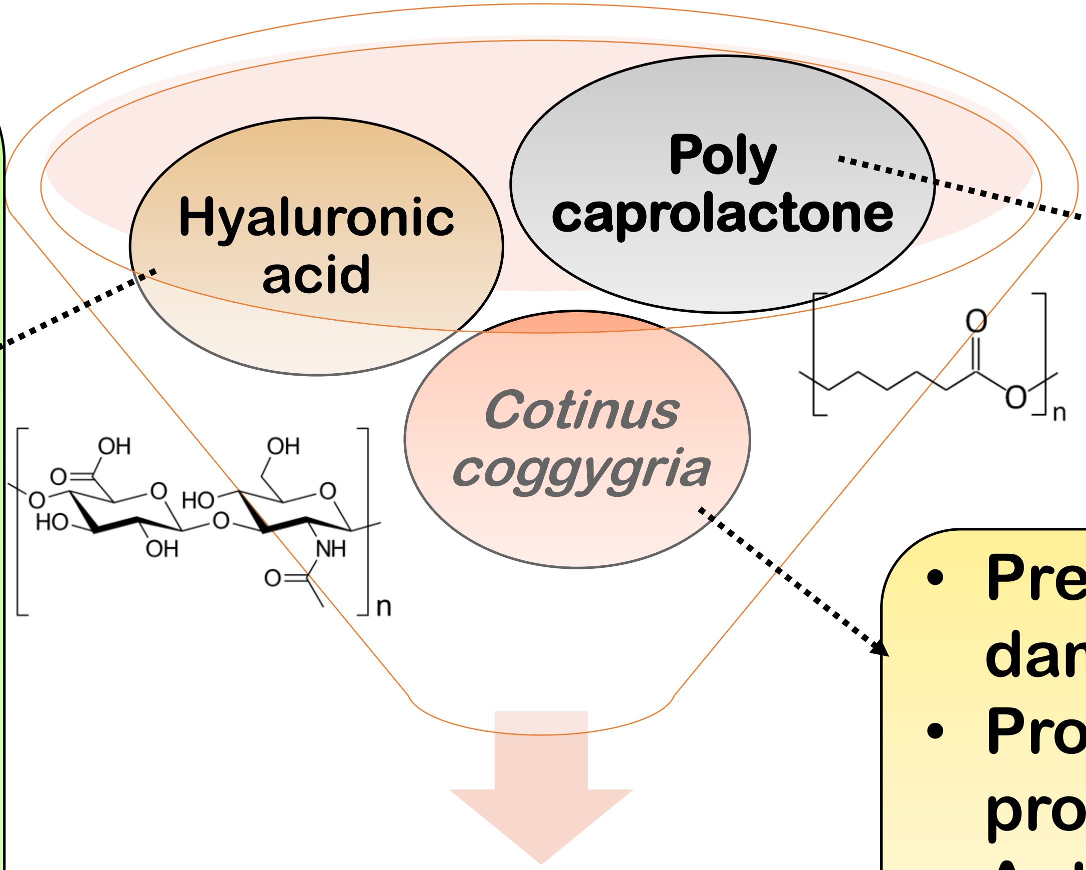




Thakkar, S., & Misra, M. (2017). Electrospun polymeric nanofibers: New horizons in drug delivery. European Journal of Pharmaceutical Sciences, 107, 148-167.

Nanofiber-Based Wound Dressing Formulation

- Fast wound healing
- Regulates inflammation levels
- Provides more vessels in the damaged area
- Reduces pain

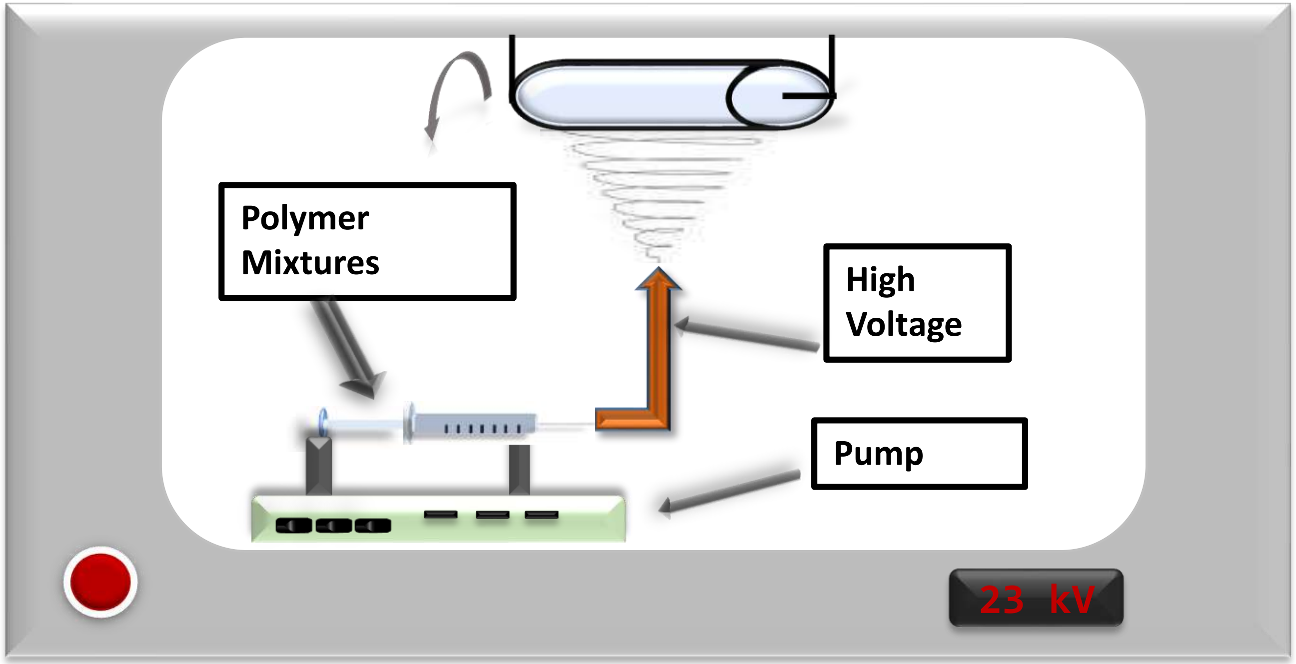


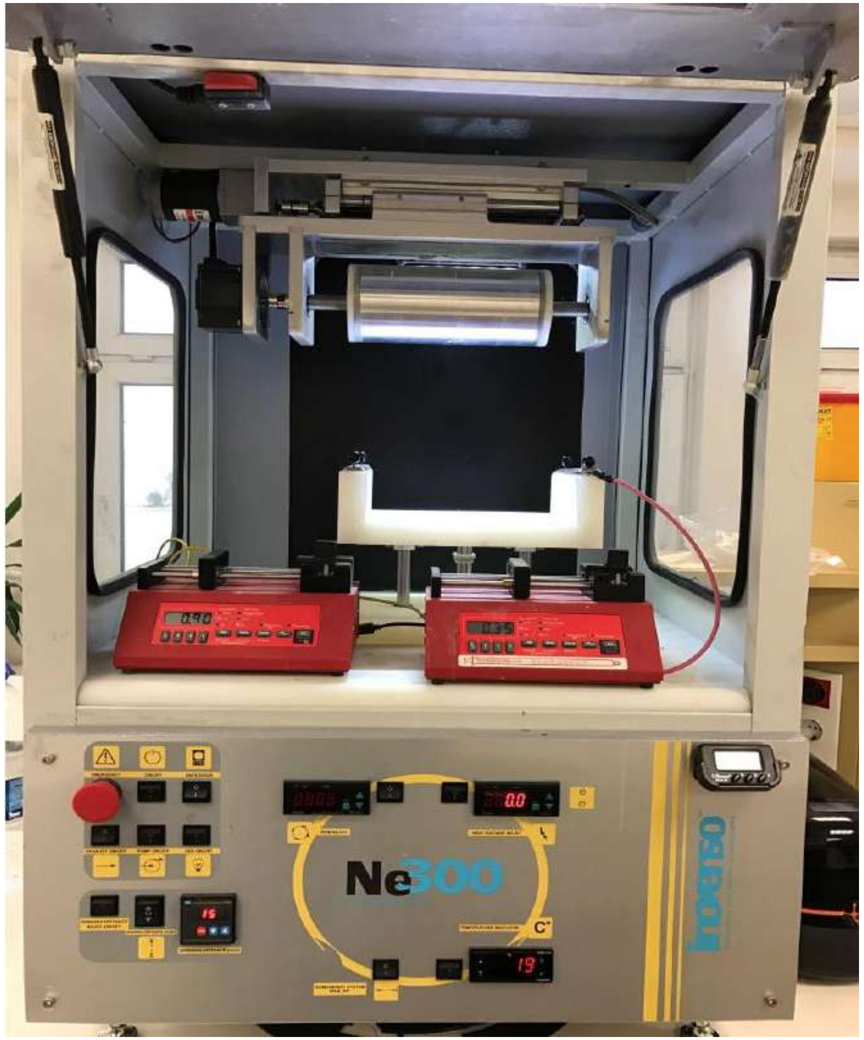
- Excellent mechanical strength
- Limits inflammation
- Biocompatible

- Prevents oxidative damage
- Promote the healing process
- Anti-inflammatory activity

Ideal wound dressing

Preparation of nanofiber formulations

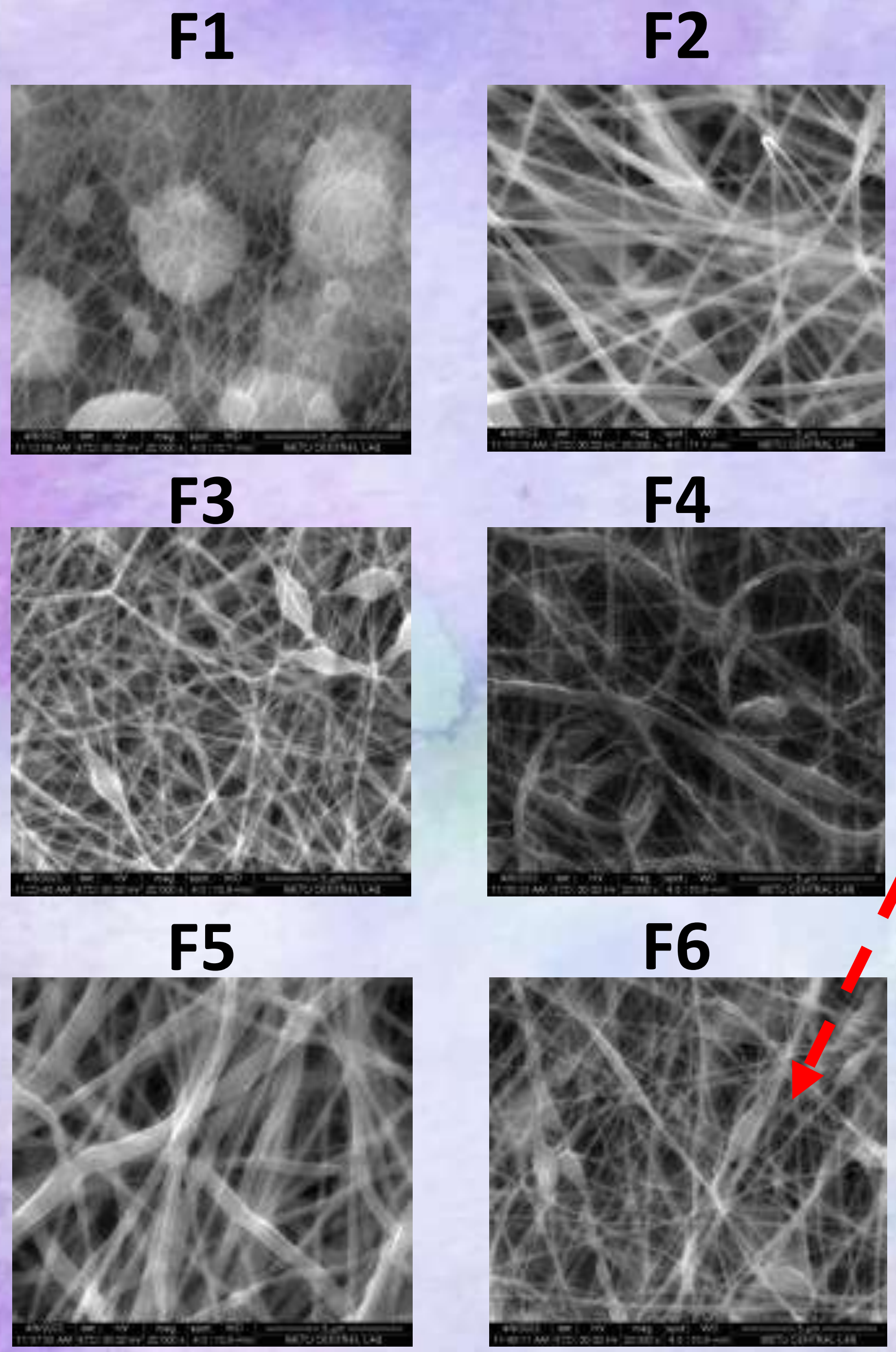




	Polycaprolactone (%)	Hyaluronic acid (%)	*Cotinus coggygria (%)*	Electrospinning parameters
F1	10	-	-	10 cm, 23 kV, 1 mL/h
F2	10	0,5	-	10 cm, 23 kV, 1 mL/h
F3	10	-	1	12 cm, 23 kV, 0,8 mL/h
F4	10	-	3	12 cm, 23 kV, 0,8 mL/h
F5	10	0,5	1	12 cm, 23 kV, 0,8 mL/h
F6	10	0,5	3	12 cm, 23 kV, 0,8 mL/h

Inovenso – NE300

Solvent system: *Chloroform/DMF (5:5) or Chloroform/DMF/water (5:4:1)*

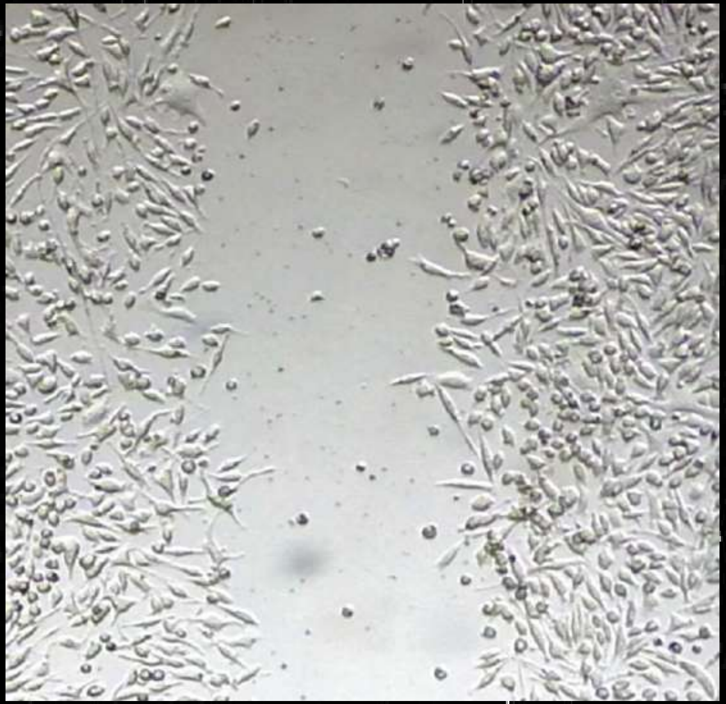


Pre-Formulation

- Beadless nanofiber surface
- High *Cotinus coggygria* content
- Porous structure

Ongoing studies

- Cell culture
- Wound streching
- Cell proliferation imaging
- Patent application



Herbal Antimicrobial Mouth Spray Developed under University-Industry Collaboration

- **Patients suffering from oral and dental diseases, consumers who want to protect their oral health against microbial attacks are the target group.**

- **It is a combined formulation**
- **Registered as medical device by Ministry of Health**
- **Ownership Gazi University**

Active ingredients including the essential oils of

- ***Salvia fruticosa* Mill. (Anatolian sage)**
- ***Eucalyptus camaldulensis* Dehn. (eucalyptus)**
- ***Origanum majorana* L. (marjoram)**
- ***Matricaria chamomilla* L. (German chamomile), and**
- ***Citrus lemon* (L.) Osbeck (lemon)**
- **as well as propolis extract and**
- **sweet almond oil (*Prunus) amygdali* var. *dulci* Oleum) as carrier.**

ePATS TÜRK PATENT VE MARKA KURUMU Elektronik Başvuru Sistemi

PATENT BAŞVURUSU

Tahakkuk No	634089	**Başvuru Numarası**	2020/22177
Evrak Numarası	2020-GE-716744	**Evrak Tarihi**	2020-12-29 12:24:19
Erken Yayın Talebi	Hayır, başvurum 18 aylık süre dolduktan sonra yayımlansın.	**Başvuru ile Birlikte Araştırma/ İnceleme Talebi**	Araştırma
Tarifname Dili	Türkçe	**Genetik Kaynak**	Hayır
Tarifname Sayfa Sayısı	4	**Kaynağın / Bilginin Coğrafi Kökeni**	-
İstem Sayısı	15	**Kamu Desteği**	Hayır
Resim Sayfa Sayısı	-	**Destek Sağlayan Kamu Kurumu**	-
Patent Yarışmasına Katılmak İstiyorum	Hayır		
		Proje Numarası	-
Patent Sınıfı	A61K		
Referans No			

BULUŞ BAŞLIĞI / ÖZETİ

Buluş Başlığı	UÇUCU YAĞ VE PROPOLİS İÇEREN FORMÜLASYON
Buluş Özeti	Mevcut buluş, oral sprey solüsyon formunda, Salvia fruticosa Mill. (Anadolu adaçayı) Uçucu Yağı, Eucalyptus camaldulensis Dehn. (Ökaliptus) Uçucu Yağı, Origanum majorana L. (Mercanköşk) Uçucu Yağı, Matricaria chamomilla L. (Alman papatyası) Uçucu Yağı, Citrus limon (L.) Osbeck (Limon) Uçucu Yağı, Propolis Ekstresi ve taşıyıcı olarak Pruni Amygdali var. Dulci Oleum (Tatlı Badem Yağı) içeren kompozisyonlar, bu kompozisyonların hazırlanması ve kullanımı ile ilgilidir.

BAŞVURU SAHİPLERİ

Ad Soyad/Unvan	GAZİ ÜNİVERSİTESİ REKTÖRLÜĞÜ		
TC Kimlik/Vergi No	8150346288	**Sahip Türü**	Tüzel
Uyruk	TÜRKİYE	**Başvuru Hak Oranı**	
Telefon	3122022023	**E-Posta**	ozgeeken@gazi.edu.tr
Adres	EMNİYET MAH.BANDIRMA CAD. REKTÖRLÜK BİNASI6 /1 YENİMAHALLE ANKARA TÜRKİYE		

BULUŞ SAHİPLERİ

Ad Soyad/Unvan	İLKAY ERDOĞAN ORHAN		
TC Kimlik/Vergi No	27794131116	**Gizlilik Beyanı**	Hayır
Uyruk	TÜRKİYE	**Başvuru Hakkı Beyanı**	Hizmet İlişkisi
Telefon	5326458543	**E-Posta**	iorhan@gazi.edu.tr

ILKAY ERDOGAN ORHAN

Patents obtained by our team

1. Invention titled "Kojic Acid-Derived Mannich Bases with Biological Effect" **Turkish Patent** (TR2015 07653 (Registration date: 21.11.2017)
2. Invention titled "Kojic Acid-Derived Mannich Bases with Biological Effect" **US Patent** (US 9,975,884 B2) (Registration date: 22.05.2017)
3. Invention titled "Kojic Acid-Derived Mannich Bases with Biological Effect" **European Patent** (EP 16 732 363.3) (Registration date: 14.03.2019)

Patent applications by our team

1. Invention titled "Skin-Bleaching Herbal Cosmetic Formulation" **Turkish Patent** (Application date: 19.12.2019)
2. Invention titled "Cosmetic Formulation with Smoke Tree Extract" **Turkish Patent** (Application date: 25.12.2019)
3. Invention titled "Red Californian Worm Extract and Its Use" **Turkish Patent** (Application date: 26.12.2019)
4. Invention titled "Propagation and Ossification Medium for Dental Pulp Mesenchymal Stem Cells" **Turkish Patent** (Application date: 26.12.2019)
5. Invention titled "Mouth Care Spray Formulation Consisting of Essential Oils and Propolis" **Turkish Patent** (Application date: 26.11.2020) & International Patent (Application date: 2022)
6. **Invention titled "A Formulation Comprising an Essential Oil and Propolis" PCT application (Application date: 26.11.2021, PCT application no: PCT/TR2021/051300)**

Our lab team

ILKAY ERDOGAN ORHAN

Acknowledgement

- Prof. Dr. Günther Bonn
- Dr. Thomas Jakschitz

adsi Austrian Drug Screening Institute

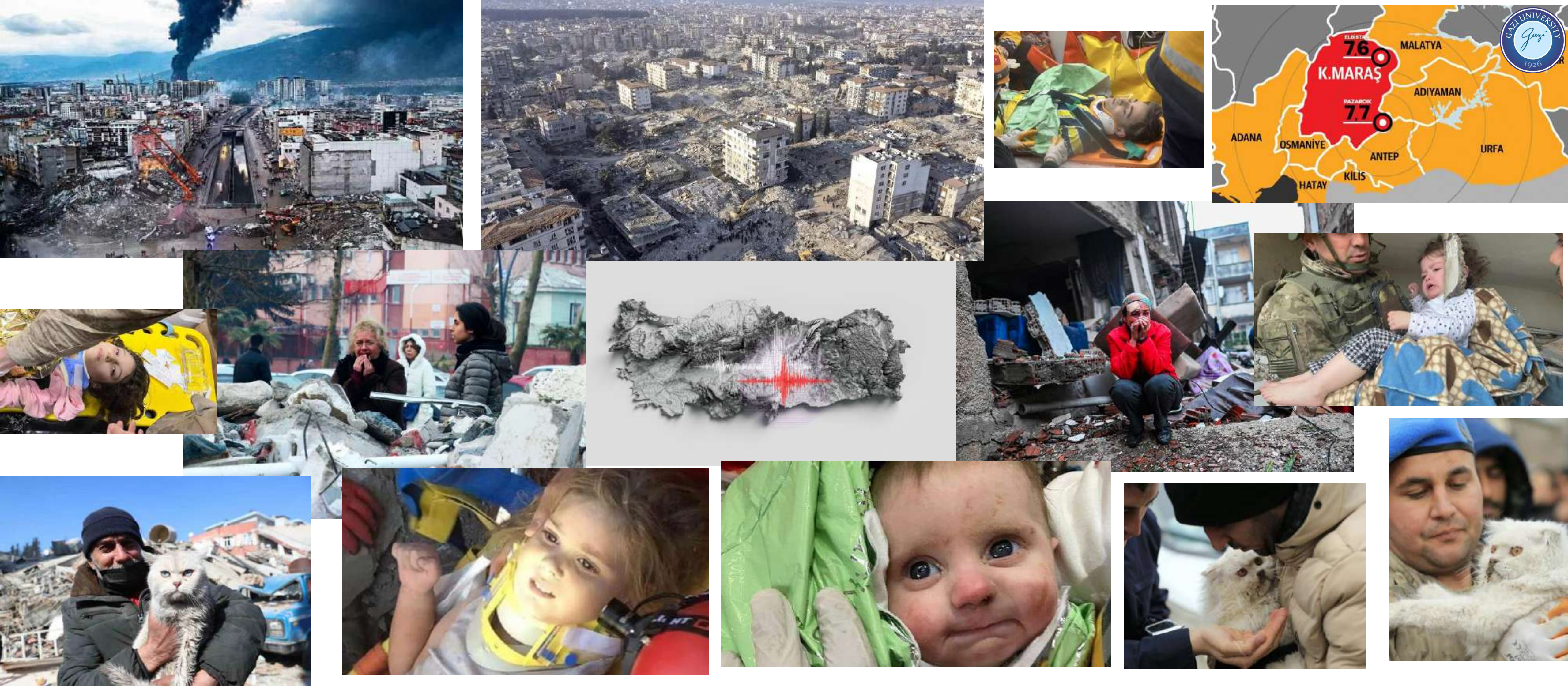
- Assist. Prof. Khaetthareeya Sutthanut

Faculty of Pharmaceutical Sciences
Khon Kaen University, Thailand

- Dr. Çağla Bozkurt Güzel

Dept of Pharmaceutical Microbiology
Faculty of Pharmacy, Istanbul University

- Dr. T. Emre Yalçın & Dr. Serdar Tort,
- Dept of Pharmaceutical Technology, Faculty of Pharmacy, Gazi University, Ankara, Türkiye



Dedicated to my deceased pharmacist colleagues and all Turkish citizens who lost their lifes in two massive earthquakes on February 6th, 2023.

ILKAY ERDOGAN ORHAN

Gazi University main campus, Ankara, Türkiye
www.gazi.edu.tr

ILKAY ERDOGAN ORHAN

THE MONTREAL PROTOCOL AND THE OZONE DEPLETING SUBSTANCES PHASE-OUT: IMPACT ON HUMAN, PLANTS AND ENVIRONMENT

MOHAMMED BESRI[1] AND ABDELHAFID LAHLAIDI[2] FIAS

[1] *Emeritus Professor, Hassan II Institute of Agronomy and Veterinary medicine, UNEP-MBTOC member, Morocco*

[2] *Vice President, IAS and Emeritus Professor, Faculty of Medicine, Morocco*

ABSTRACT

The ozone layer resides in the stratosphere, surrounds the entire Earth and absorbs sun radiations. As a result, the amount of UV-B reaching Earth's surface is greatly reduced. Prolonged exposure to UV-B can have serious effects on human health, on plants, on Phytoplankton and on environment including climate change. On September 16, 1987, governments around the world agreed on the Montreal Protocol (MP) on Ozone Depleting Substances (ODSs) that deplete the ozone layer (CFCs, HCFCs, HBFCs, halons, carbon tetrachloride, and methyl chloroform). Methyl bromide (MB) was later classified as an ODS under the Copenhagen Amendment of the MP in 1992. The MP has been ratified by 197 parties (196 states and the European Union), making it the first universally ratified treaty in United Nations' history. A global phase-out schedule of the ODSs was established by the MP. To phase-out the ODSs, the MP has developed a strategy including the establishment of 5 Technical Option Committees (TOC): Foams TOC, Halons TOC, Medical and Chemical TOC, Refrigeration TOC, and Methyl Bromide TOC. TOCs identify existing and potential alternatives to the ODSs, provide recommendations and advices to the Parties on the technical and economic feasibility of the alternatives. Some TOCs e.g. MBTOC have also the task of evaluating the Critical Use Nominations submitted. Without the Protocol, the destruction of the ozone layer would have continued, thus increasing the impact of UV-B radiation on humans, the environment, and climate change. The ozone hole is slowly recovering, and it is expected that the ozone layer will return to 1980 levels between 2050 and 2070. This will be the first time in history that humankind has reversed an environmental problem of such magnitude. The MP is considered as one of the most successful and effective environmental treaties ever negotiated and implemented. About 70 synthetic highly toxic pesticides to humans and to environment have already been banned in developed countries but, unfortunately, continue to be used in many developing countries, including the Islamic ones. Therefore, an Islamic agreement and an action plan are needed to reduce and then completely phase out these toxic synthetic pesticides in the Islamic world. Many lessons can be learned from the MP.

UNESCO Chair on Medicinal and
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University of Karachi
Karachi, Pakistan

PCMD

United Nations
Educational, Scientific and
Cultural Organization

24th INTERNATIONAL SCIENTIFIC CONFERENCE ON *"CHALLENGES TO PROMOTE SCIENCE & TECHNOLOGY FOR SOCIO-ECONOMIC DEVELOPMENT IN OIC COUNTRIES"*

MARCH 7 – 8, 2023, KARACHI, PAKISTAN.

ISLAMIC WORLD ACADEMY OF SCIENCES
اكاديمية العالم الإسلامي للعلوم
L'ACADÉMIE DES SCIENCES DU MONDE ISLAMIQUE
Founded as the Islamic Academy of Sciences, Amman, Jordan, 1986

The Montreal Protocol and the Ozone Depleting Substances Phase-out : Impact on Human, Plants and Environment

Mohammed Besri , Emeritus Professor, Member of the UNEP-MBTOC committee
Abdelhafid lahlaidi; Emeritus Professor, Vice President of IAS

Introduction 1/2

- The ozone layer acts like a shell or a solar cream protecting man and his environment from the harmful effects of sun UV-B rays.
- Prolonged exposure to UV-B can have serious effects on human health, on plants, on Phytoplankton and on environment including climate change
- A wide range of man-made gases is responsible for ozone depletion . On September 16, 1987, governments around the world agreed on the Montreal Protocol (MP) to phase out Ozone Depleting Substances (ODSs): CFCs, HCFCs, HBFCs, halons , carbon tetrachloride, methyl chloroform and Methyl bromide .

Introduction 2/2

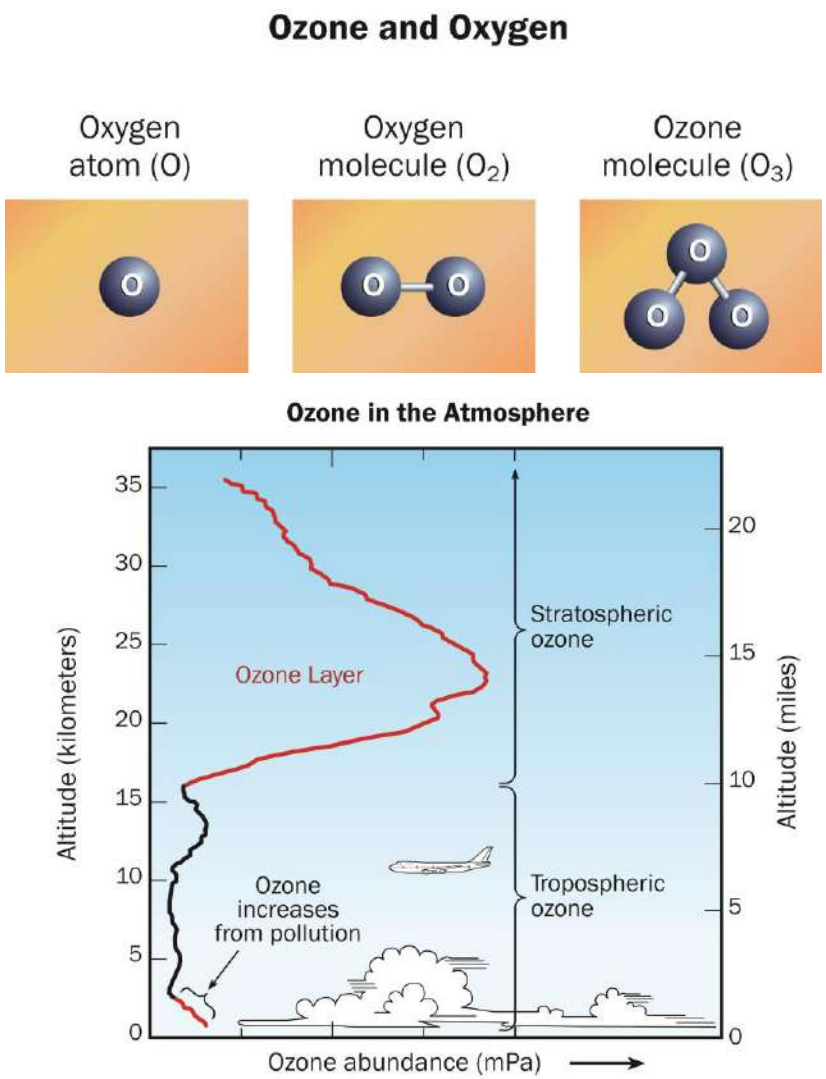
This conference will address the following points :

1. Ozone and ozone layer
2. Human contribution to ozone depletion
3. Consequences of ozone depletion on :
   a. Human health
   b. Plants
   c. Environment: marine ecosystems, climate change
4. The Montreal Protocol and the ODSs phase out
5. Example: Methyl bromide phase out
6. The Montreal Protocol successes

THE OZONE , THE OZONE LAYER AND THE OZONE DEPLETION

The ozone and ozone layer

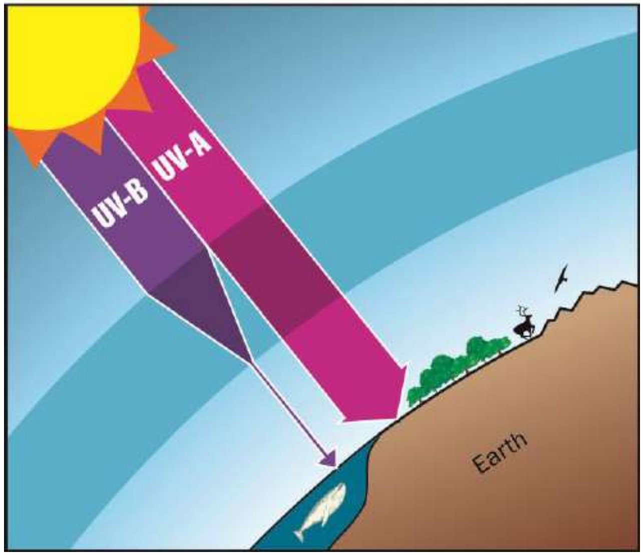
- Ozone: a molecule with 3 oxygen atoms;
- Most ozone resides in the stratospheric ozone layer (more than 15 kilometers above Earth's surface) and surrounds the entire Earth
- The concentration of ozone varies with altitude.

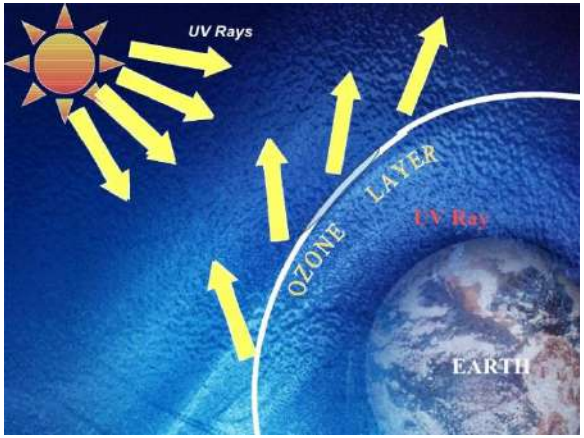


UV-B protection by the ozone layer

- UV-A (315- to 400 nanometer (nm) wavelength), visible light, are not strongly absorbed by the ozone layer and are the least dangerous ;
- UV-B radiation (280- to 315 (nm) wavelength) , the most dangerous radiation, is strongly absorbed in this layer. As a result, the amount of UV-B reaching Earth's surface is greatly reduced.
- UV-B have serious effects on human health, on plants, on Phytoplankton and on environment including climate change

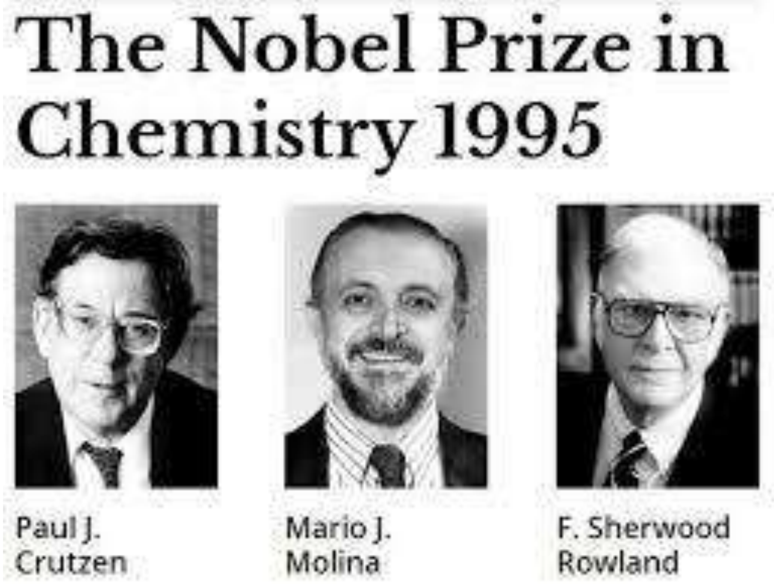
UV Protection by the Ozone Layer

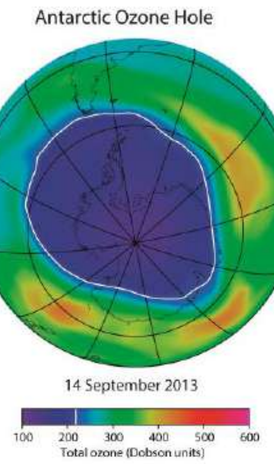




Nobel Prize in Chemistry in 1995

- In 1974, three scientists, Mario Molina, F. Sherwood Rowland and Paul Josef Crutzen formulated, for the first time, the theory of the ozone layer depletion by Chloro Fluoro Carbons (CFCs). In 1995 they won the Nobel Prize in Chemistry;
- Many other gazes are depleting the ozone layer.





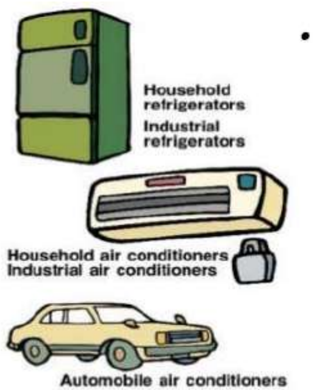
CFC, HCFC, HFC, HC, PFC, and Halon

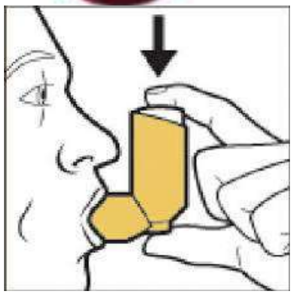
Prefix	Meaning	Atoms in the Molecule
CFC	chlorofluorocarbon	Cl, F, C
HCFC	hydrochlorofluorocarbon	H, Cl, F, C
HBFC	hydrobromofluorocarbon	H, Br, F, C
HFC	hydrofluorocarbon	H, F, C
HC	hydrocarbon	H, C
PFC	perfluorocarbon	F, C
Halon	N/A	Br, Cl (in some but not all), F, H (in some but not all), C

CFC-11 (CCl_3F) Trichlorofluoromethane
CFC-12 (CCl_2F_2) Dichlorodifluoromethane
CFC-113 (C_2F3Cl_3) 1,1,2-Trichlorotrifluoroethane

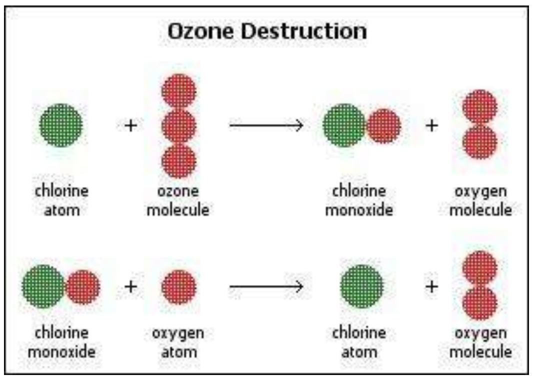
Human contributions to ozone destruction

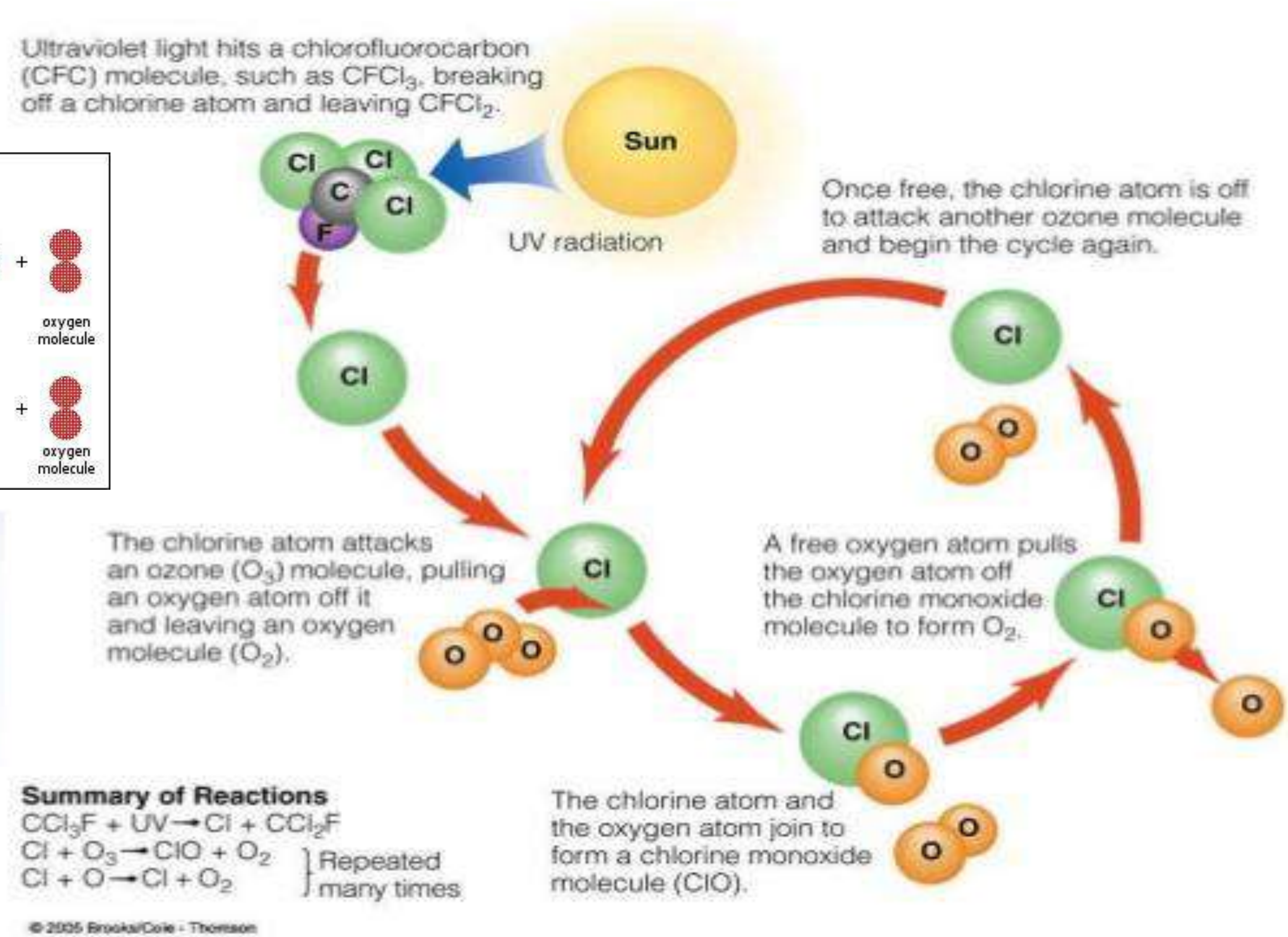
- These man -made gases are responsible for ozone depletion. For example, CFCs **were** used in fridges, air-conditioning units, plastic foams and aerosol sprays.
- These gases are transported high into the stratosphere where they are broken down by UV radiation. The reaction releases free chlorine , which acts as a catalyst in the ozone destruction
- Other gazes such as HCFCs, Methyl Bromide, halons also deplete the ozone layer.





How Ozone is depleted ? : Example of CFCs





CONSEQUENCES OF OZONE DEPLETION LAYER

Consequences of ozone depletion

Increased UV

Effect on human health

Effects on non human animals

Crop production is affected

UV-B radiation exposure has a great impact on human health , on animals on plants and on the environment including climate change

Effect of ozone layer depletion on human health

- **Prolonged exposure** to UV-B can have serious effects on human health
- It can lead to sun burns, cataracts, skin cancer, reduced effectiveness of immune system, respiratory illness , heart problems, premature aging of the skin etc..





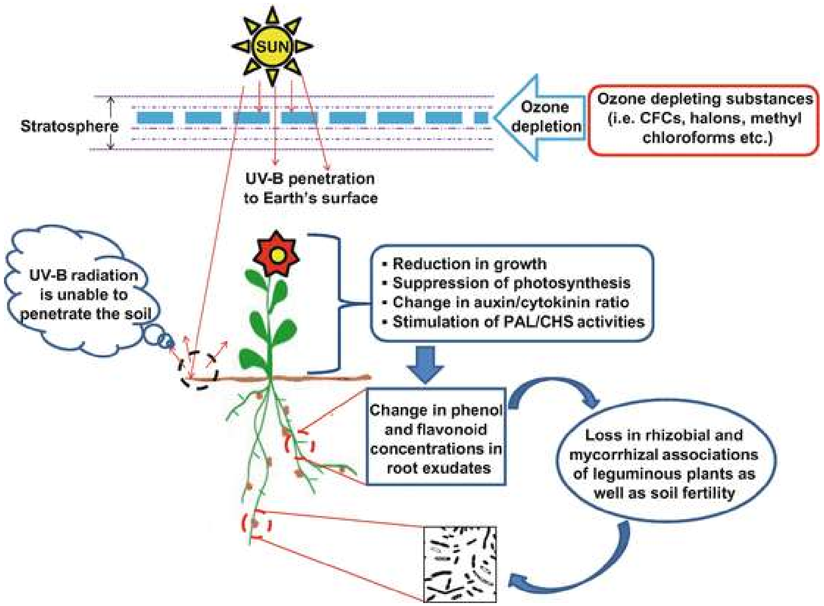


Effects of enhanced UV-B radiation on Plants

- Reduced photosynthesis;
- Reduced water use efficiency;
- Enhanced drought stress sensitivity;
- Reduced leaf area;
- Inhibited flowering;
- Reduced dry matter production;
- Reduced yields;
- Increased plant susceptibility to pathogens.

Effect of UV-B Radiation on Plants: Example of Leguminous Plants

- Significant reductions in total biomass up to 93 %, photosynthesis up to 90 %, and yield up to 62 % have been reported ;.
- Studies reported reduction of about 62 % in nodulation, 78 % in nitrogenase activity, 31 % in nitrate reductase activity, 67 % in nitrite reductase activity and 76 % in leghaemoglobin
- Significant negative impacts of UV-B were also reported on microbial biomass of rhizosphere.

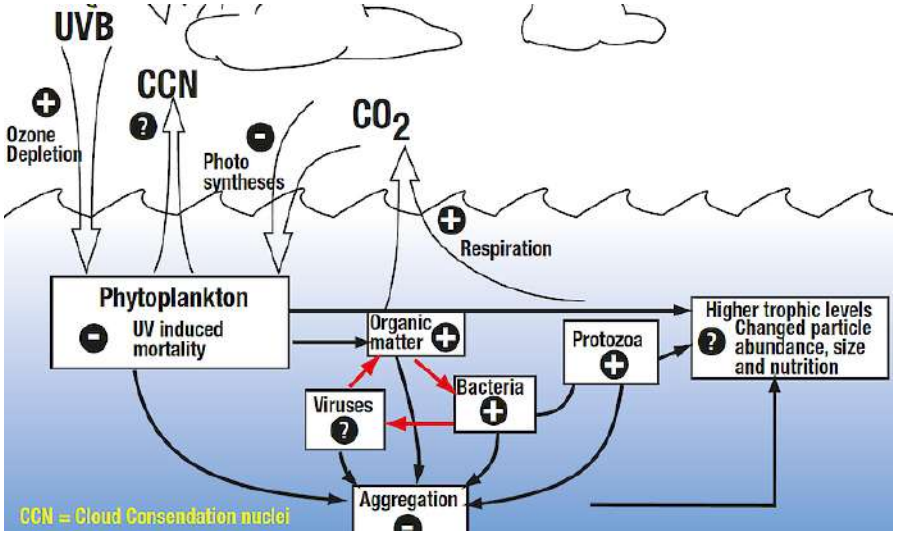


Effect of ozone depletion on marine ecosystem

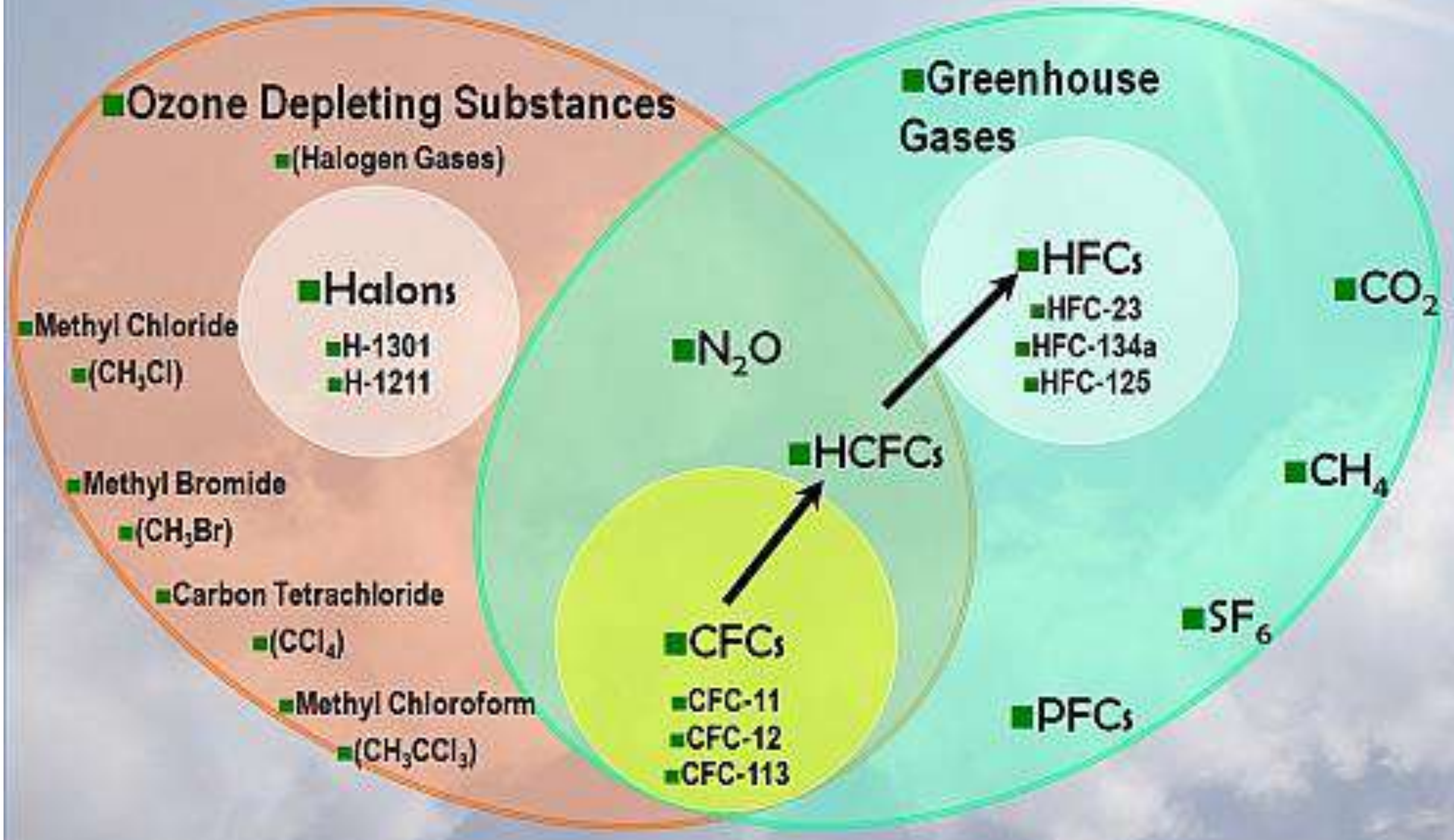
- UV-B can penetrate clear water to a depth of 20 m
- Phytoplankton productivity is limited to the euphotic zone, the layer closer to the surface that receives enough light for photosynthesis to occur and in which there is sufficient sunlight to support net productivity.
- UV-B is damaging to single celled marine plants (phytoplankton) and other micro organisms, protozoa, bacteria and viruses.
- UV-B radiation affects the Phytoplankton survival , causes damage to reproductive capacity and early developmental stages of fish, shrimp, crab, amphibians and other animals.
- Increases in UV-B exposure result in significant reduction in the size of the population of animals that eat these smaller creatures.

Effect of ozone depletion on marine ecosystem

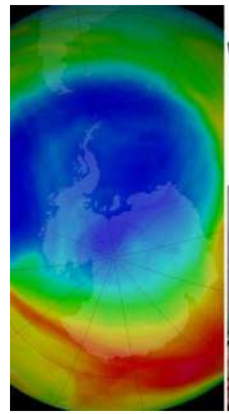
- Due to the interactions between trophic levels of the microbial community, any UVB-induced impact at one level can alter the entire community.
- Continued depletion of ozone will lead to increased penetration of UV into the upper layers of the ocean, resulting in damage to various forms of marine life such as phytoplankton , Zooplankton, fish, shrimp, crab, amphibians, and other marine animals.
- Phytoplankton is also important in determining global climate. It moderates the global greenhouse effect by absorbing CO_2 from the atmosphere

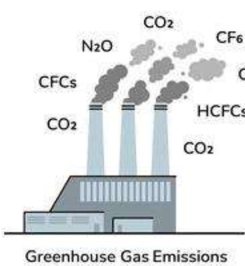


Relationship Between ODS and Other Greenhouse Gases



ODSs , green house gases and public awareness



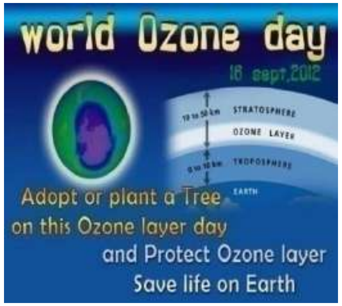


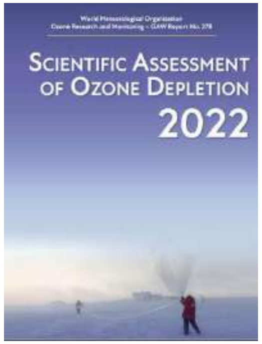
Public awareness has arisen with the negative impacts of ODSs and green house gases on human health , on plants and on the environment

THE MONTREAL PROTOCOL AND THE ODSs PHASE OUT

The Montreal Protocol

- On September 16, 1987, governments around the world agreed on the Montreal Protocol on Substances That Deplete the Ozone Layer (CFCs, HCFCs, HBFCs, halons, carbon tetrachloride, and methyl chloroform)
- Every year, September 16 is observed as the International Day for the Preservation of the Ozone Layer across the world. The celebrations are also known as World Ozone Day.
- A global phase-out schedule of the ODSs was established by the MP.



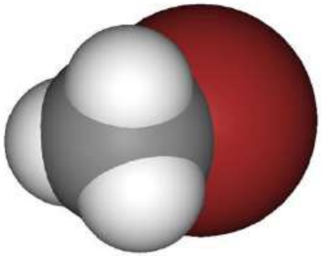


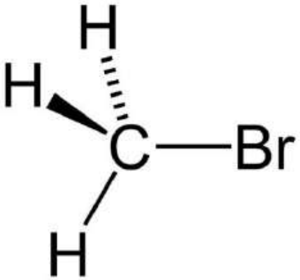
Global phase-out schedule of the ODSs established by the MP

Ozone Depleting Substances	Developed Countries	Developing Countries
Chlorofluorocarbons (CFCs)	Phased out end of 1995 [a]	Total phase out by 2010
Halons	Phased out end of 1993	Total phase out by 2010
Carbon tetrachloride	Phased out end of 1995 [a]	Total phase out by 2010
Methyl chloroform	Phased out end of 1995 [a]	Total phase out by 2015
Hydrochlorofluorocarbons (HCFCs)	Freeze from beginning of 1996 [b]	
	35% reduction by 2004	
	65% reduction by 2010	Freeze in 2016
	90% reduction by 2015	at 2015 base level
	Total phase out by 2020	Total phase out by 2040
Hydrobromofluorocarbons (HBFCs)	Phased out end of 1995	Phased out end of 1995
Methyl bromide	Freeze in 1995 at 1991 base level	Freeze in 2002 at average
	25% reduction by 1999	1995-1998 base level
	50% reduction by 2001	20% reduction by 2005
	70% reduction by 2000	Total phase out by 2015
	Total phase out by 2005	

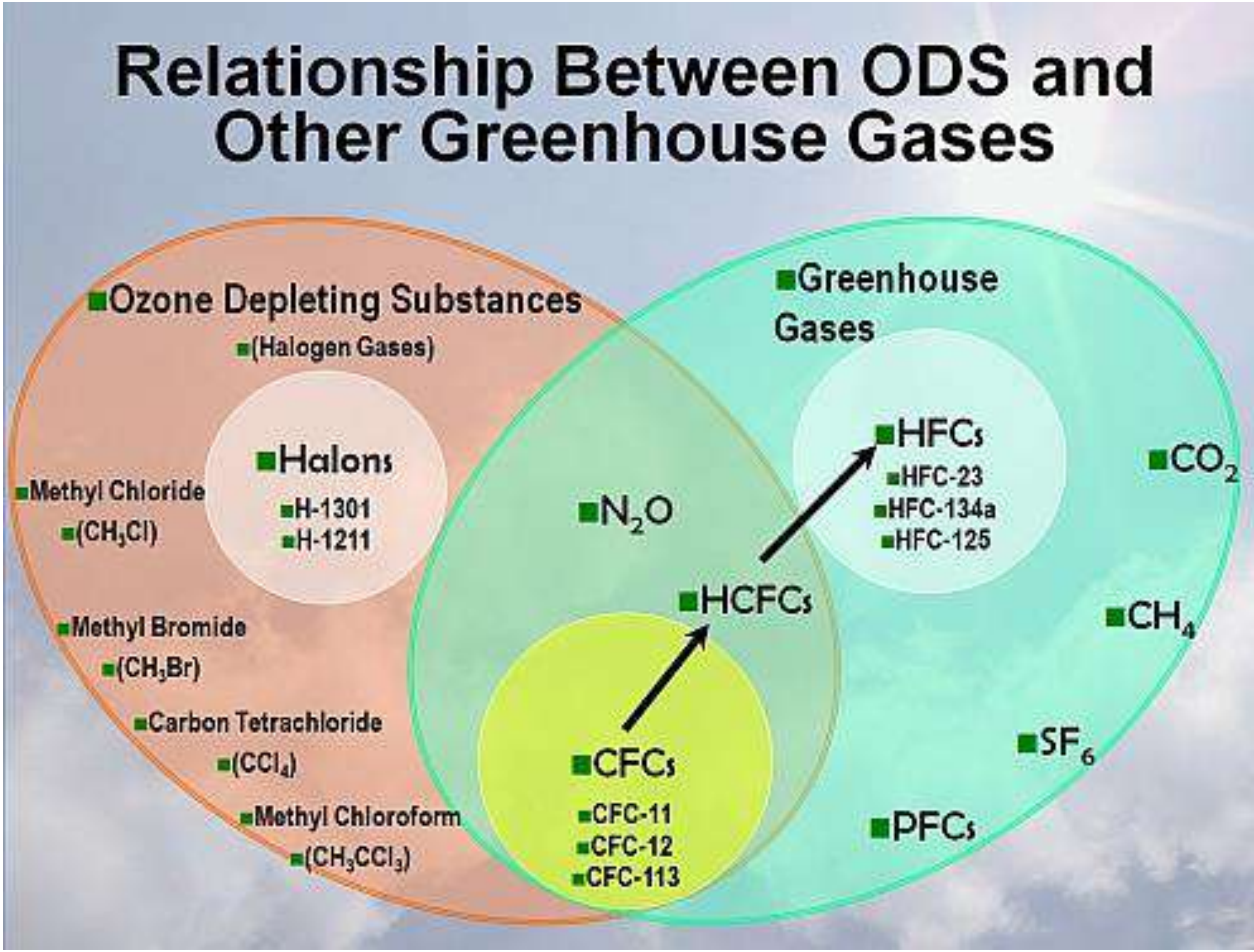
EXAMPLE : METHYL BROMIDE PHASE OUT

Methyl bromide uses





- Methyl bromide, **was** used extensively in the past (total phase out in 2005 and 2015 respectively in developed and developing countries) as a fumigant for controlling a wide range of pests, weeds and pathogens present in soils (fungi, bacteria, nematodes, viruses) as well as in post-harvest commodities, in buildings or structures to control insects, mites, rodents …
- MB continue to be used for quarantine and preshipment

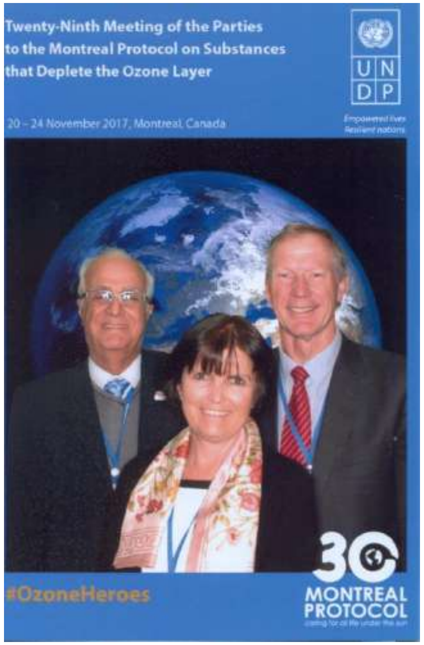

Relationship Between ODS and Other Greenhouse Gases
Ozone Depleting Substances
(Halogen Gases)
Halons
H-1301
H-1211
Methyl Chloride
(CH_3Cl)
Methyl Bromide
(CH_3Br)
Carbon Tetrachloride
(CCl_4)
Methyl Chloroform
(CH_3CCl_3)
N_2O
CFCs
CFC-11
CFC-12
CFC-113
HCFCs
Greenhouse Gases
HFCs
HFC-23
HFC-134a
HFC-125
CO_2
CH_4
SF_6
PFCs

MB Phase-out Schedules Agreed by the Montreal Protocol

Year	Non-Article 5 Countries	Article 5 Countries
1991	Consumption/production baseline	
1995	Freeze	
1995–1998 average		Consumption/production baseline
1999	25% reduction	
2001	50% reduction	
2002		Freeze
2003	70% reduction	Review of reductions
2005	*Phaseout with* ***provision for CUEs***	20% reduction
2015		*Phaseout* ***with provision for CUEs***
Source: Ozone Secretariat UNEP , Montreal Protocol Handbook.		

UNEP Technical Option committees

- To eliminate the ODSs, the MP has developed a strategy comprising several points including the establishment of five technical option committees (TOC) to identify existing and potential alternatives to ODSs : Foams, Halons , Medical and Chemical, Refrigeration , and *Methyl Bromide* TOCs.
- TOCs provide recommendations and advices to the Parties on the technical and economic feasibility of alternatives . Some TOC e.g. MBTOC have also the task of evaluating Critical Use Nominations submitted by Article 5 and non-Article 5 Parties to the MP

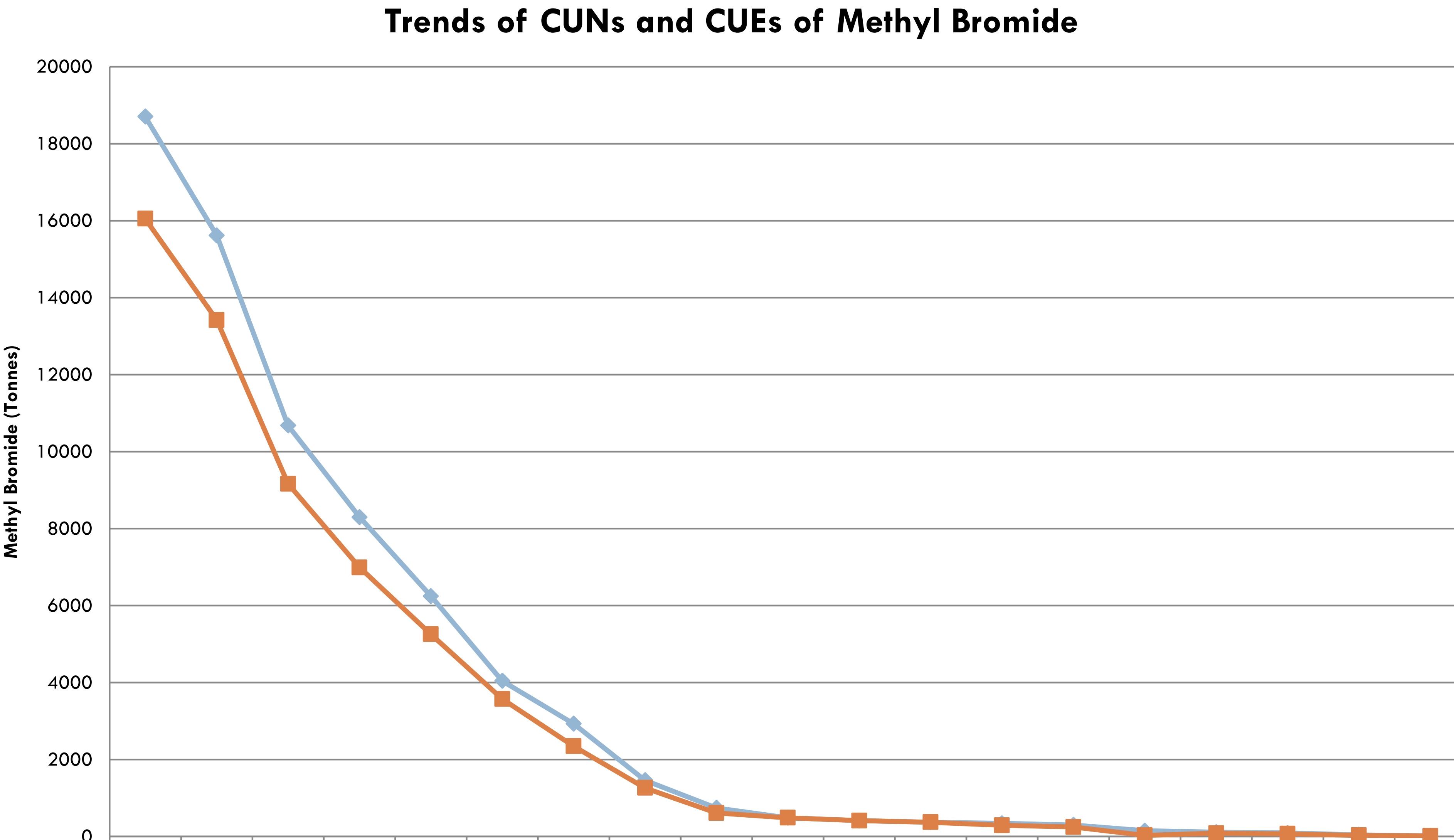


MBTOC Co chairs
Marta Pizano: Columbia
Ian Porter: Australia
Mohammed Besri: Morocco

CUNs and CUEs

- In 1997, the Parties to the MP recognized a justifiable need for transitional access to MB and adopted a formal decision to allow limited CUEs. Since 2005, exemptions have been allowed for "Critical Uses" in non-A5 Parties and since 2015 in A5 Parties.
- Exemptions were to be granted only when the following criteria defined by the Decision IX/6 were met :
  - Failure to provide access to MB would result in a significant market disruption.
  - There were no technically and economically feasible alternative available to an applicant that is acceptable from environmental and human health standpoints.
  - The applicant had taken all feasible steps to minimize their use of MB and the associated emissions.
  - Appropriate efforts were being made to evaluate, commercialize, and register alternatives to MB for use by the applicant.
- MBTOC evaluates the CUNs and makes recommendations to the Meeting of the Parties (MOP): recommends the full amount requested; a reduced amount ; did not recommend the nomination

THE MONTREAL PROTOCOL SUCCESSES

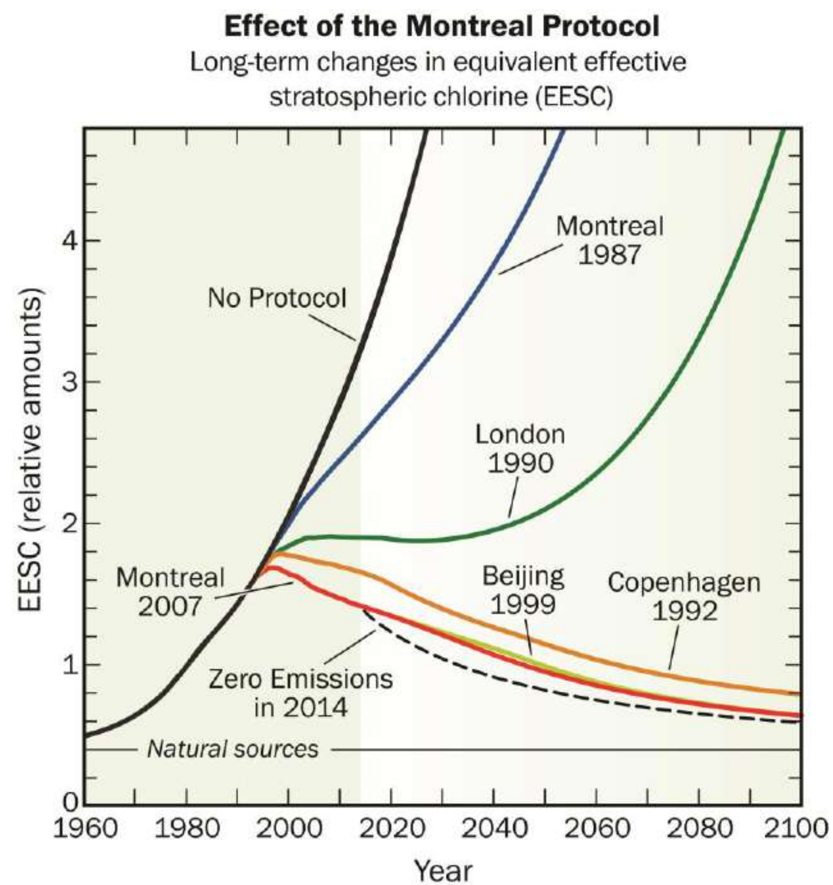


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
CUNs	18704	15618	10678	8297.7	6244.5	4044.4	2928.1	1460.2	740.53	483.59	412.22	369.83	341.3	298.7	147.2	111.4	89.57	43.59	14.49
CUEs	16050	13418	9160.7	6990	5254.8	3572.2	2343	1261.3	610.89	483.59	412.22	369.83	290	244.3	28.98	82.92	69.6	29.98	14.49

The amount of MB requested for CUNs has fallen from 18,700 t submitted for 2005 (135 nominations) to 14 t submitted for 2023 (2 nominations).

Recovering of the ozone layer

- Without the Protocol and its amendment, Equivalent Effective Stratospheric Chlorine (EESC) values are projected to have increased significantly in the 21st century .
- The implication of this would have been hazardous and have been estimated to include: 20 million more cases of cancer and 130 million more cases of eye cataracts if there have been no MP.
- The ozone hole is slowly recovering, and it is expected that the ozone layer will return to 1980 levels between 2050 and 2070
- Some ODSs are also potent greenhouse gases, and the protocol has delivered substantial climate benefits too.



Visit of the Department of Plant Protection by The King Hassan the second (1982)

Some awards obtained for phasing out Methyl Bromide in climate temperate countries

A-National Medal of merit, awarded by the King Mohamed VI for contribution to the Moroccan sustainable agricultural development (2000).

2- Two UNEP Awards: 2007 and 2017

Some awards obtained for phasing out Methyl Bromide in climate temperate countries

C- National Associations of fruits, vegetables and ornamental plants growers (Morocco)

تارودانت في 02 مارس 2010

رسالة شكر وامتنان وعرفان بالجميل

إلى الأستاذ: محمد بصري، أستاذ بمعهد الحسن الثاني للزراعة والبيطرة

سلام تام بوجود مولانا المنصور بالله

وبعد:

تتشرف الموقعون أسفله أن يشكروكم على كل المجهودات التي بذلتموها والأبحاث القيمة التي قمتم بها والتكوين العالي الذي ساهمتم به لثلة من الأطر المغربية والأجنبية. وتتويجكم بوسام الاستحقاق الوطني الذي أنعم عليكم به صاحب الجلالة الملك محمد السادس، أيده الله ونصره، هو خير دليل على تفانيكم في عملكم وخدمتكم لوطنكم وللجميع.

"وقل اعملوا فسيرى الله عملكم ورسوله والمؤمنون"

صدق الله العظيم

والسلام عليكم ورحمة الله.

إمضاء:

- رئيس الغرفة الجهوية الفلاحية بسوس ماسة درعة: الحاج علي قيوح.

- رئيس جمعية حوامض المغرب « Maroc Citrus »: مولاي محمد الولتيتي.

- رئيس جمعية منتجي الحوامض بالمغرب: الحاج محمد بوهدود بودلال

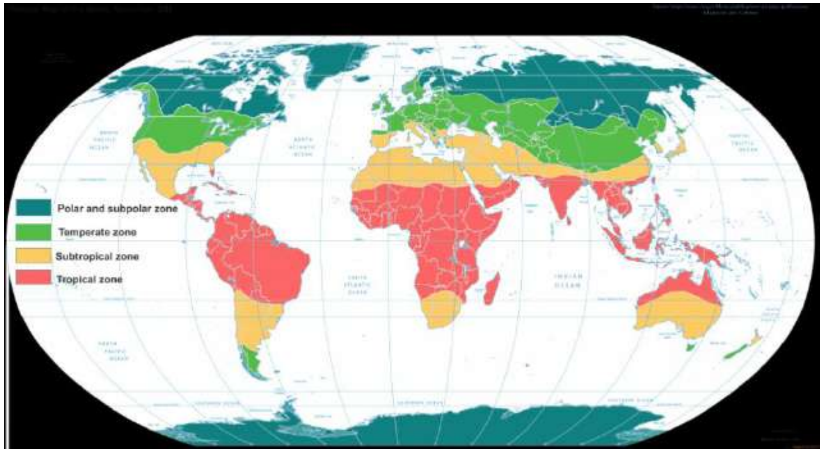
Some awards obtained for phasing out Methyl Bromide in climate temperate countries

- D-Moroccan Association for plant Protection , Two awards, 2008 and 2010

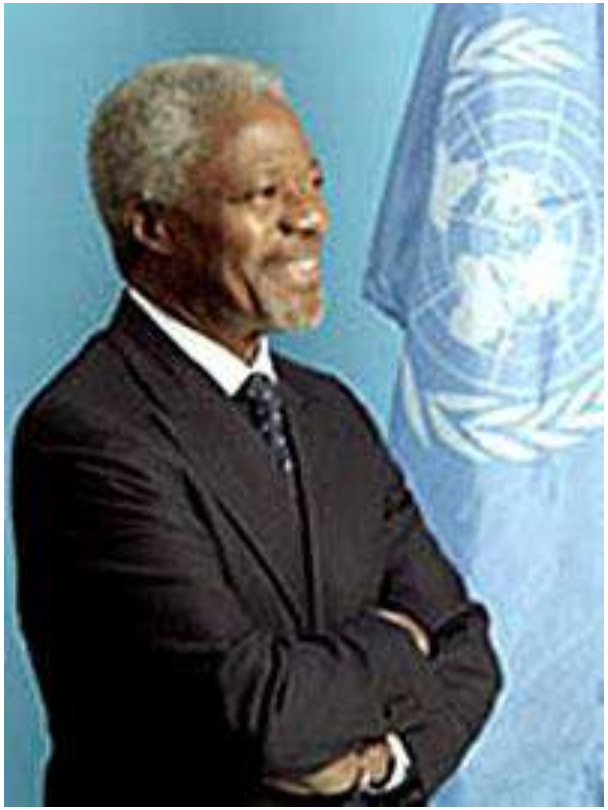
- Others: FAO, Khalifa date Palm, UNIDO….

Some countries located in non temperate climate zones and using some alternatives to MB

- Subtropical :
  - Africa: Morocco, Algeria, Tunisia, Egypt, South Africa
  - Middle East: Lebanon, Turkey, Jordan, Syria, Irak…
  - USA: California
  - Latin America: Argentina (S), Brazil….
  - Asia : India, China (S)
  - Australia (S)
- Tropical :
  - Africa; Kenya….
  - Australia (N)
  - Latin America: Mexico, Brazil, Argentina….



The Montreal Protocol on Substances that Deplete the Ozone Layer



" Perhaps the single most successful international agreement to date has been the Montreal Protocol " , Kofi Annan, Former Secretary General of the United Nations

Conclusion

- Technically and economically effective alternatives to ODSs have been developed for all uses;
- The MP on substances that deplete the ozone layer is an international treaty designed to protect the ozone layer by phasing out the production and consumption of ODSs ;
- The MP has been ratified by 197 parties (196 states and the European Union), making it the first universally ratified treaty in United Nations' history.

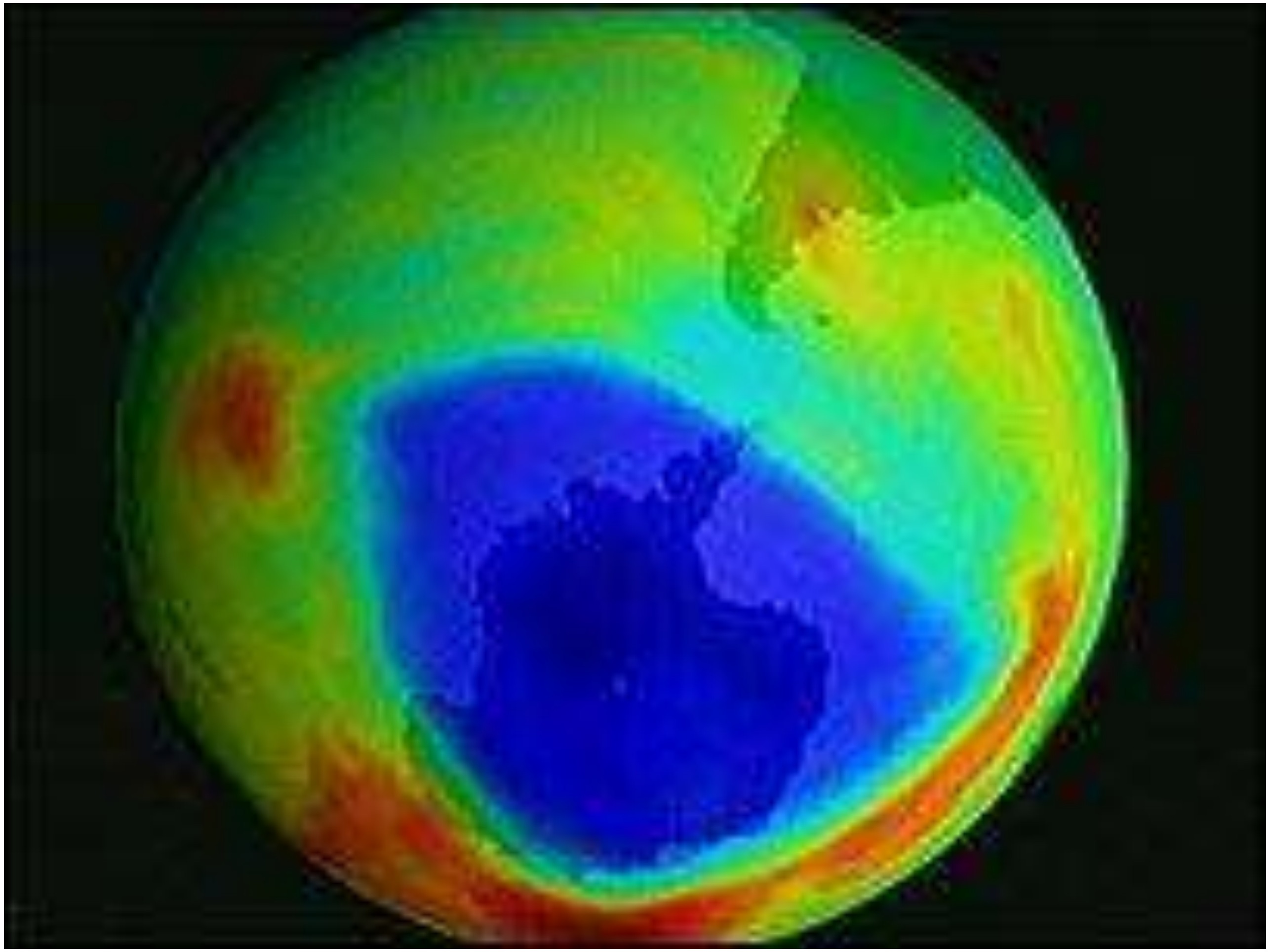
Conclusion

- The implementation of the MP has shown that setting strict phase-out schedules for developed and developing countries have promoted research and innovation of alternatives to the ODSs and speeded their transfer, acceptance, and implementation ;
- The ozone hole is slowly recovering, and it is expected that the ozone layer will return to 1980 levels between 2050 and 2070 ;
- This will be the first time in history that humankind has reversed an environmental problem of such magnitude. The MP is considered as one of the most successful and effective environmental treaties ever negotiated and implemented.

Conclusion: Lessons to be learned from the MP

- In addition to the ODSs and many other dangerous chemical compounds, currently, about 70 synthetic highly toxic pesticides to humans and to the environment have already been banned in developed countries but, unfortunately, continue to be used in many developing countries , including the Islamic ones.
- Therefore, an agreement and an action plan are needed to reduce and then completely phase out these toxic synthetic pesticide. Many lessons can be learned from the MP.

Thank you for your attention



PLANT SCIENCES: A TOOL TO ACHIEVE TARGETS OF SDGS

ZABTA SHINWARI FIAS
Vice President, IAS
Professor Emeritus, Quaid-i-Azam University, Pakistan

ABSTRACT

Pakistan is sitting on a gold mine of well-recorded and traditionally well-practiced knowledge of herbal medicine. Folk medical (Hakeems or Pansars) have deep foundations in Pakistan. "Greeco-Islamic medicines","Yunani Tibb" or "Yunani Dawakhana" are most commonly used traditional systems in Pakistan. Approximately 75118 registered *Unani* medical practitioners are practicing both in the public and private sector in urban and rural areas. About 360 *tibb* dispensaries and clinics provide free medication to the public under the control of the health departments of provincial governments. The treasure of Biodiversity resources in Pakistan can be used to address the SDGs.

For example: SDG-1: End poverty in all its forms everywhere:
The inhabitants of rich biodiversity areas are the poorest, these resources can be sustainably used to reduce poverty. Unfortunately, the indigenous people sell these treasures on negligible prices and get almost nothing in return. If SDG 1 is addressed, it can help to achieve not only SDG 2 but 3 also. Because if proper guidance is given, it will end hunger, achieve food security and improved nutrition, and promote sustainable agriculture by introducing off seasons vegetables, high price medicinal plants etc.

To address SDG 3 regarding healthy life: there are complains that herbal products are not scientifically proven and no proper clinical trials conducted. Clinical trials are performed to investigate if a therapeutic strategy is effective and safe for human... The results gathered as a result of clinical trials can be used for health care decision making. Herbal medicine has become a popular form of healthcare; even though several differences exist between herbal and conventional pharmacological treatments. Herbal medicines are not always safe and do carry risks so the research should be intensified in terms of clinical trials.

- Ayurveda in India, Unani in Pakistan, Traditional Chinese Medicine, and other systems, have been written down and codified for centuries, but other traditional practices emerge and evolve more organically and have fewer controls over their safety and practice, or guarantees of their effectiveness.
- The World Health Organization (WHO) had a traditional medicine strategy in place from 2002, since updated to a 2014-2023 strategy.
- Current WHO strategy aims to **support WHO Member States in developing proactive policies and implementing action plans to strengthen the role traditional medicine plays in keeping people healthy. The way to achieve it in addressing SDG 4 & 5, "Ensure inclusive and equitable quality education and gender equality and empower all women and girls". Major collectors of medicinal plants being women and children.**

The way to achieve the first 6 SDGs would be involving these indigenous people and involving the in **sustained, inclusive and sustainable economic growth hence addressing SDGs 8 & 9.** The poor countries are rich in natural resources while developed world has technology, if SDG 10 is considered "Reduce inequality within and among countries", we can achieve the goals. That is the only way to achieve the targets of SDGs 13 to 16 and possible through international partnership (SDG 17).

The real issue is: how does science cater to the poor? Misidentifications or adulteration of materials lead to reduced effectiveness of herbal products or accidental poisonings. Current research in the lab is focused on molecular barcoding of medicinal plants, therapeutic applications of medicinal plants, and bio-synthesis of nanoparticles.

Plant Sciences: A tool to achieve targets of SDGs

Zabta K. Shinwari T.I., S.I.; UNESCO Laureate

Distinguish National Prof./Prof. Emeritus, Quaid-i-Azam University, Islamabad-Pakistan.

Fellow, TWAS; Pakistan Academy of Sciences & Vice President Islamic World Academy of Sciences

Immediate Former V Chair UNESCO-World Commission for Ethics in Sci. Know & Technology

These goals focuses on ending poverty, protecting the planet, and ensuring prosperity for all (United Nations, 2015).

The sustainable development goals.
1 **End poverty in all its forms everywhere**
2 End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
3 **Ensure healthy lives and promote well-being for all at all ages**
4 **Ensure inclusive and equitable quality education and promote life-long learning opportunities for all**
5 **Achieve gender equality and empower all women and girls**
6 Ensure availability and sustainable management of water and sanitation for all
7 Ensure access to affordable, reliable, sustainable, and modern energy for all
8 **Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all**
9 **Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation**
10 **Reduce inequality within and among countries**
11 **Make cities and human settlements inclusive, safe, resilient and sustainable**
12 **Ensure sustainable consumption and production patterns**
13 Take urgent action to combat climate change and its impacts (in line with the United Nations Framework Convention on Climate Change)
14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
16 **Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels**
17 **Strengthen the means of implementation and revitalize the global partnership for sustainable development**
Goals listed in bold relate to sustainable development through Natural Resource Management

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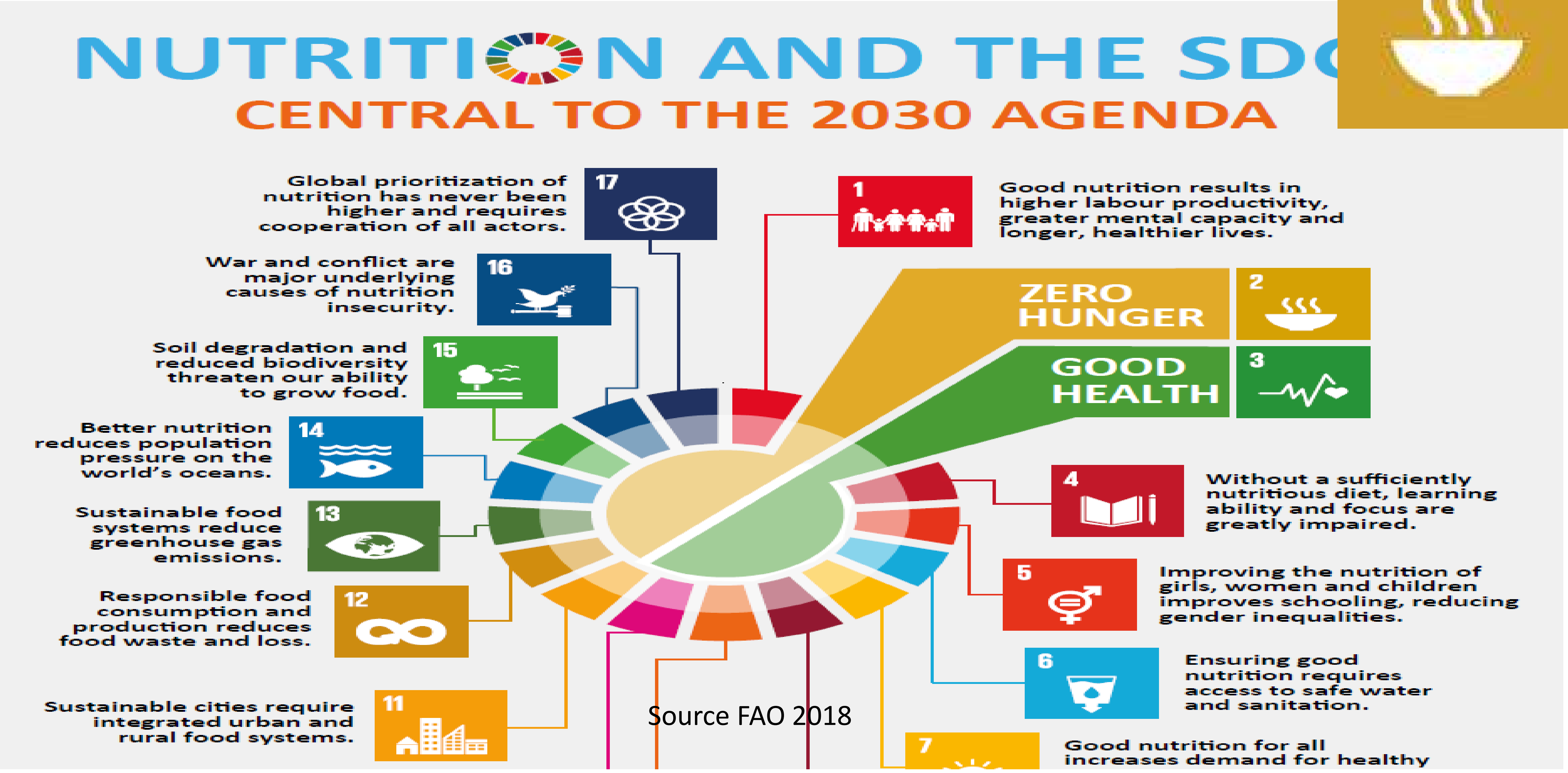
SDG 2

- End hunger, achieve food security and improved nutrition and promote sustainable agriculture.



Source FAO 2018

Mass Poverty and Inequality

- Phenomenal Growth per capita in 300 years
- Yet, every second 4 people die because of starvation or related diseases
- 1% of world population has 50% of world wealth

- **The top 26 billionaires own $1.4 trillion — as much as 3.8 billion other people**
- **The world's billionaires are growing $2.5 billion richer every day, while the poorest half of the global population is seeing its net worth dwindle. Billionaires, who now number a record 2,208, have more wealth than ever before.**

aOxfam International report

Plant Sciences may help in reducing Mass Poverty and Inequality

1. Improving agricultural productivity: Pest control, Increase agricultural yields, improve food security, and provide farmers with greater incomes.
2. Enhancing nutrition:
3. Creating employment opportunities:
4. Developing sustainable and climate-resilient agriculture: Reduce the vulnerability of farmers to the impacts of climate change and contribute to poverty reduction by improving food security and increasing the resilience of agricultural livelihoods.
5. Preserving biodiversity:

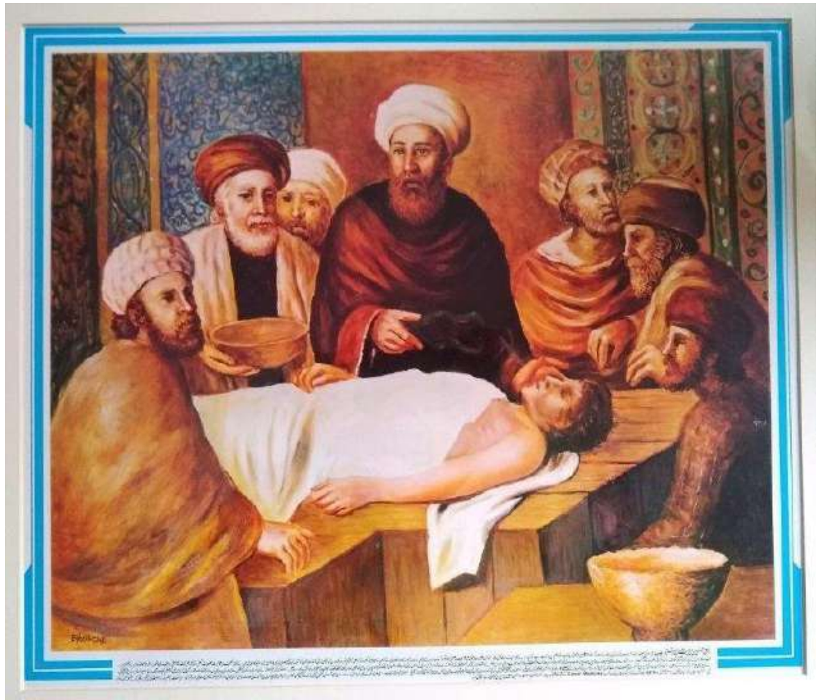
Overall, plant sciences can play a vital role in reducing mass poverty and inequality by improving agricultural productivity, enhancing nutrition, creating employment opportunities, developing sustainable agriculture systems, and preserving biodiversity.

WHY HERBAL MEDICINE

- It is being used by about 80% of the world population primarily in the developing countries for primary health care.
- SAFETY,EFFICACY, CULTURAL ACCEPTABILITY AND LESSER SIDE EFFECTS.
- Ancient literature also mentions herbal medicines for age-related diseases namely Memory Loss, Osteoporosis, Diabetic Wounds, Immune And Liver Disorders, etc. for which no modern medicine or only palliative therapy is available.

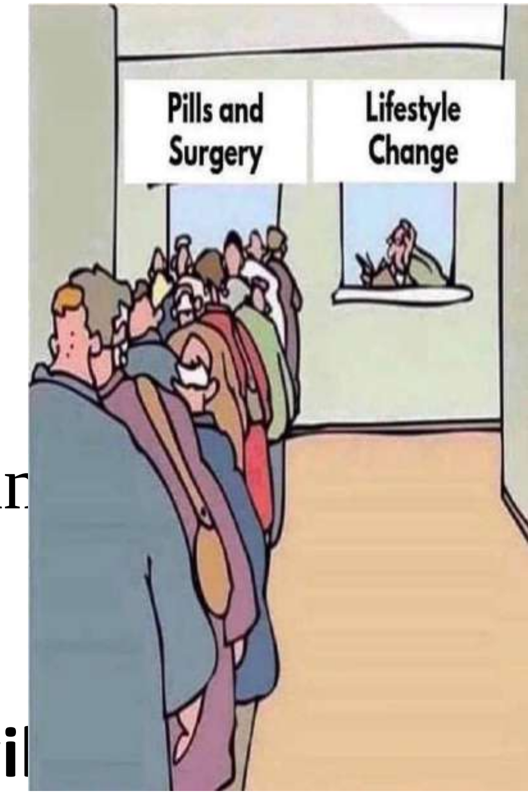
Herbal Medicine then and now??

- "Most illnesses, even those which lead the sufferer to the specialist, arise solely from long-continued errors of **diet and regime.**" Ibn Sina (also known as Avicenna) 'Prince of Physicians' 980-1037 CE



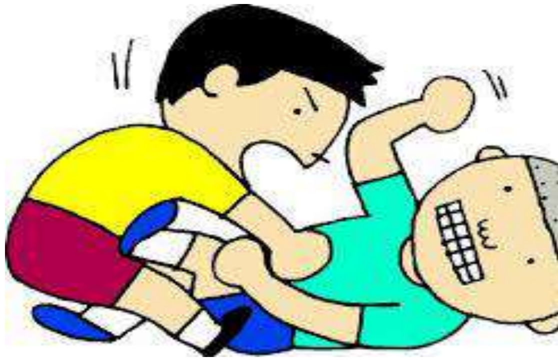
Global Burden of Disease report

- Poor diet linked to one in five deaths
- **Obesity (Which is preventable) will be an economic & social burden to the world in future & by the year 2040**
- The **obese population within past 40 years has tripled** worldwide.
- **Diabetes rose from the 17th to the 9th leading cause of death** in low-middle income countries.
- **HUMAN DIET CAUSING 'CATASTROPHIC' DAMAGE TO PLANET**
- **five kilos of grain to produce a kilo of meat,** about **30 percent will wind up in the garbage bin**.



Changing people's behavior and circumstances is proving more difficult than fighting infectious disease.

"triad of troubles" – obesity, conflict, and mental illness.



https://www.weforum.org/agenda/2017/10/the-world-s-biggest-killers-diseases-linked-to-human-behaviour

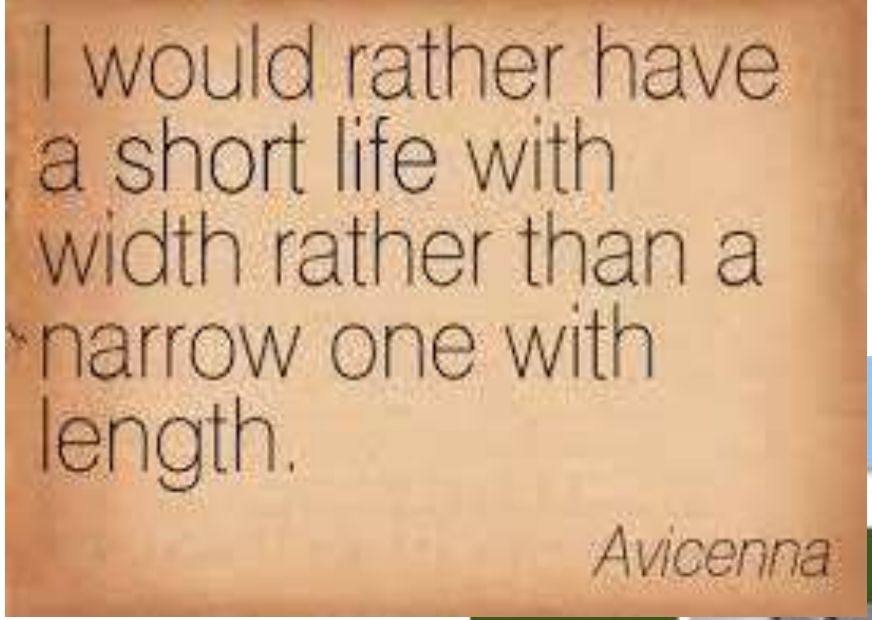
Extinction of Indigenous languages leads to loss of exclusive knowledge about medicinal plants

- 3,597 vegetal species with 12,495 medicinal uses and linked this data with 236 Indigenous languages from three biologically and culturally diverse regions—the northwestern Amazon, New Guinea and North America. *In a regional study on the Amazon, New Guinea and North America, researchers concluded that 75% of medicinal plant uses are known in only one language.*
- *The study evaluated 645 plant species in the northwestern Amazon and their medicinal uses, according to the oral tradition of 37 languages. It found that 91% of this knowledge exists in a single language, and that the extinction of that language implies the loss of the medicinal knowledge as well.*
- “Every time a language disappears, a speaking voice also disappears, a way to make sense of reality disappears, a way to interact with nature disappears, a way to describe and name animals and plants disappears,”
- The project Ethnologue concluded that 42% of the world’s more than 7,000 existing languages are endangered. Of the 1,000 Indigenous languages spoken in Brazil prior to the arrival of the Portuguese in 1500, only about 160 are still ali

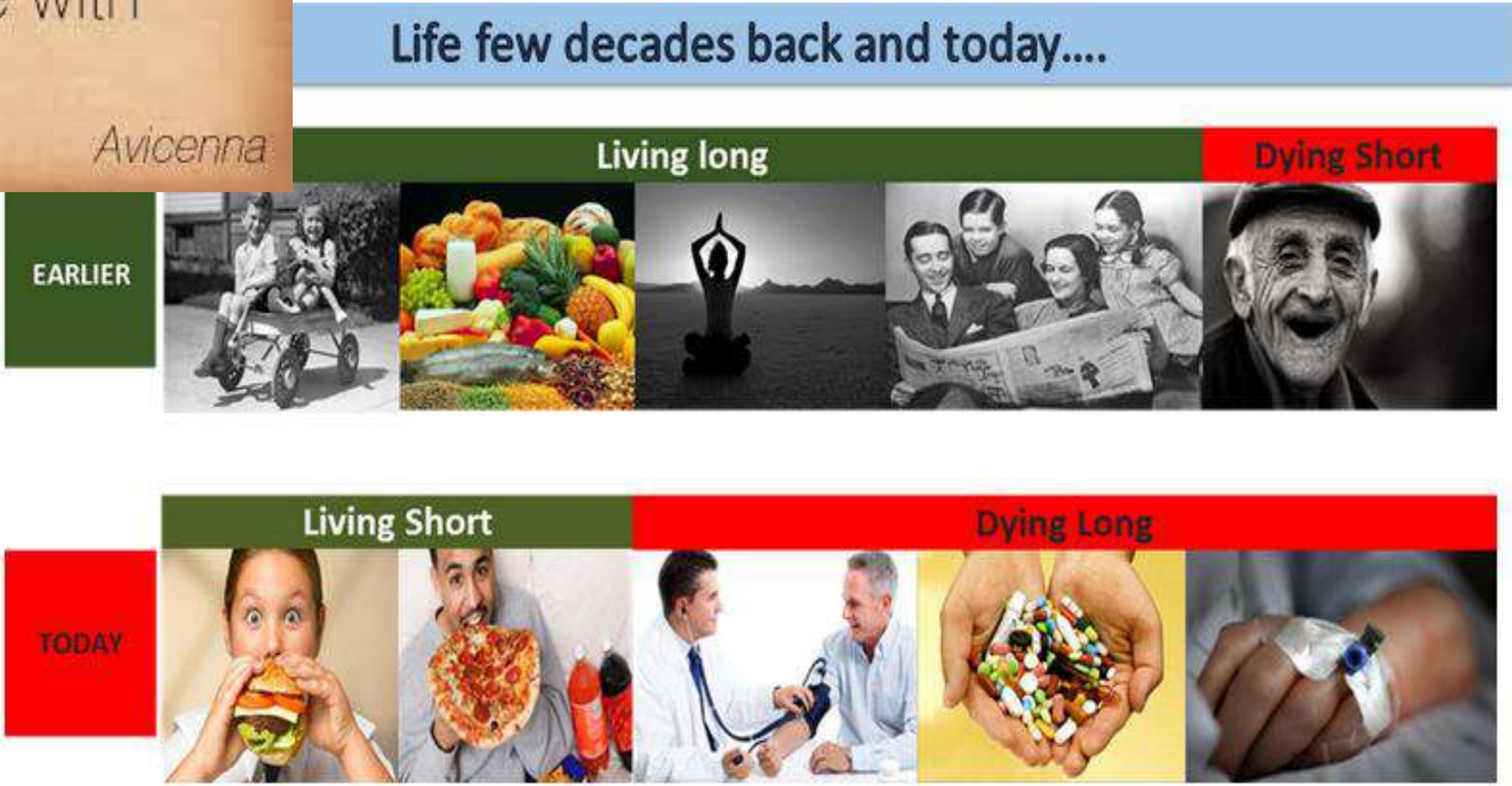
https://news.mongabay.com/2021/09/extinction-of-indigenous-languages-leads-to-loss-of-exclusive-knowledge-about-medicinal-plants/?utm_source=Nature+Briefing&utm_campaign=b1e8359524-briefing-dy-20210921&utm_medium=email&utm_term=0_c9dfd39373-b1e8359524

The Future Of Nutraceuticals Market In Pakistan?

- Present worth is $1.2 billion.
- However, the industry is expanding rapidly.
- Estimated worth $3 billion, by the end of 2020 with CAGR 20%



Why use Nutraceuticals?



Exploring Traditional Medicine

- Among the targets of **SDG3** are access to **safe, effective, quality and affordable essential medicines for all.**
- In Africa, Asia, Latin America and the Middle East, for example, between 70 and 95 per cent of the population still use traditional medicine for their primary healthcare.
- Ayurveda in India, Unani in Pakistan, Traditional Chinese Medicine, and other systems, have been written down and codified for centuries, but other traditional practices emerge and evolve more organically and have fewer controls over their safety and practice, or guarantees of their effectiveness.
- The World Health Organization (WHO) had a traditional medicine strategy in place from 2002, since updated to a 2014-2023 strategy.
- Current WHO strategy aims to **support WHO Member States in developing proactive policies and implementing action plans to strengthen the role traditional medicine plays in keeping people healthy.**

the interacademy partnership

From the other side

Examples of species being endangered because they are reputed (falsely) to possess medicinal properties.

BUSINESS

Why Does a Rhino Horn Cost $300,000? Because Vietnam Thinks It Cures Cancer and Hangovers

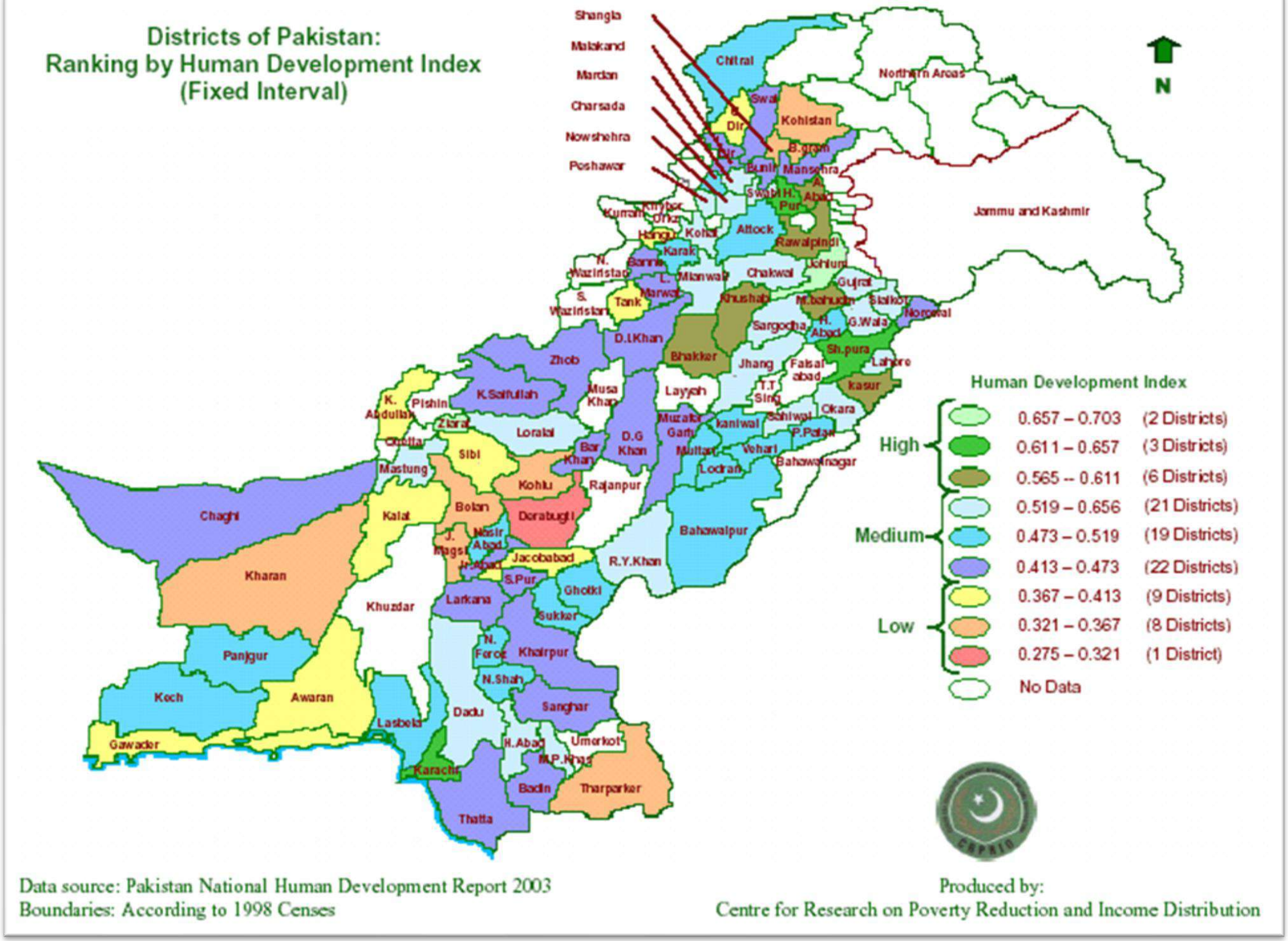
A rhino-head heist spree is sweeping the world and destroying rhino populations, mostly because of some ridiculous myths

GWYNN GUILFORD MAY 15, 2013

Avoiding fooling ourselves

Risking finding that we were wrong

https://www.theatlantic.com/business/archive/2013/05/why-does-a-rhino-horn-cost-300-000-because-vietnam-thinks-it-cures-cancer-and-hangovers/275881/


Districts of Pakistan:
Ranking by Human Development Index
(Fixed Interval)
Human Development Index
High
0.657 – 0.703 (2 Districts)
0.611 – 0.657 (3 Districts)
0.565 -- 0.611 (6 Districts)
Medium
0.519 – 0.656 (21 Districts)
0.473 – 0.519 (19 Districts)
0.413 – 0.473 (22 Districts)
Low
0.367 – 0.413 (9 Districts)
0.321 – 0.367 (8 Districts)
0.275 – 0.321 (1 District)
No Data
N
Shangla
Malakand
Mardan
Charsada
Nowshehra
Peshawar
Chitral
Swat
Kohistan
Northern Areas
Jammu and Kashmir
B.gram
Mansehra
Buner
Swabi
Attock
Rawalpindi
Jehlum
Chakwal
Kohat
Karak
Hangu
Kurram
Bannu
Mianwali
Khushab
Gujrat
Sialkot
Narowal
Sargodha
G.Wala
Tank
D.I.Khan
Bhakker
Jhang
Lahore
kasur
Okara
Layyah
Zhob
K.Saifullah
Pishin
Quetta
Loralai
Sibi
Mastung
Kohlu
Dera bugti
Rajanpur
Multan
Lodran
Vehari
Bahawalnagar
Bahawalpur
R.Y.Khan
Chaghi
Kalat
Bolan
Jacobabad
Larkana
Ghotki
Sukker
Khairpur
Kharan
Khuzdar
Panjgur
Kech
Awaran
Gawader
Lasbela
Dadu
Sanghar
Umerkot
Karachi
Badin
Tharparker
Thatta
Data source: Pakistan National Human Development Report 2003
Boundaries: According to 1998 Censes
Produced by:
Centre for Research on Poverty Reduction and Income Distribution

Poverty & Terrorism: Is there any link?

- There is strong anecdotal evidence but very little analytical work establishing the link between poverty and terrorism in Pakistan
- Concentration of extremists and religious fanatics against the most deprived districts in Pakistan, also rich in biodiversity

www.images.google.com

School in Chaghi (Baluchistan)

SDG 4: Ensure inclusive and equitable quality education and promote life-long learning opportunities for all
SDG 5: Achieve gender equality and empower all women and girls
SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

The cost of terror

- The last category that is causing a decline in the world's health lies outside of the control of the individual; war, conflict or environmental factors.
- The largest increase in deaths from injuries was from:

1. conflict
2. Terrorism

- which have doubled over the past decade.
- Recent conflicts, such as those in Syria, Yemen, South Sudan and Libya, are major public health threats, both in regard to casualties and because they lead to long-term physical and mental health consequences.

https://www.weforum.org/agenda/2017/10/the-world-s-biggest-killers-diseases-linked-to-human-behavi

10 Reduce inequality within and among countries
11 **Make cities and human settlements inclusive, safe, resilient and sustainable**
12 **Ensure sustainable consumption and production patterns**
13 Take urgent action to combat climate change and its impacts (in line with the United Nations Framework Convention on Climate Change)

Climate Change and Pakistan

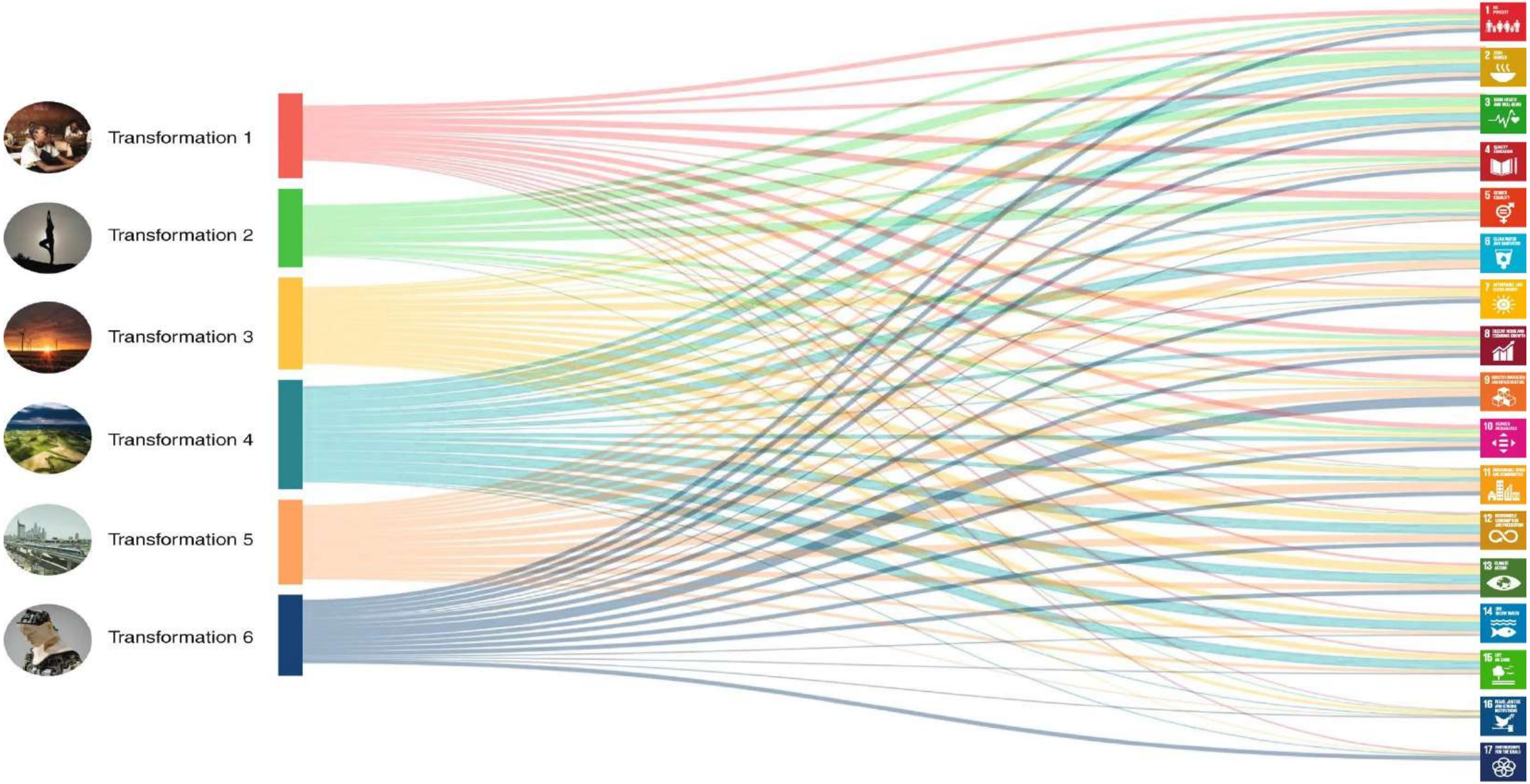
- Rice yield would reduce by 16.2% in 2050 under medium pace of climate change
- There will be 13% yield reduction of wheat crop due to changing climate
- There would be increase of 2.8°C in day and 2.2°C in night temperature in Punjab for mid-century (2040-2069).
- Increase in CO_2 concentration is expected from 390 to 571 ppm
- Glacier reservoirs will retreat in 50 years and will become empty, resulting in decrease of flows up to 30% to 40% over the subsequent 50 years (World Bank, 2006).

(AgMIP-Pakistan; Ahmad et al., 2015)

Six Transformations to achieve the SDGs

Nature Sustainability **2**: 805–814(2019)

Six Transformations to achieve the SDGs



Nature Sustainability **volume 2**, pages805–814(2019)

No Poverty

Quality Education

Health

Gender Equality

Economic Growth

Sustainable Health and Well Being one Health

SDG Goals 1-3, 5, 9, 14

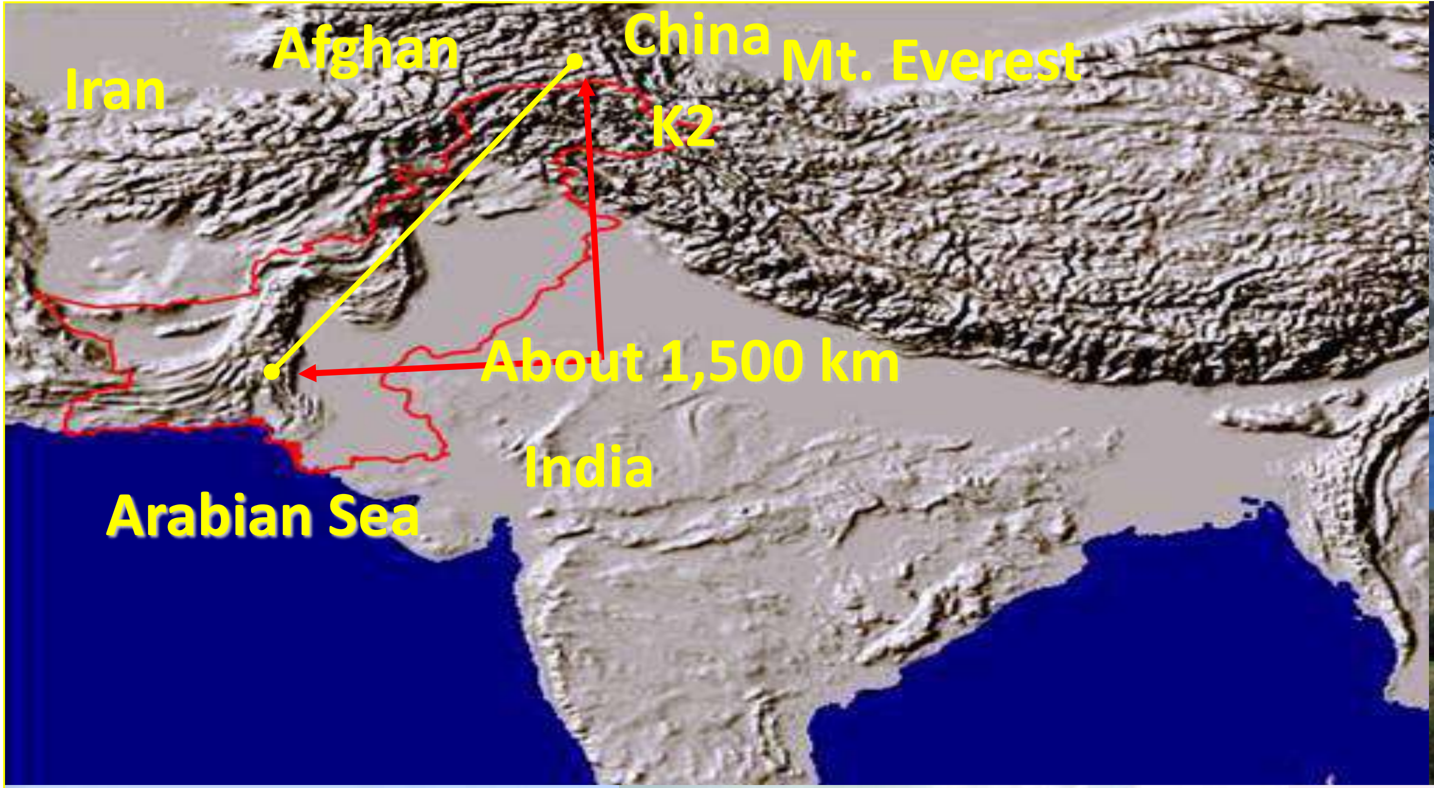
- Human population is not only increasing in number but also moving into areas which were the preserve of animals causing disruption of habitat, deforestation.
- Animals serve as early warning signals and spread:
    - 6 of 10 infectious diseases (rabies, salmonella) and 3 of 4 emerging new infections (avian flu) in man
- One health refers to more than zoonotic diseases and includes environmental factors such as climate and land use changes
    - It is multidisciplinary, involves physicians, veterinarians, environmentalists, behavior scientists etc.
    - Its reach is beyond borders and impinges on global health security

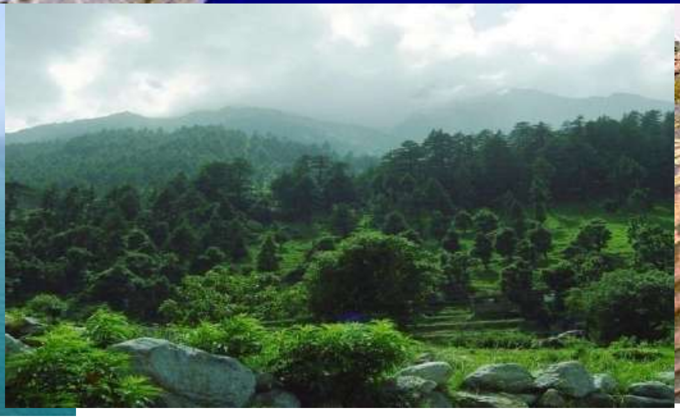
Major problems with TM

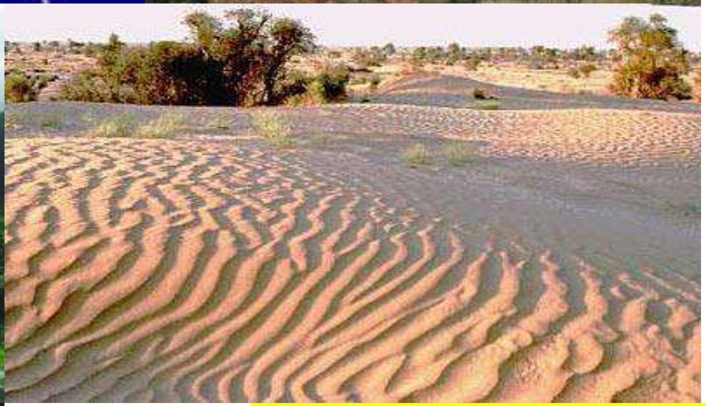
- Uncritical Enthusiasm
- Uninformed skepticism (Biased)
- Commercial Interest of Major comp.
- Incorrect diagnoses
- Improper dosage
- Low hygienic
- Secrecy of Formula (IPR & Patent)
- Clinical Trials data
- Limited Scientific Data available
- Mistrust & Perception of People
- Marketing
- Scientific Evidence (Toxicology eval. Standardization, Efficacy & Safety, Value addition, New Products of Phytochemical & Pharmacological)

Studies in the UK have found that there has been adulteration with steroids of some traditional dermatological preparations. In an analysis of herbal creams prescribed for dermatological conditions, Keane *et al.4* (1999) found that eight of eleven creams analysed contained steroids.

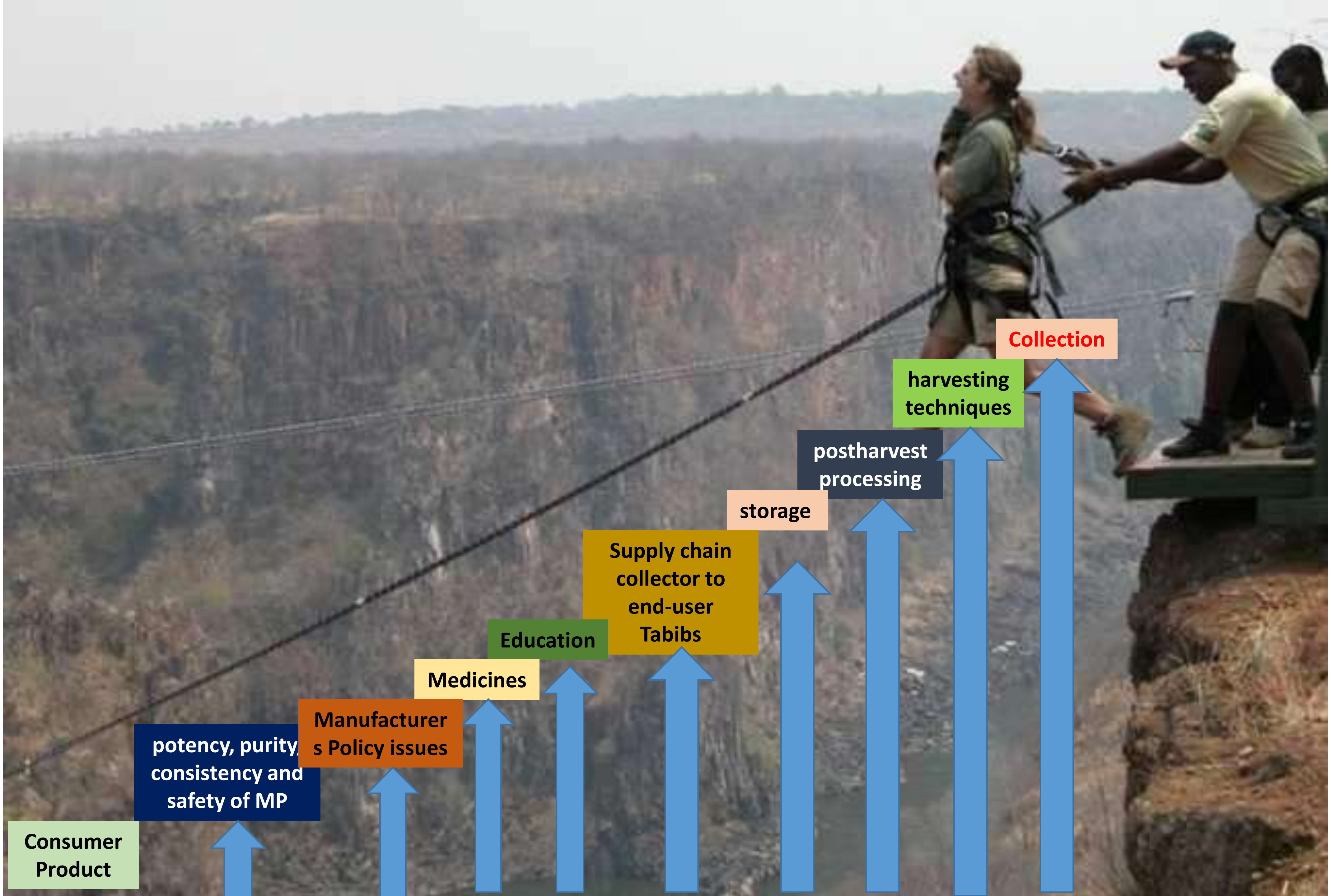
THE ORIGIN OF PAKISTAN'S PHYSICAL DIVERSITY







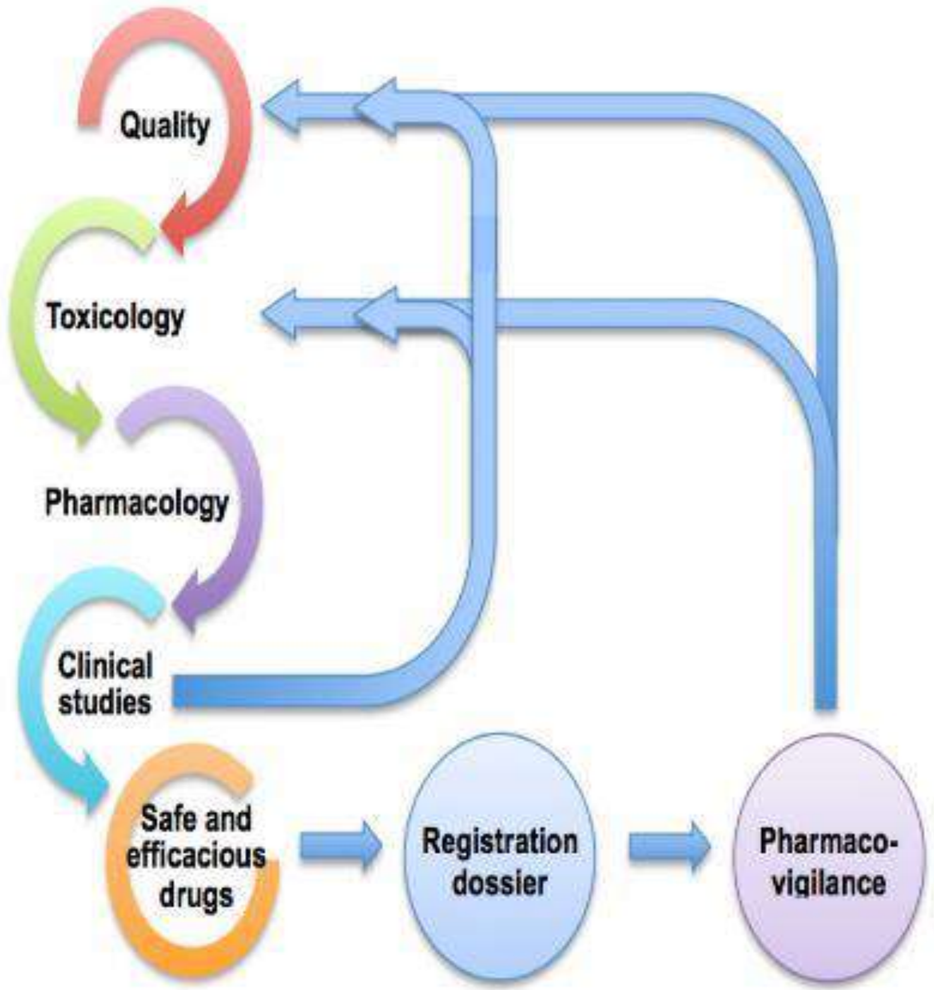
www.images.google.com


Collection
harvesting techniques
postharvest processing
storage
Supply chain collector to end-user Tabibs
Education
Medicines
Manufacturers Policy issues
potency, purity, consistency and safety of MP
Consumer Product

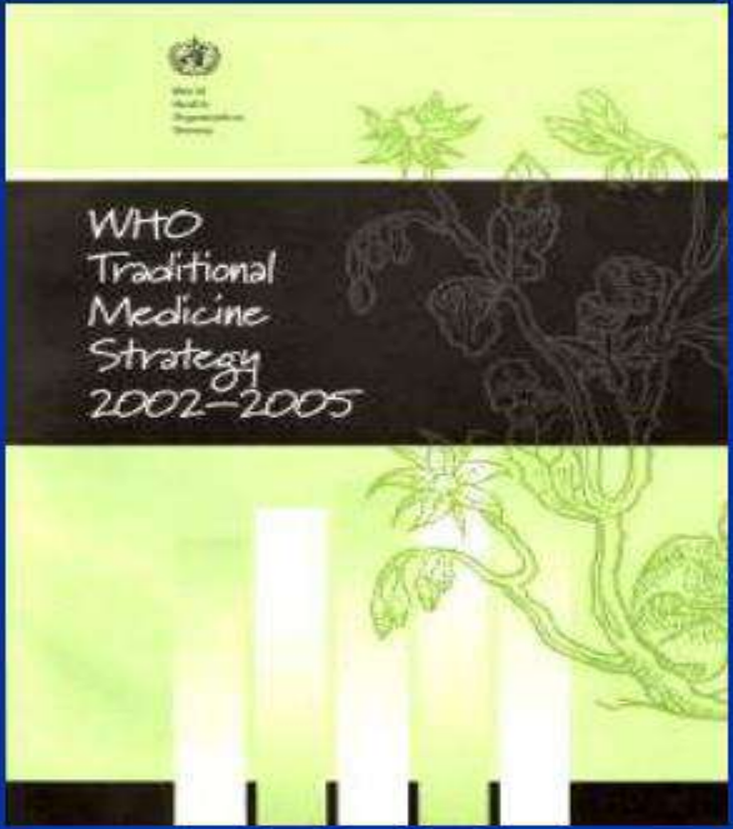
Key requirements for regulation

- Safety?
- Efficacy? (science based evidence)
- Quality?
- History of use?
- Claims?
- Trials?

Required Legislation:
Full marketing authorization (efficacy, clinical trials) to NCT Fraudulent Acts for Unlicensed manufactured tibb medicines Statuary assurance



WHO Traditional Medicine Strategy 2002-2005



1. ***Policy:*** integrate TM/CAM with national health care systems
2. ***Safety, efficacy and quality:*** provide evaluation, guidance and support for effective regulation
3. ***Access:*** ensure availability and affordability of TM/CAM, including essential herbal medicines
4. ***Rational use:*** promote therapeutically-sound use of TM/CAM by providers and consumers

Amphibian species

- Nearly one third of the approximately 6,000 known amphibian species are threatened with extinction.
- **Promising Treatment for Peptic Ulcers Lost (Brooding frog (Rheobatrachus)**
- Alkaloids made by species like the Ecuadorian Poison Frog, which could be the source of a new and novel generation of pain-killers.
- **Antibacterial compounds** produced in the **skin of** frogs and toads such as the **African Clawed Frog and South and Central American leaf frogs**.
- One compound, known as ziconotide, is thought to be 1000 times more potent than morphine and has been shown in clinical trials to provide significant pain relief for advanced cancer and AIDS patients. Another cone snail compound has been shown in animal models to protect brain cells from death during times of inadequate blood flow.

Marine snail

Lab studies suggest medicinal plants can help repair human bone and tissue

Eucomis autumnalis

- biomedical engineering techniques that can restore lost tissue and bone.
- tissue engineering and regenerative medicine. to reactivate biological processes to form products that can help with bone regeneration and tissue loss caused by trauma.
- two plants commonly used by South African traditional healers and herbalists to treat bone fractures and ease pain caused by osteoarthritis. compounds drawn from these medicinal plants could offer a valuable way to support bone regeneration and tissue loss in people who've suffered trauma.
- Tissue engineering and regenerative medicine is based on three key requirements working together: signals from body tissues and organs, responding stem cells, and scaffolds.
- Scaffolds are materials that work with biological systems to evaluate, treat, augment or replace any of the body's tissues or functions such as mature bone stem cells, cartilage, skin cells, and brain cells and neurons.
- next step is to carry out our work on animal models. The value of biomedical scaffolding is predicted to reach $1.5 billion by 2024.

The conservation: Australia August 11, 2019

Endophytic Microbes

"Microbes that live within plants without causing them disease"

- Live in a symbiotic realtionship with their host
- Provide phytohormones, acquisition of nutrients and inhibit phytopathogens and pests in return for food and shelter
- Both fungi and Bacteria

•*Fagonia cretica*
(Family Zygophyllaceae)



Applications of Endophytes

Industrial & Medical

- Antibiotics (Cryptocin, Ecomycins, Ambuic acid)
- Antiviral (Cytonic acids A and B)
- Anticancer (Paclitaxel)
- Immunosuppressant (Subglutinol A and B, Cyclosporine)
- Antioxidants (Pestacin, Isopestacin)
- Anti-diabetic agent (L-783,281)
- Biofuels

Bioremediation

- Phenols
- Chloro-phenols
- MTBE
- TCE
- 2,4-D
- TNT
- BTEX

Plant Health & Protection

- Antimicrobial compound production
- Induced Systemic Resistance (ISR)
- Bio-insectisides (Nodulisporic acids)

Plant Yield & Growth promotion

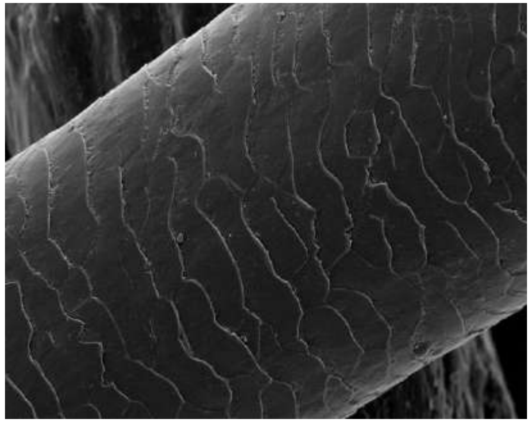
- Growth Hormones (IAA)
- Nitrogen fixation
- P solubilition
- Nutrient availability
- Phyto-stimulation

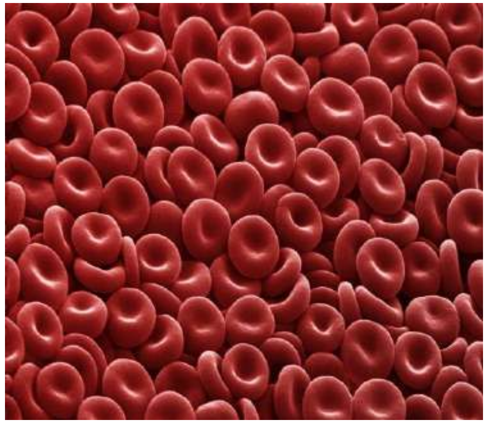
"Being Small is Excellent, Being Nano is exciting"

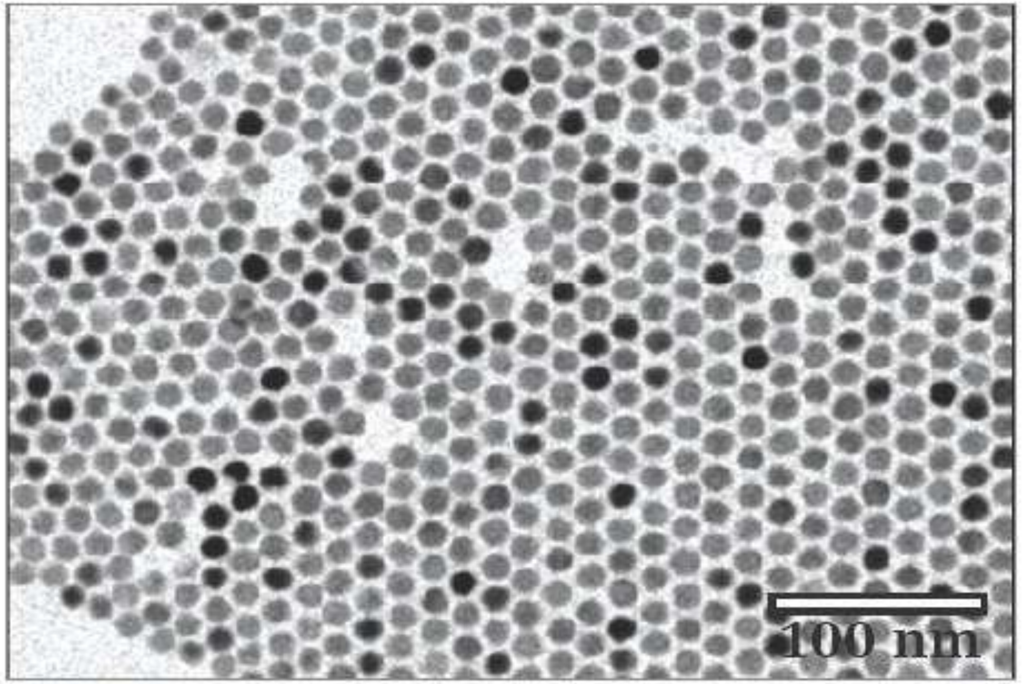
- "Nano" is Greek for "dwarf"
- Nanotechnology can be a key driving force for the accomplishment of SDGs
- Nanotechnology is applied in diverse applications.
- Apprehension at nanoscale with at least one dimension ranging from 1 to 100 nm in size
- Shape and size of the nanoparticles below 100 nm has a profound impact on their chemical, physical and biological properties
- These properties can be tuned through providing different conditions

Understanding Nano

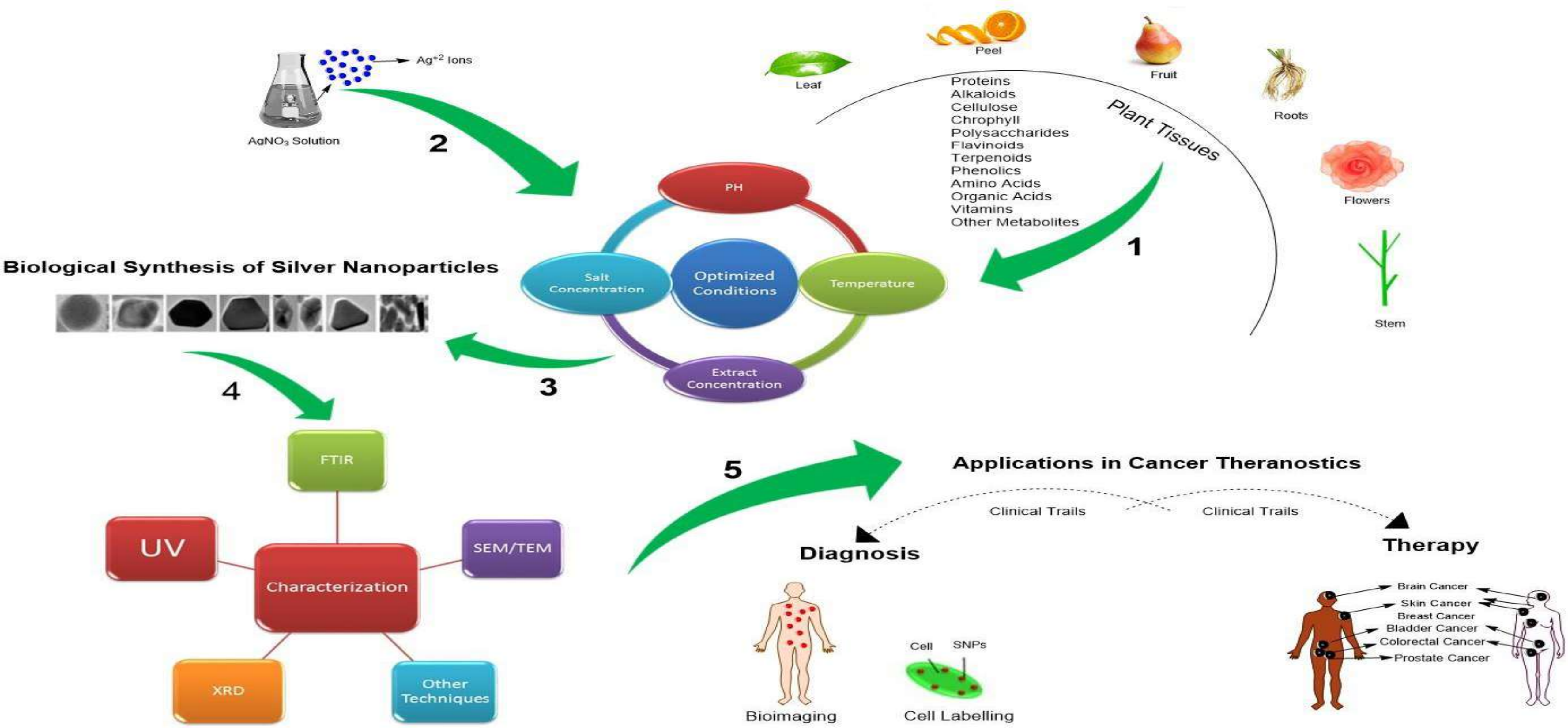
- A human hair is about 100, 000 nm in diameter
- A red blood cell 8000 nm
- Bacteria are approximately 1000 nm
- A virus particles is around 100 nm
- A hemoglobin molecule is around 5 nm
- Nanoparticles (1-100 nm).







Phytonanotechnology: A novel approach



Ovais M *et al*., "Green synthesis of silver nanoparticles via plant extracts: beginning a new era in cancer theranostics." *Nanomedicine*, 2016, 12(23): 3157-3177.

Applications (already performed)

- **Medicinal**
  - **Antibacterial**
  - **Antifungal**
  - **Antioxidant**
  - **Enzyme inhibition**
  - **Anticancer**
  - **Antileishmanial**
  - **Antiviral**
  - **Compatibility**
  - **Alzheimer Disease**
  - **Nanoscosmaceutical cream (Patent)**

- **Energy**
  - **Super capacitors**
  - **Metal oxide based electrode material (Patent)**

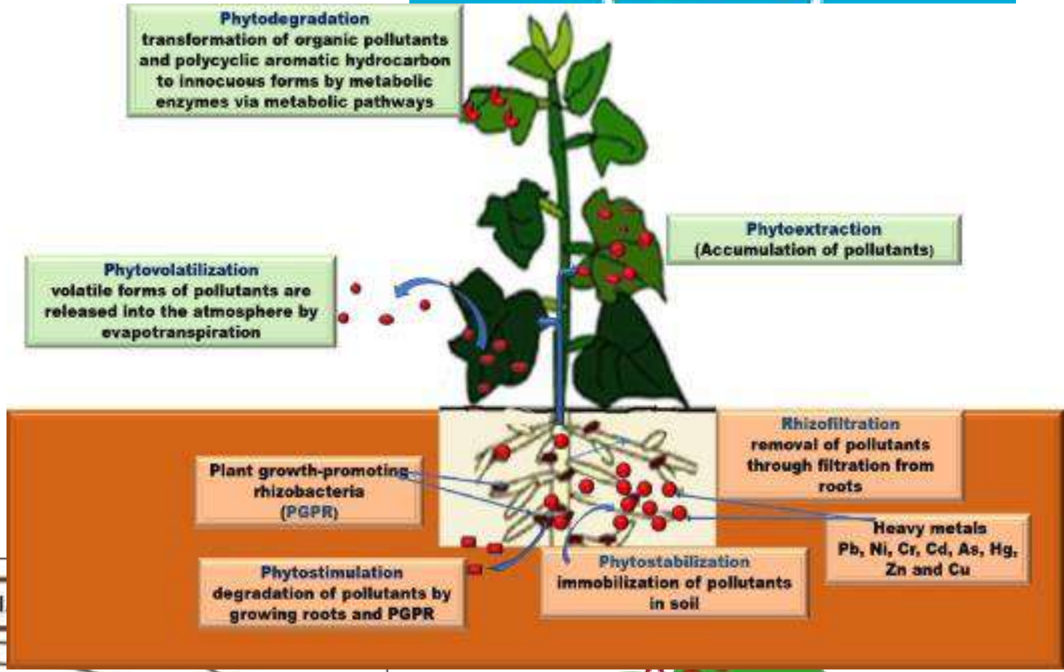
- **Environmental**
  - **Dye degradation**

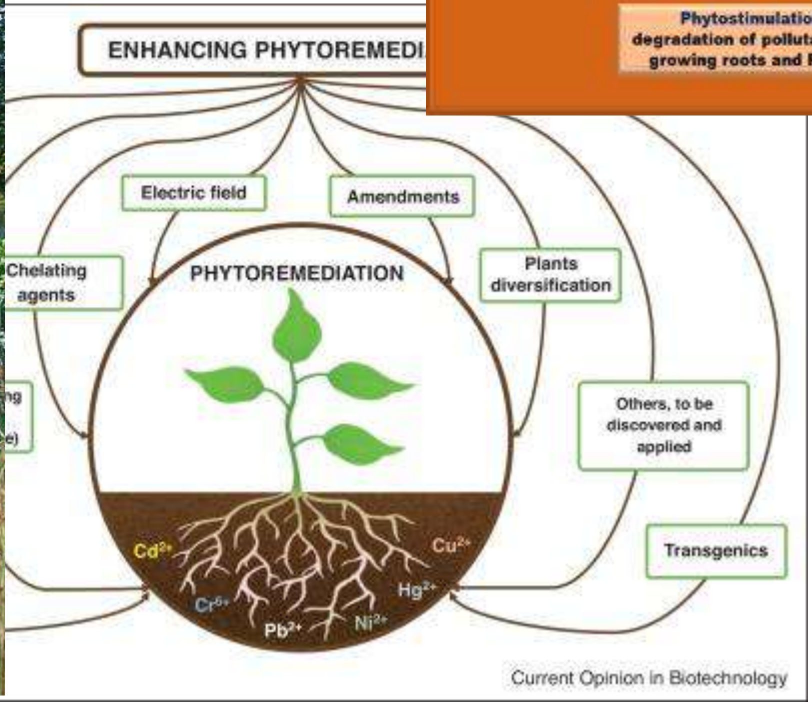
Nanoparticles assisted phytoremediation

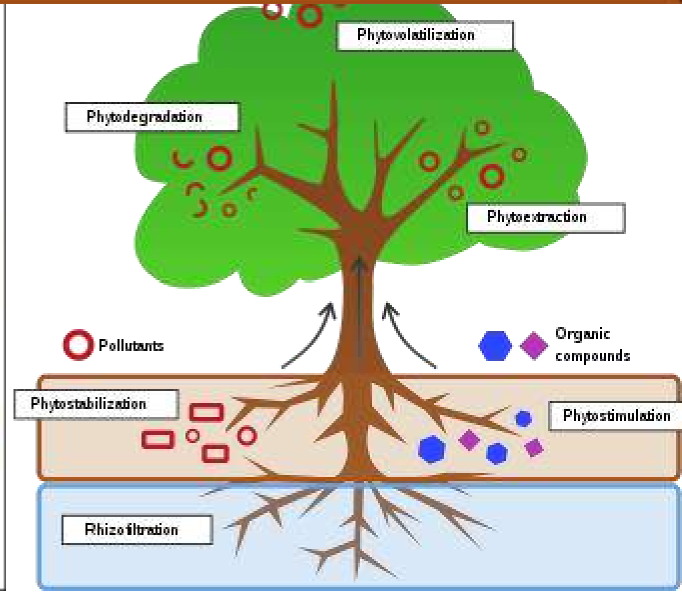
6 CLEAN WATER AND SANITATION

A natural cleaning process

- Phytoremediation is **a plant-based approach, which involves the use of plants to extract and remove elemental pollutants or lower their bioavailability in soil** (Berti and Cunningham, 2000). Plants have the abilities to absorb ionic compounds in the soil even at low concentrations through their root system.

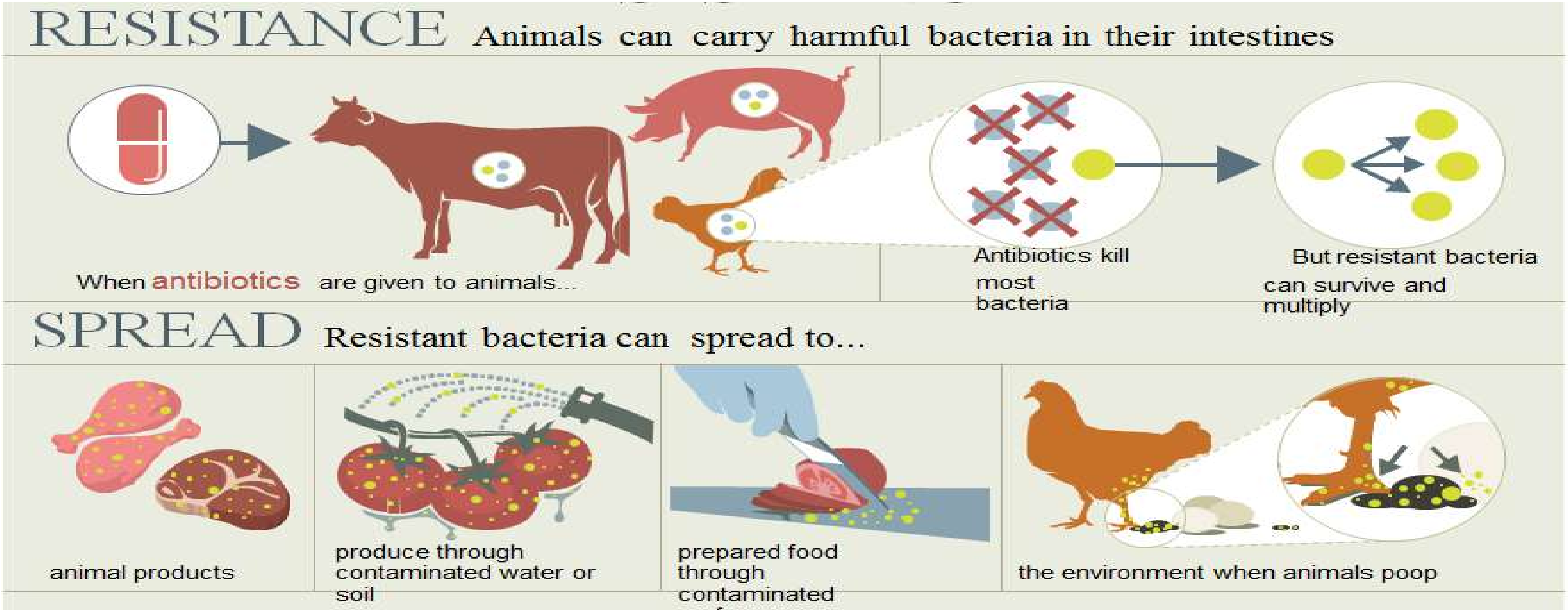






Antibiotic Resistance

https://www.cdc.gov/onehealth



[WDF and IDF launch effort to improve diabetes care for displaced people | World diabetes foundation].

An **unprecedented 66 million people worldwide have been forced from their homes -** the highest levels of displacement on record, according to (UNHCR)

A special issue explores the study of inequality, and how socio-economic divides affect the science workforce

Science and inequality

- In every society some citizens find their talents being sacrificed to poverty, prejudice, poor schooling and lack of opportunity.
- On the subject of inequality, it seems, science still has a lot of work to do

Poverty forces Afghan families to sell their kidneys, children

- **Afghan families struggle to survive amid looming economic and humanitarian crisis.**
- **Extreme poverty forces families to make life-altering decisions like selling kidneys.**
- **Father sells daughters for the sake of meeting basic needs.**

https://www.geo.tv/latest/395341-poverty-forces-afghan-families-to-sell-their-kidneys 27 Jan, 2022

DAWN

Financial crisis forcing Afghans to sell their kidneys to feed families

- **Jobless, debt ridden, and struggling to feed his children, Nooruddin felt he had no choice but to sell a kidney — one of a growing number of Afghans willing to sacrifice an organ to save their families.**
- The practice has become so widespread in the western city of Herat that a nearby settlement is bleakly nicknamed "one kidney village".
- **A kidney for $1,500**
- It is illegal to sell or buy organs in most developed nations, where donors are usually related to the recipient or are people acting out of altruism.
- In Afghanistan, however, the practice is unregulated.
- "There is no law... to control how the organs can be donated or sold, but the consent of the donor is necessary,"
- "I sold my kidney for 250,000 Afghanis (around $2,500),"
- In developed nations, donors and recipients usually go on to lead full and normal lives, but their after-surgery health is usually closely monitored — and also dependent on a balanced lifestyle and diet.

March 01, 2022 https://www.dawn.com/news/1677657/financial-crisis-forcing-afghans-to-sell-their-kidneys-to-feed-families

Support at-risk, displaced and refugee scientists

Every two seconds, an individual is forcibly displaced from their home. Among them are countless scientists, engineers and others with advanced training, who may be displaced internally or forced into exile, unable to continue their vital research and teaching work and their contributions to science.

This a loss for the entire scientific community, as well as for society more widely.

"Science represents a shared asset for all humanity — one that may be directed at rebuilding and bettering communities, economies and the environment. Securing the fractured science communities of regions in turmoil is essential to healing and regrowth."

https://council.science/current/press/international-science-organizations-unite-in-support-of-at-risk-displaced-and-refugee-scientists/ May 3, 2022

15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
16 **Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels**
17 **Strengthen the means of implementation and revitalize the global partnership for sustainable development**

International debate: Need for a Balance

- The vast majority of plant genetic resources and other forms of biodiversity are found in - or originate from - developing countries

- Need to find a balance between:
  - Developed countries' needs to access biodiversity resources
  - Developing countries seek to ensure that access is regulated so as to ensure fair and equitable sharing of benefits, including through transfer of technology and finance

17 **Strengthen the means of implementation and revitalize the global partnership for sustainable development**

Why not Developing Countries Themselves Utilize These Resources ?

We can choose

- Business as usual in a materialistic society ignoring the future

- Retreating to a fortress world of old values

- Making a transition to sustainability with science and religion in harmony

"Only Health Spirit is Guarantee of Health".

Old Civilization may resolve current issues: Leadership role in defining right from wrong

- With the old adage that **with great power comes great responsibility**, it's time for the data **science community to take a leadership role in defining right from wrong**.
- Much like the Hippocratic Oath defines Do No Harm for the medical profession, the data science community must have a set of principles to guide and hold each other accountable as data science professionals.
- To collectively understand the difference between helpful and harmful.
- To guide and push each other in putting **responsible behaviors into practice**.
- To help **empower the masses rather than to disenfranchise them**.
- Data is such an incredible lever arm for change
- We need to make sure that the change that is coming, is the one we all want to see.

https://www.linkedin.com/pulse/code-ethics-data-science-dj-patil/?trk=eml-email_feed_ecosystem

Goal 7: Biofuels, which are made from plant-based materials, mitigate the negative effects of climate change.

7 AFFORDABLE AND CLEAN ENERGY

A field of rice could be used to generate electricity

- Geo-engineering and plants

- : the current speed at which the effects of global warming are starting to manifest themselves is giving a strong impetus to the development and implementation of climate engineering technologies, either to capture CO2 or to 'dim' the intensity of the sunlight. These technologies also bring many risks, and challenge our ethical frameworks. How to deal with the intrinsic value of 'nature' when nature becomes an engineering project? Whose moral rights should be respected: those of currently living human beings, or also those of future generations? Should we also attribute moral rights to nature: to oceans, rivers, ice caps? And how to deal with intercultural differences in ethical frameworks?

Plant Production Systems "Phactories"

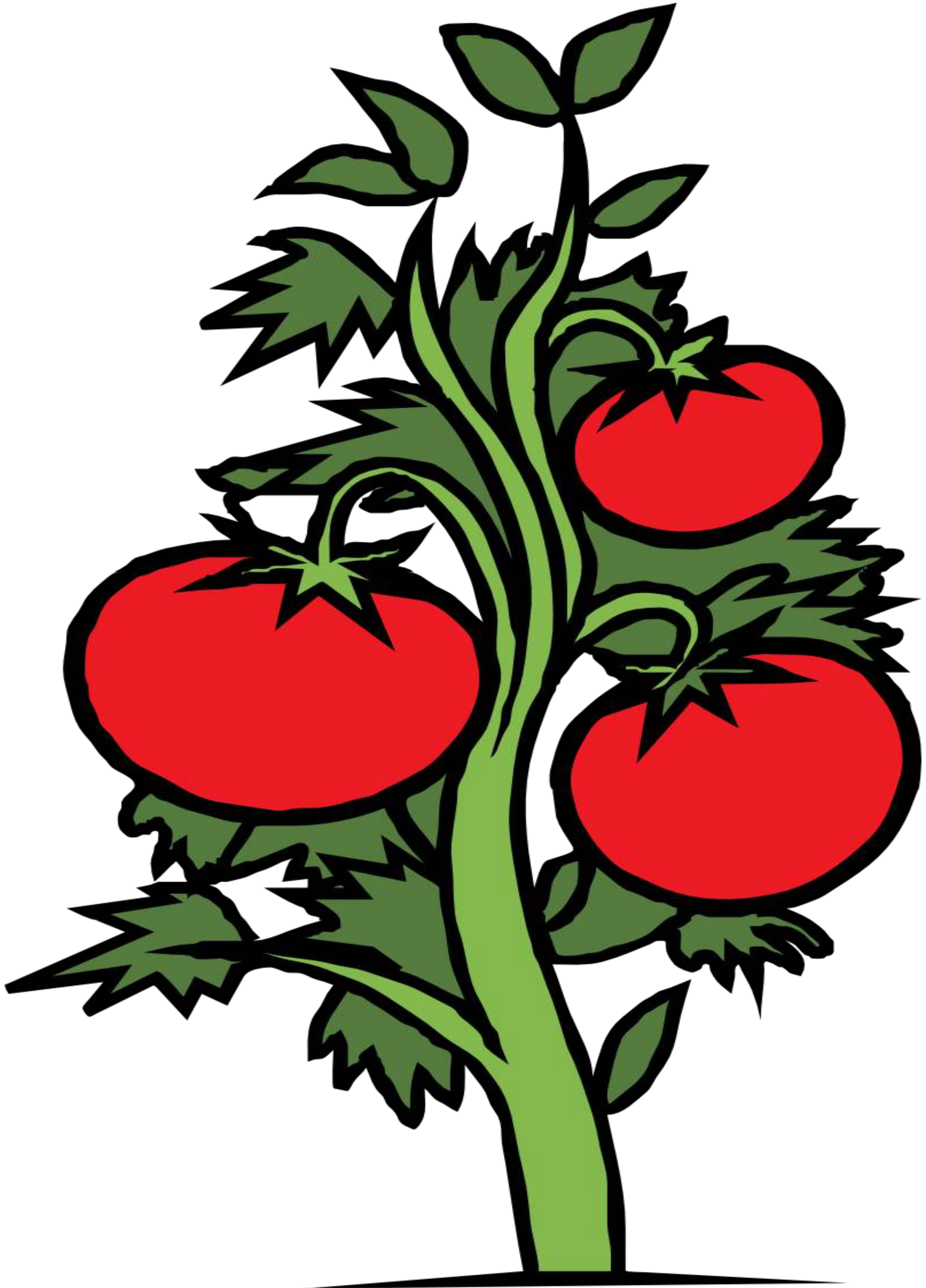
1. Industrial products

- Proteins
- Enzymes
- Modified starches
- Fats
- Oils
- Waxes
- Plastics

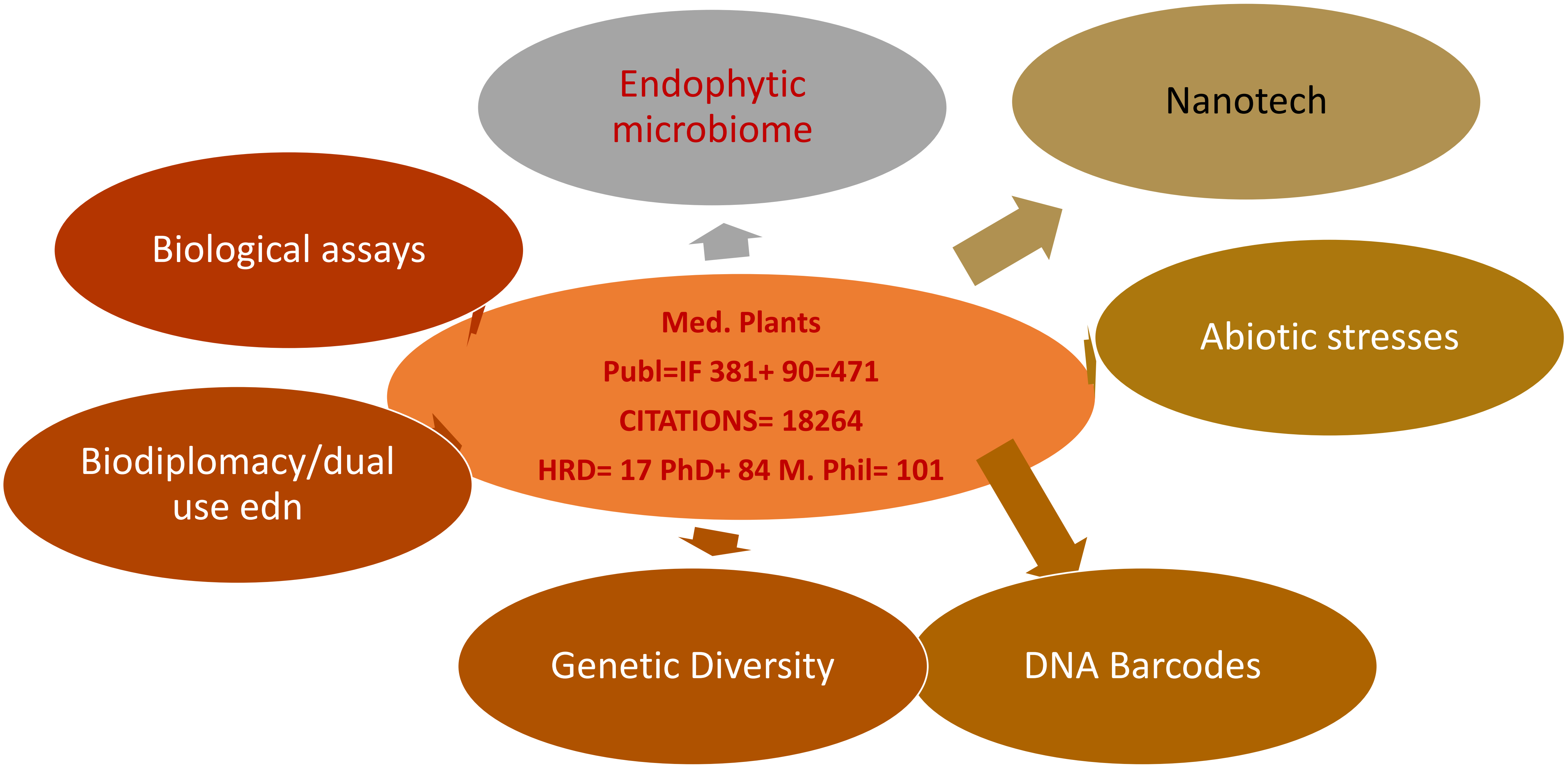
- Nutritionally enhanced crops
- Plant production systems "Phactories"

2. Pharmaceuticals (Pharmcrops)

- Enzymes
- Antibodies (Plantibodies)
- Vaccines



Summary of research work at MoSAEL labs



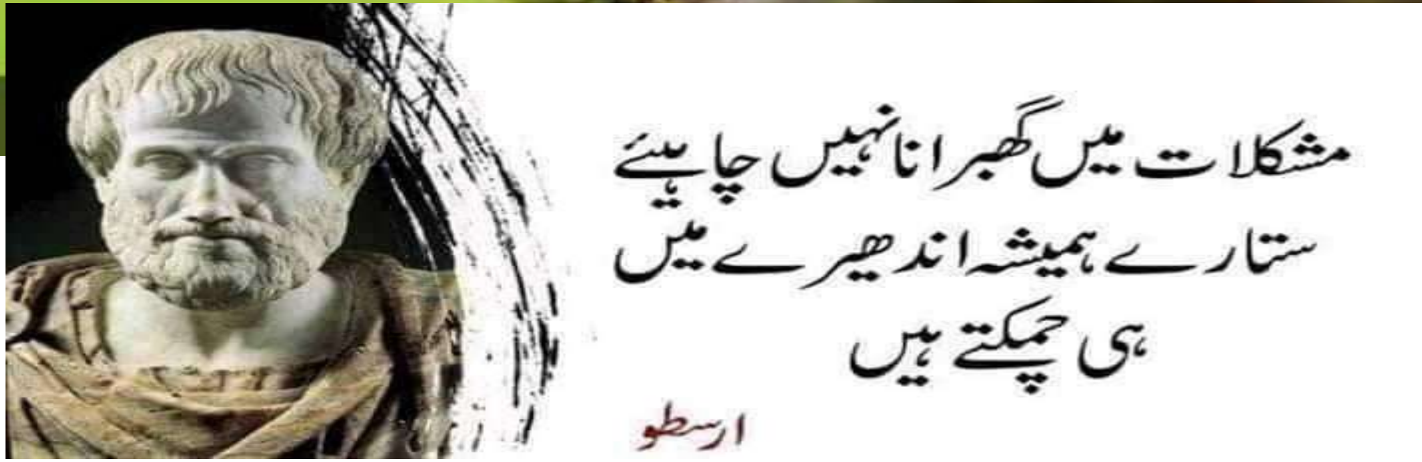
Achieving targets of SDGs: Strengthening contributions from **academia**

- Existing bibliometrics that assess the quality of academic work are usually quantitative and self-referential, reducing the focus on real-world issues. The same measurements are often adopted by funding bodies, pressuring researchers to increase compliance, and further reducing integrity and real-world impact.
- Suggestions to assist greater adoption of the SDGs and targets as a measure of impact included: aligning governmental and institutional funding; changing key performance indicators; increasing cross-disciplinary work; aligning mission/vision statements; and legitimizing SDG-focused projects at conferences.
- The changing nature of academia as neoliberal policies are stripping away the **autonomy of universities** (Harris, 2005), requiring a pedagogy that **challenges the social and political construction of knowledge**, and **implanting that in curricula**. These embedded neoliberal ideologies lean towards a **market-based system** in which education becomes training for the **global industry, rather than a public good** enhancing society as a whole. In this system, **scholars are no longer seen as the experts** in the field, but **rather as facilitators or trainers for preparing the next generation of employable workers** (Jankowski & Provezis, 2014).

If we all work together as a team..

Then we will achieve our goals

Believe you can & you are half way there



HEALTH AS AN ETHICAL ISSUE: LESSONS FROM THE COVID-19 PANDEMIC

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ABSTRACT

The COVID-19 Pandemic has created unprecedented health and economic challenge in the history of mankind. At the same time, human civilization is facing a great ethical crisis. The duty- vs right-based moral values led to justified dilemmas in the ethical decision-making process of the health care providers, specially physicians. The duty towards the patients affected by the highly contagious virus (often in the face of PPE shortages) on the one hand and the right (as individuals) of preservation of self and family members on the other hand, is difficult to be solved only by a legal framework. The rationing of life saving measures (like HFNC, ICU bed or Ventilator), in the context of acute shortages, is another example where the Physicians and Managers need to make very difficult ethical choices. Revelation of the self-centered nature of individual human beings, families, social groups and even countries have been widely noticed during the pandemic and it may not be a surprising phenomenon. But, the crisis has brought into forefront the traditional debates on the relative merits of the utility-, duty- and right-based ethics in a wider social perspective. In particular, the illusory blessings of the globalized market economy and associated neoliberal ethical principles have been facing critical questions during the whole year. The rise of ultranationalism has been exposed with its vulgar faces all over the world. It is now obvious that the worst sufferers of the pandemic are poorer and marginalized people (forming the major bulk of the world population) who are now increasingly subject to rapidly increasing health and socioeconomic inequality and injustice due to the existing world order. Managing the pandemic through authoritarian approaches (lockdown, tracking etc) have also raised certain fundamental ethical issues related to human dignity, freedom and autonomy, and, in many cases, the pandemic has been used as a tool to justify certain ideological platforms. Ethics of biomedical and health related research (and their dissemination) are also facing some basic questions regarding the sacrifice of some age-old scientific and moral practices in the face of urgent need of the humanity. Critical discussion and working consensus on those ethical issues have now become urgent for future advancement of biomedical research.

HEALTH AS AN ETHICAL ISSUE: LESSONS FROM THE COVID-19 PANDEMIC

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COVID-19 PANDEMIC

- Unprecedented health and economic challenge in the history of mankind
- Human civilization facing a great ethical crisis
- Justified dilemmas in ethical decision making process of health care providers
- Physicians as examples-
    - Duty- vs right-based moral values
    - Duty towards patients affected by the highly contagious virus (often in the face of PPE shortages)
    - Right (as individuals) of preservation of self and family members

COVID-19: RATIONING OF LIFE-SAVING MEASURES

- Example: HFNC, ICU bed or Ventilator in the context of acute shortages
- Physicians and Managers need to make very difficult ethical choices
- Difficult to be solved only by a legal framework

REVIVAL OF TRADITIONAL DEBATE

- Revelation of the self-centered nature of individual human beings, families, social groups
- Traditional debates on the relative merits of the utility-, duty- and right-based ethics in a wider social perspective
- Illusory blessings of the globalized market economy and associated neoliberal ethical principles facing critical questions
- Rise of ultranationalism with its vulgar face
- Worst sufferers of the pandemic - poorer and marginalized people, forming major bulk of world population
- Rapidly increasing health and socioeconomic inequality and injustice due to existing world order

APPROACHES IN MANAGING THE PANDEMIC

- Liberal approaches – relatively unsuccessful, but more compatible with ethical principles
- Populist approaches – utter failure
- Authoritarian approaches – relatively successful in the beginning, but raises fundamental ethical issues related to human dignity, freedom and autonomy
- Authoritarian/Popular approaches - use of the pandemic as a tool to justify certain ideological platforms and dogmas
- Individual vs State dilemma

ETHICS OF HEALTH RESEARCH AND DISSEMINATION

- Facing some basic questions - sacrificing some age-old scientific and moral practices in the face of urgent need of the humanity
- Examples- Hasty clinical trials, Challenge studies, Noncompliance to Helsinki Declaration
- Dissemination: Relative validation of non-peer reviewed publications – eg, Press briefings and Preprints

KEY VALUES IN PUBLIC HEALTH ETHICS

Value	Other relevant values or concepts
Health	Utility, wellbeing, benefits, harms, etc.
Fairness	Equality, equity, distributive justice, procedural justice, etc.
Freedom	Liberty, autonomy, human rights, respect for persons, etc.

PRINCIPLES OF PUBLIC HEALTH ETHICS

Public Health Ethics Principle	Interpretation/Example
Need for evidence	Evidence of likely benefits is needed to justify imposition of potentially burdensome public health interventions.
Least restrictive alternative	Where two interventions are expected to be equally effective, the intervention that involves the least restrictions of liberty should be selected.
Least harmful alternative	Where two interventions are expected to be equally effective, the intervention that involves the least harms should be selected.
Proportionality	The burdens (and/or harms) involved in an intervention should be outweighed by public health benefits achieved.
Equity	The intervention should be implemented (and burdens imposed) in an equitable, non-discrimintory manner.
Reciprocity	Those who benefit from public health policies/interventions have a reciprocal duty to assist and/or compensate those on whom burdens are imposed.
Due legal process	Appropriate legal procedures should be followed and individuals should have the right of appeal.
Transparency	Policymaking should be transparent and democratic.

Table 1. Role of Values in Decision Making during Public Health Emergencies.

Point at Which Values Enter into Pandemic Decision Making	Explanation	Sample Policy Questions
When explicitly invoking values	Equity, fairness, solidarity, trust, security, and transparency are all examples of values explicitly invoked by decision makers. Values reflect judgments about what is important or of worth, which can form the basis for ethical action. Ethics involves the systematic study of the values that do, or ought to, underpin choices in pandemic response.	• What does equity require in the allocation of scarce vaccines? • Does solidarity mean ensuring that people in low- and middle-income countries receive first and second vaccine doses before people in high-income countries receive booster doses? • What does a commitment to transparency or inclusion mean for decision-making processes?
When establishing policy objectives	Because policy objectives reflect judgments about what is important or of worth, they are closely linked with values, even if that link is not always made explicit. Science alone cannot tell us which objectives are important or of worth; value judgments are required.	• In a vaccine rollout, should we aim to minimize deaths, protect frontline workers, or protect critical infrastructure (e.g., services essential to the health and well-being of the public)?
When navigating trade-offs	When two or more objectives come into conflict, values come into conflict. Decision makers must determine how much weight to give certain values and assess whether the promotion of one or more values should be traded off against the promotion of other values.	• Should we prioritize suppressing a pandemic virus even if doing so could harm the economy? • Should we jeopardize in-person schooling for the sake of reducing community transmission of a pandemic virus?
When navigating uncertainty	When decisions must be made in the context of uncertainty, they may turn out to be wrong. Values inform the weight we attach to the consequences of these possible errors and our judgments about how much risk to accept.	• Should vaccinated persons be exempted from public health measures such as isolation and quarantine? • Should the interval between vaccine doses be extended to ensure that more people receive first doses more quickly?

Table 2. Fundamental Values Affecting Allocation of Scarce Medical Resources.

Value	Definition
Maximizing benefits and preventing harms	Prioritization of a good or service should maximize benefits and minimize harms. Harms may be broad and include both health harms (e.g., morbidity and mortality) and non-health harms (e.g., poverty). They can also derive directly from the disease or indirectly, as health system functioning is compromised.
Mitigating disadvantage	Special concern and prioritization should be given to people who are disadvantaged because of their income or because of discrimination based on their race, ethnicity, religion, or other factors.
Reciprocity	Preferential allocation of medical resources should be given to people who, in the past, have mitigated harm for others and faced a disproportionate burden (e.g., research participants and food-processing workers).
Instrumental value	Benefits should be provided and harms mitigated for people who can, in the future, mitigate harms and disadvantage for others. Instrumental value is not an independent value but facilitates realizing the other values, particularly maximizing benefits.
Equal moral concern	People should be treated as moral equals, and discrimination on the basis of morally irrelevant characteristics such as race, ethnicity, or religion should be avoided. People in different circumstances (e.g., in communities with higher or lower burden of disease) can typically be treated differently given unique needs.

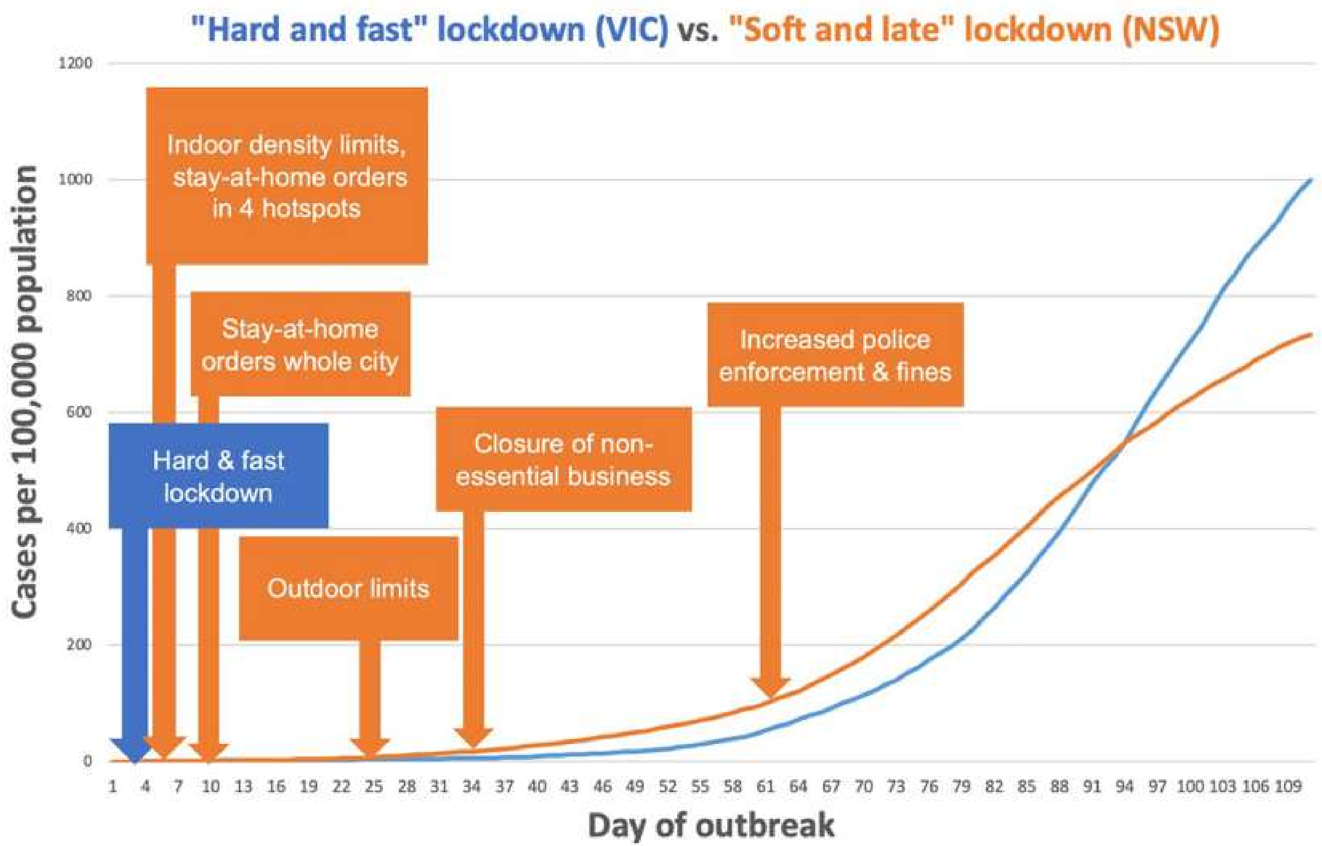

Fig. 1 Natural experiment on the effectiveness of "hard and fast" lockdown. In mid-2021, the Australian states of Victoria (VIC) and New South Wales (NSW) faced similar outbreaks of a similar variant of covid19 at similar times. Victoria instituted an immediate hard lockdown and experienced a higher peak of cases of covid19, whereas New South Wales gradually instituted a range of measures over several weaks and a experienced a lower peak of cases. Data available at https://www.covid19data.com.au/compare-lockdowns [accessed 1 September 2022].

AN ETHICAL CRISIS

- Moral errors may explain why other failures can lead to situations of crisis. Three levels of analysis.
- Moral failings of individuals, manifested in inappropriate behaviors that can lead to a crisis.
- Organizational level: because the strategies and cultures of health facilities show the existence of ethical lapses at an organizational level.
- Social and theoretical ethics, whose failures have hampered corrective mechanisms or aggravated the moral consequences of individual or organizational decisions.
- Vices are always present in one way or another in all human activity. And a cause present irrespective of whether or not the effect occurs cannot be a satisfactory explanation.
- If many agents have been motivated by greed in many places and for centuries, why did the crisis occur now and in these countries, and not at other times and in other places?
- A society has long developed protective mechanisms, not against immoral behavior itself but against its consequences, ranging from law, courts and fines to the social rejection of offenders. It is possible that these social mechanisms have relaxed in recent years

OPERATIONALIZING ETHICAL APPROACHES IN HEALTH

- Policymakers should heed the lessons of the pandemic by appreciating the ethical, not just the technical, dimensions of all challenges faced during emergencies; by starting from existing knowledge about the right values and principles to guide policy
- Ethical values cannot apply themselves or resolve conflicts among themselves. Positioning ethics to meaningfully inform decisions requires changing the policymaking proces.
- Ethics must be considered at the start of any response to a health emergency
- Government policies should be expected to be not just evidence-informed but also explicitly ethics-informed
- During an emergency, policymakers call on epidemiologists and others to bring their expertise and experience to policy formulation; they should also call on ethicists to inform a coherent ethical response
- How can this approach be operationalized? First, like epidemiology and vaccine development, ethics cannot simply be switched on during an emergency
- Institutional capacity and memory cannot be built or restored ad hoc
- The agencies responsible for responding to public health emergencies need to have trained ethicists on staff, regularly participating in scenario planning and advising

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CONCLUSION

Critical discussion and working consensus on ethical issues have now become urgent for future advancement of healthcare and biomedical research. Organizations like IAS and COMSTECH may play a role in creating such consensus

Thank You

BIODIVERSITY ECONOMICS

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ABSTRACT

The biodiversity economics consider the biosphere (Natural Capital) as a self regenerative asset or stock with humans being part of it. Since the biosphere is inherently bounded, the global output of goods and Services are inevitably bounded. The standard economics, however, use the biosphere as an arena to accumulate produced capital and human Capital as indicated by GDP and HDI while ignoring the natural capital. The notion of Sustained growth and development in global Output, speculated by the development economists and promoted by the world bank, is thought to be possible when investing in future science and technology coupled with the application of proper institutions.

While natural capital is similar to produced capital in being consumed and depreciated, its regenerative capacity may slow down or cease to exist abruptly at a tipping point without warning as a result of continuous cumulative sight disturbances. This is ascribed to the fact that the biosphere renders its goods and Services through myriad of healthy and functional ecosystems. The ecosystems could occur in different stability regimes where biodiversity acts as enabling asset and exerts non-linear impact on its productivity and resilience. The temptation to overuse or undervalue natural capital stems from the intrinsic characteristics of nature being silent, invisible and mobile. Often, it's goods and Services are free at the source and are not subjected to property rights. This is aggravated by governmental subsidies and institutional failure.

The pervasive human activities to improve the standard of living give rise to externalities that transcend space and generations. Currently, we experience the rise of global temperature, Climate Change, sea water rise and acidification, frequent environmental extreme events, biodiversity loss and shift in 9 of biosphere biophysical processes known as planetary boundaries, with the biodiversity loss and nitrogen biochemical flows had already crossed their boundaries.

The biodiversity economics calls for proper management of the whole capital portfolio (produced, human and natural) taking into account that most of natural capital goods and services come free or low cost, so they don't appear scarce to a private entity or person.

The government subsidies and institutional imperfections create a gap between market price of the goods and services rendered by the biosphere and their social worth as reflected by their accounting price. This translates into disparity between private incentives in accumulating profits regardless of the externalities and the social aspiration for well-being. In essence, the biodiversity economics advocates the concept of inclusive wealth which essentially reflects the social worth of an economy's portfolio value of capital goods as reflected by the quality of life or the well-being but not mere accumulation of produced capital (through raising GDP).

This concept Calls for the portfolio manager (the government) to compare the assets in his portfolio employing the rate of return to account for the depreciation of the capital. In this sense, he is expected not to choose an asset with a lower rate of return. To exercise prudent management of his portfolio he has to evaluate the set of choices and remain neutral among various forms of capital goods. Accounting prices but not the market prices should be employed for fair valuation of assets' yield (rate of return).

In this regard Field *et al* (1988) estimated the planetary net primary production at the end of the 20th century to be 105 trillion Kg/year. The global stock of biomass was estimated by Bar-on *et al* (2018) to be 550 trillion

kg/year. Thus, the biosphere average yield on the Stock (105/550) per year equals 19% a year. This figure deviated from the long-run global yield on Prudent management of produced capital which was calculated by Jordà *et al* (2019) to be 5%. The difference is 14%. Knowing that the demand for natural capital does not necessarily equal the regenerative rate of the biosphere. The difference is accommodated by exhausting or consuming the stock. It follows that we are actually overusing our natural resources by 14%. This Condition creates Impact Inequality which is driven by excessive demand on the biosphere. It is proportional to the ever-increasing world population (N) and our consumption pattern or standard of living (Y) as proxied by GDP and inversely proportional to the technology and institution with which the goods and services are converted into GDP and the extent to which the biosphere is transformed by global waste (∝). When such demand exceeds the regenerative rate of the biosphere (G), Impact Inequality is substantiated. The above relationship is reflected in the formula $NY/\propto > G$.

For sustainable development in the context of considering the current and future human societies' well-being, we are to strive to achieve Impact Equality where by our demand on the biosphere goods and services are to be within the limit of its regenerative capacity ($NY/\propto = G$).

The Global Ecological Footprint is a ratio between our demand and the regenerative capacity of the biosphere ($\frac{\text{Ny}}{\propto}/G$); its current value is 1.7 meaning that we need extra 0.7 earth to satisfy our current consumption sustainably. The above argument raised a legitimate question of whether the UN SDGs could be fulfilled by 2030 under business as usual practices. In other words, can the average annual increase in the rate of technology as suggested by the development economists neutralize the externalities of our excessive demand on the biosphere? To examine this Dasgupta calculated the current global rate of annual increase of technology and what it should be if to achieve sustainably by 2030 by applying this formula using data generated by different authors regarding the global average rate of increase in GDP (proxy of consumption) and the global average rate of change in the biosphere regeneration.

$$g\left(\frac{\text{Ny}}{\propto}/G\right) = g(\text{Ny}) - g(\propto) - g(G)$$

Where g(x) is the rate of change of any variable.

He found that the current global average rate of annual increase in technology (∝) is 3.5% whereas he calculated the needed value for (∝) to be 10% to achieve sustainable growth which necessitates that we reduce our Global Ecological Footprint from 1.7 to 1.0; a condition at which the demand ($Ny/\propto$) will be equal to the Supply (G).

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Biodiversity Economics

1. Biodiversity Economics vs. Standard Economics.

2- Characteristics of Natural Capital and its goods and services mechanism of delivery:

  Ecosystem

  Biodiversity

3- Econometrics of Natural Capital:

  Demand

  Supply

  Impact Inequality

  Impact Equality

  Ecological foot print

4- Inclusive wealth and Portfolio Management.

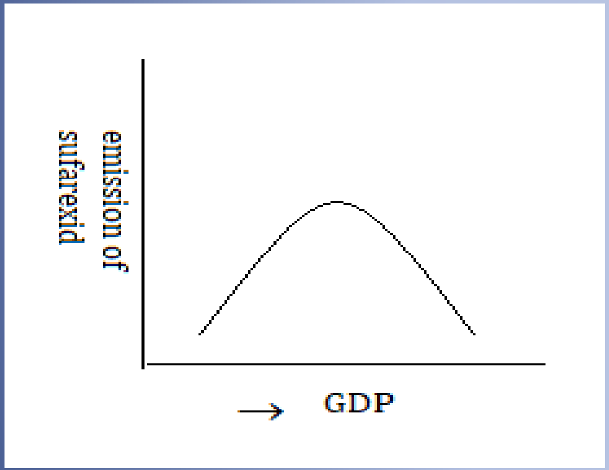
5- Are UN SDG_s achievable by 2030? (quantitative analysis)

The biodiversity economics consider the biosphere (Natural Capital) as a self regenerative asset or stock with humans being part of it. Since the biosphere is inherently bounded, the global output of goods and Services are inevitably bounded.

The standard economics, however, use the biosphere as an arena to accumulate produced capital and human Capital as indicated by GDP and HDI while ignoring the natural capital.

The limited view of the place of nature in economy can be traced to the World Bank (1992), which propagated the Kuznets Curve which illustrated that the emission of Sulfur oxides is related to GDP/capita in the form of inverse U.

Emission of sulfur oxides is not representative of environmental harm.



Consider: 1. destroying mangrove forest in favor of shrimp farms.

Loss of goods and services of water sheds for downstream farmer in forest being destroyed for logging.

The development economists thought that because there is no obvious limit on human ingenuity; technological progress and institutional improvement can enable the global output (GDP) of final goods and services to grow indefinitely.

This has been illustrated in 15 X increase in global GDP over the past 70 years. But this has been translated into ecological footprint that exceeds the biosphere's ability to deliver its goods and services on a sustainable base.

The development economists speculated that the global population and the global output /capita (GDP/capita) or both could increase with extra demand on the biosphere if we are able to increase the rate of science invention and technology innovation coupled with proper policies and institutions correspondingly. This notion, advocates the idea of indefinite economic growth, which is encountered in the literature on economy of Climate Change.

Examples: decarbonizing the economy, raising the supply of biosphere ($G_{(s)}$) through technology and institution to bridge the gap in the inequality equation.

However the biodiversity economics considered humanity as embedded in the biosphere. It says that the global population and the global output can’t be increased indefinitely. It is instead bounded. It involves a dynamic resource allocation problem. The demand we make on the biosphere doesn't have to equal the biosphere's ability to supply goods and services, because the difference is naturally accommodated by a change in the biosphere’s stock.

A nation could choose to draw on the biosphere and use the goods and Services it supplies so as to accumulate produced and human capitals. This is the core of economic development and Standard economics.

The Biodiversity Economics calls for proper management of the whole capital portfolio taking into account that most of natural capital goods and services come free or cheap. So they don't appear scarce to private entity or person. This even get worse by government subsidies. Such institutional imperfections create a gap between the prices (market price) of goods and services and their social Worth (accounting price). These in turn create disparity between private incentives and public aspiration.

The economic value of the biosphere

In an attempt to persuade the skeptics, the global flow of goods and services was estimated towards the end of the 20th century worth us $ 16-56 trillion annually with an average figure of US $ 33 trillion. This figure is larger than global national product in mid-1990 which is estimated at the time to be US $ 18 trillion annually.

Characteristics of Natural Capital and its goods services mechanism of delivery:

1- Natural capital is similar to produced capital, in being consumed and depreciated but it is durable (regenerative). However their regenerative capacity may slow down or cease abruptly at a tipping point without warning as a result of continuous cumulative slight disturbances.

2- Natural capital as a stock is accounted for by biodiversity economics as a social scarcity value that contributes to wealth along with produced capital and human capital.

3- Most of natural capital is free at the source and undervalued and open to all rendering it vulnerable to degradation due to over use or misuse.

   Institutional failure, the characteristics of natural capital being mobile, silent and invisible or being subjected to inadequately enforced or weakly defined property rights contributed to this end.

4- Production and consumption possibilities involving biosphere are characterized by non-linearity; a characteristic that is at odds with the requirement of a well-functioning market system.

The biosphere's regeneration is carried out through the ecosystems processes and functions and these constitute the key to sustainability. Biodiversity decline disrupts these processes such as these governing the climate system. Thus the economics of biodiversity is the economics of the biosphere which combine abiotic environment and the self-organizing, regenerative functional biotic forms that control the flow of energy, nutrients and organic matter.

A)Ecosystems are thus constitute a capital goods. like produced capital, they depreciate if they are misused or overused but they differ from the produced capital in three ways:

1. Depreciation in many cases is irreversible or at best can take tedious work and long time to recover.
2. It is not possible to replicate a depleted or degraded ecosystem.
3. Ecosystems can collapse abruptly without much prior warning.

B) Ecosystem regenerates via function and processes, that are non-linear and are mediated by biodiversity which:

1- Connect biotic and nonbiotic components of ecosystem by nutrient cycles and energy flow.

2- Form the basis for ecosystem's productivity and resilience as an important feature that contribute to ecosystem integrity.

Biodiversity reduces uncertainty under stress condition akin to diversity function in financial portfolio:

1. Variation among diverse species and within species will increase the capacity of the ecosystem resilience to shocks. Some Species have obscure presence, but become prominent once the dominant species became weak due to disturbance. (Otters, urchins, kelp and fish).
   It plays a complementary role in the ecosystem productivity through various functional groups and traits through mutual dependence among species. Examples Lipid-rich fruits are adapted for animal dispersal. which mean that the demise of the birds-eating fruits can have adverse consequences for forest regeneration.
2. It is analogous to complementarities among inputs in industrial production, if one component is lacking, the whole process will come to halt.

Biodiversity affects the productivity of natural capital like skills, health and education affect the human capital and the infrastructure affects the produced capital "It is an enabling asset".

From the Anthropocentric point of view biodiversity exerts non-linear Impact on the ecosystem's productivity where it declines at accelerated rate as biodiversity loss increases. In addition, loss of biodiversity across trophic levels has the potential to influence ecosystem functions even more strongly than diversity loss within trophic level.

1. If you divide an ecosystem into parts by creating barriers, the sum of the productivities of the parts will typically be lower than the productivity of the whole. (Dams, fragmentation and corridors may lead to extinction of some species).

2. Non-linearity is a reason markets are inadequate system of institutions for protecting the biosphere from overuse, or ensuring that our consumption and investment decisions are based on reflective balance between our own well-being and well-being of our descendants.

The Millennium Ecosystem Assessment (MA 2005) recorded biodiversity loss in the last 3 decades as follows 50% of marches, 35% of mangroves, 40% of reefs.

Buceini et al (2017) estimated that forest captured around 435 million tonns of Carbon annually, but lost 860 million tonnes, 70% (602 million) due to deforestation and land degradation.

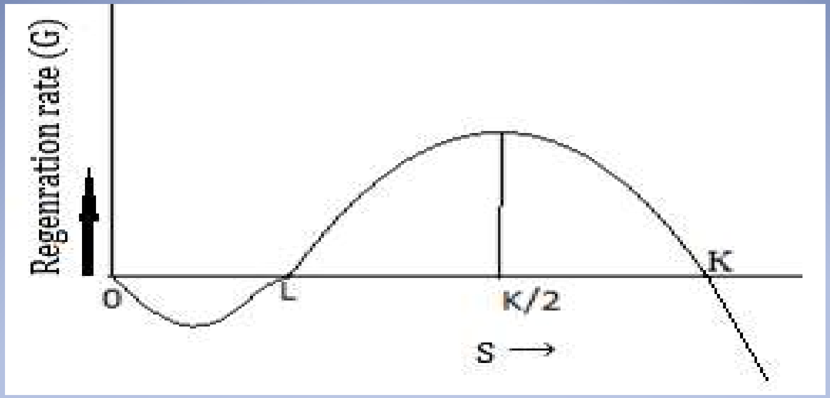
Biodiversity is maximized at intermediate level of disturbance due to successional sequence where species trade off Colonization ability with competitive advantage until the Climax species take over.

Unfortunately, increasing level of disturbance can drive the System backwards to low diversity.

Resilient ecosystem harbor redundancy, where species sit in the wings like spare capacity in economic production System. Reduced variation means reduce capacity for adaptation and consequent loss of resilience.

Ecosystems occur in different stability regimes where the stability regimes states are Well defined, but the uncertainty lies in the location of the states that separate the regimes, so the magnitude of disturbance the ecosystem can tolerate before it moves to a different stability regime could not be determined exactly.

Example: the fishery stock in the lake.



Dynamic of ecosystem and prudent management of a fishery in lake ecosystem

S = the stock; (G) = Regenerative rate birth rate-death rate; L = the stock threshold (If it falls below, the fishery would be doomed);K = the carrying capacity of the system; r = the reproductive rate.

$\frac{ds}{dt}$= $G_{(s)}$ = r S [1-$S_{(t)}$/K] [($S_{(t)}$-L)/K]

There are three stationary points in the system

When S=0 stable; S = L non stable; S = K stable ← attained when no interference with system

If finishing took place at the rate of $R_{(t);}$ Than $dS_{(t)}/d_{(t)}$= $rS_{(t)}$[1-$S_{(t)}$/K][($S_{(t)}$-L)/K]- $R_{(t)}$

Good management practice would demand that the stock be prevented from dropping below L. The prudent management calls for harvesting at K/2.

Some example of extreme disturbances in ecosystems:

1. Sea otter in North East pacific by preying on urchins enable Kelp forest to thrive - As kelp provide habitat for many fish. An explosion of urchins can create Kelp barren and depress the fish population.

   A balance between native Species is reached in ecosystem over extended span of time.

2. Introduction of non-native Species may change the composition and reduce the resilience of the ecosystem.

   "Nile perch" a predatory fish introduced to Lake Victoria in 1950 decimated native species.

Econometrics of Natural Capital

Definitions

A market Price: is the price at which a good, service or asset is exchanged in a market

An Accounting price: Is the price that reflects the true value to society of any good, service or asset.

(It augments value of externalities that emanated from the destruction, degradation of natural capital).

The inclusive wealth is the aggregate value of the nation produced capital, human capital and natural capital.

The changes in the inclusive wealth can point to the Status of Sustainable development.

Ecological foot print: is identified as a ratio of demand /Impact over the supply or the regenerative rate of the biosphere: $[NY/\propto]/G$.

Natural Capital Econometrics

Supply

It is the regenerative rate of the biosphere $G_{(s)}$ which is a function of the biosphere's stock (S).

$G_{(s)}$ can be affected by policy:

Examples

1. Transplanting heat tolerant corals for more survival under bleaching conditions.
2. Importing foreign species into the ecosystem may result in unintended, detrimental consequences.
3. Intervention involving using genetically modified Crop is Controversial.

Demand

A) Demand (impact)

Humanity exerts its impact on the biosphere through

a) the global population size (N).

b) Individual demand on the biosphere proxied by GDP/Capita (standard of living) (Y)

c) Technology and institution ($\propto$) Which is a numerical value of the efficiency with which the goods and Services are converted into GDP and the extent to which the biosphere is transformed by global waste.

The Demand = $\frac{NY}{\propto}$

The demand is a function of the population (N) and its activity (Y) which inevitably associated with waste and inversely related to ($\propto$).

Impact Inequality occurs when

$$\frac{NY}{\propto} > G_{(s)}$$

The left side is the impact (demand)

The right side is the supply

If the global Impact (I) exceeds the biosphere's regenerative rate (G), the biosphere Stock diminishes as a result of the presence of a gap between I and G.

Impact Equality

The condition under which we can attain Sustainable development points to ways in which we stabilized the biosphere Stock.

This requires that the Impact must equal the biosphere's regenerative rate.

That is

$$^{NY}/_{\propto} = G_{(s)}$$

The many paths that we opt to achieve this becomes a dynamic portfolio management problem that must satisfy the arbitrage conditions among all assets (produced, human, and Natural).

Inclusive wealth and portfolio management

- The inclusive wealth is the social value of an economy's portfolio of capital goods.
- It is the sum of accounting values of produced capital, human capital and natural capital
- Inclusive wealth should be the instrument to evaluate economic change
- The social well-being is maximized if inclusive wealth is maximized
- A society could raise its inclusive wealth and thereby its well-being by improving its institutions and practices with regard to providing protection to environment.

Then we are talking about 2 equities: the wealth and well-being

The biodiversity economics apply the wealth/well-being equivalence theory which requires the policy analysis at a point of time to evaluate alternatives to which capital good and yield can be put for sustainable assessment which measure prosperity (does not mean high GDP) as reflection of the quality of life or the well-being. Its task is to weigh change in the asset structure.

- So the study of biodiversity economics become the study of inclusive capital Portfolio (produced, human and natural) under arbitrage conditions.
- Comparing the assets in the portfolio employs using its own rate of return (yield) but this is misleading since it doesn’t account for depreciation of the capital or yet we can use the rate of return which means its yield plus appreciation or depreciation of the capital. This value then measures the wealth which is calculated on the basis of the accounting price but not the market price.

The Arbitrage Condition

At the local level

The portfolio manager “The government in this case” will not choose an asset with lower rate of return than others.

Assume the asset is mineral deposit in a forest (S) and the market price for the mineral is (X) that its yield, however its accounting price (or rate of return) is

The market price (X) + (-Y) where (Y) has negative value due to externalities created by environmental damage

The ideal situation is achieved when the market value of a portfolio would equal its accounting value but this is not the case because private incentives and social imperatives differ. So, the agent task is to put into practice polices that bring the two into alignment as close as possible (This done by using accounting price as an option to act as proxy for inclusive wealth to maximize social well-being).

At the global level

Assets that are open to all to use as each see fit, free of charge. They are known as open access resources

1. Like the atmosphere as a sink of CO_2.
2. Marine fisheries beyond nation’s jurisdiction (200 mile from cost) in open seas.

Estimates of own rate of return (yield) on global primary producers compared to own rate of return (yield) on representative financial assets points to the fact that global investments in produced capital, and human capital have come in tandem with enormous deterioration of natural capital.

Managi and Kumar (2018) estimated the global per capita accounting values of the 3 classes of Capital Goods over the period 1992-2014 They found produced capital increase by 100%.

Human capital increase by 13%

Natural capital decreased by 40%

Net primary production calculations and the own rate of return (yield) of an ecosystem

Let $S_{(t)}$ is the plant biomass at time (t)

Let $X_{(t)}$ is the herbivores biomass at time (t)

Let $Z_{(t)}$ is the carnivore's biomass at time (t)

Where r is the intrinsic rate of increase.

K is the Carrying Capacity of the ecosystem

$\propto$ rate of attack of carnivores or herbivores

NPP = $r\, S_{(t)}\, (1 - S_t/K) - \propto S_{(t)} . X_{(t)}$

The ecosystem total biomass

$S_{(t)} + X_{(t)} + Z_{(t)}$

The yield = $\dfrac{rS_{(t)}\left(1-\frac{S_{(t)}}{k}\right)-\propto \mathbf{S}_{(t)}.\mathbf{X}_{(t)}}{S_{(t)}+X_{(t)}+Z_{(t)}}$

Rate of Return on Primary producers

-Planetary NPP estimated at the end of 20th century to be: 105 trillion kg/year (field et al 1988)

Global Stock of biomass = 550 trillion kg/year (Bar-on, Philips and Milo, 2018) The biosphere average yield on the Stock 105/550 per year = 19% a year.

Now Jorda et al (2019) estimated the long-run global yield on produced Capital to be around 5%

Assume we manage our global portfolio of assets in an efficient manner. The difference is 14% which means that the difference had been generated at the expense of the capital

That is, we are overusing our natural capital by 14% as compared to prudent management of our produced Capital. This simply means that the accounting price of primary producer’s relative to that of produced capital is declining by 14% a year.

Are the UN SDG_s achievable by 2030?

I) Given Data

The impact equality offers a way to device policies and behavioral changes required to achieve UN SDG_s by 2030.

Are these attainable?

Calculations:

The global foot print Network (GFN) = $\frac{NY/\propto}{G_{(^s)}}$ = global ecological foot print

1. Wackernagel and Beyers 2019 calculated that global ecological footprint increased from 1.0 in 1970 to 1.7 in 2019; this means the ratio increased at an average annual rate of [1.1%]
2. The global GDP has increased since 1970 at annual average rate of 3.4%
3. The global natural Capital decline per capita was estimated to be 40% between 1992 and 2014 (Managi and Kumar 2018) Accordingly, the calculated global capital decline annually = -1.2% (Dasgupta 2021).

The global Ecological footprint could be calculated using this formula (Dasgupta 2021):

$g\ [\frac{NY}{\propto}/G] = g\ (NY) - g\ (\propto) - g\ (G)$

Where g (x) is % rate of the change of any variables

g (NY) = represents the average ratio of annual increase of global consumption of biospheres goods and services represented by increase of global GDP.

g (∝) = The average ratio of annual increase of technology that can neutralize waste and increase efficiency by which we convert the biosphere's goods and services into products (It augments also the institution foam)

g (G) = The average ratio of annual increase (decrease) in the regenerative rate of the biosphere

$g\ (\frac{NY}{\propto}/G)$ = Average ratio of annual increase or decrease of global footprint Network

$+1.1\% = 3.4\% - 9\ (\propto)\ \ (-1.2\%)$

$g\ (\propto) = 3.5\%$

This is the calculated global increase in annual ratio of technology that aimed at neutralizing global waste and pollution.

Now suppose we want to reach impact equality by 2030.

as stipulated by UN SDGs: How much annual increase in technology we need to neutralize our waste and pollution?

This requires $(\frac{NY}{\propto}/G)$ should shrink from 1.7 to 1. To achieve this the ratio of annual decline in global foot print should be (-5.4%)

Assume that GDP will maintain Its course of increase (+3.4%)

and the global annual decline in the regenerative rate of biosphere will be the same (-1.2%).

$$g\left(\frac{NY}{\propto}/G\right) = (Ny) - g(\propto) - g(G)$$

$$-0.054 = 0.034 - g(\propto) - (-0.012)$$

$$g(\propto) = 0.1 = 10\%$$

This means that to achieve UN SDGs we need to increase $\propto$ by 2.9 times its current rate, and this is far fetched.

Suppose now that the global output (GDP) is to remain constant (that means the rate of annual increase is zero, from now till 2030, and we depress the deterioration of the biosphere so drastically to annual rate of 0.1%.

Calculation of the % of (∝) technology needed to neutralize our waste will be according to this formula

$g\left(\frac{NY}{\propto}/G\right) = g\,(NY) - g(\propto) - g(G)$

$-0.054 = 0.0 - g(\propto) - (-0.001)$

$g\,(\propto) = 0.055 = 5.5\%$

This means that if we even keep our output constant, we need a hike in ∝ to 5.6% which is higher than the Current increase (3.5%).

($\propto$) represent technology and institutions. Both have mutual influence on each other. Since Institution is the seat of incentives and incentives that shape technology. The climate change economist ascribed degradation of the biosphere to institutional failure. They also advocates that progress in science can put things right.

But advance of technology also can enhance the biosphere degradation (clearing the rain forest, fishing, solar panels can raise demand for biosphere's goods and services (i. e, Zink, Cadim and other minerals needed to manufacture solar panels; and this may require forests to be destroyed).

Thank you

METAMATERIALS AND THEIR APPLICATIONS

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Islamic University, Gaza, Palestine

ABSTRACT

Nanomaterials have distinctive optical, mechanical, electrical, and magnetic properties. Thus, they have salient applications including but not limited to sensors, solar cells, optoelectronic devices. In particular, the sensor and solar cell technologies have high leap in the technology world due to the use of nanotechnology and nanomaterials.

In this talk, I will give a preview about nanomaterials and a specific type of nanomaterials named metamaterials (MTM). MTMs is a man-made material with parameters can be tuned easily to fit certain application. Various classes of MTM are defined both experimentally as well as theoretically based on either wavelength region or design of metamaterial atoms.

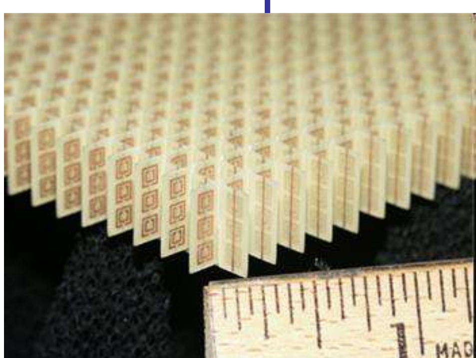
I will focus in this talk on fabrication of sensors and solar cells with different structures consists of multilayers. The proposed structures are made of variant type of materials including nanomaterials to enhance their working efficiencies.

Metamaterials and their applications

Prof. Dr. Hala J. El-Khozondar

Electrical Engineering Department

Islamic University of Gaza



The 25th General Assembly Meeting of the Islamic World Academy of Sciences (IAS)

Karachi – Pakistan

Wednesday, 8 March 2023

Abstract

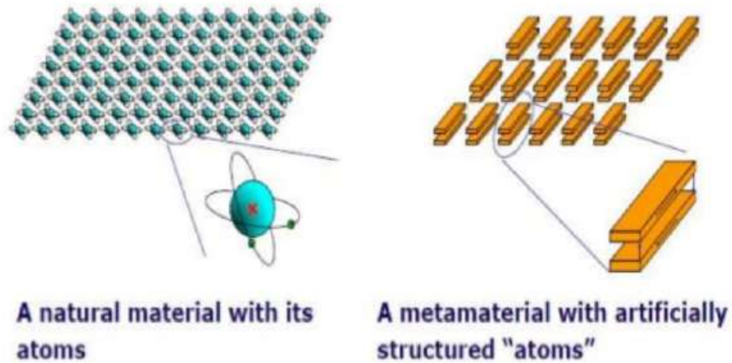
MTMs is a man-made material with parameters can be tuned easily to fit certain application. Various classes of MTM are defined both experimentally as well as theoretically based on either wavelength region or design of metamaterial atoms.

I will focus in this talk on fabrication of sensors and solar cells with different structures consists of multilayers. The proposed structures are made of variant type of materials including nanomaterials to enhance their working efficiencies.

Metamaterials-Introduction

- metamaterials (MTMs) - engineered materials -various applications.

- atoms are arranged periodically with a distance of less than one nm. This value is much less than the wavelength of the visible light. Incident light experiences homogenous distribution in these materials.



- Unit cell plays a key role in adjusting the properties of metamaterials.
- Different ways to fabricate MTMs are presented in literatures.

What is an Electromagnetic Metamaterial?

- A composite or structured material that exhibits properties not found in naturally occurring materials or compounds.

- Metamaterials are periodic or quasi-periodic, sub-wavelength metal structures. The electro-magnetic material properties are derived from its structure rather than inheriting them directly from its material composition.

- Double negative materials have electromagnetic properties that are distinct from any known material, and hence are examples of metamaterials.

Metamaterial-the name

- "**Meta**-" means "altered, changed" or "higher, beyond".

Metamaterials?

- Existing materials only exhibit a small subset of electromagnetic properties theoretically available.

- Metamaterials can have their electromagnetic properties altered to something beyond what can be found in nature.

- Can achieve negative index of refraction, zero index of refraction, magnetism at optical frequencies, etc.

Metamaterial
DN / Veselago Material-history

- Theoretically 1968, V. G. Veselago
- Experimentally proposed 1999, John Pendry
- D. R. Smith experimentally achieved 2000

V. G. Veselago


John Pendry

Negative index of refraction??

- **We are interested in how waves propagate through various media; therefore, we consider solutions to the wave equation.**

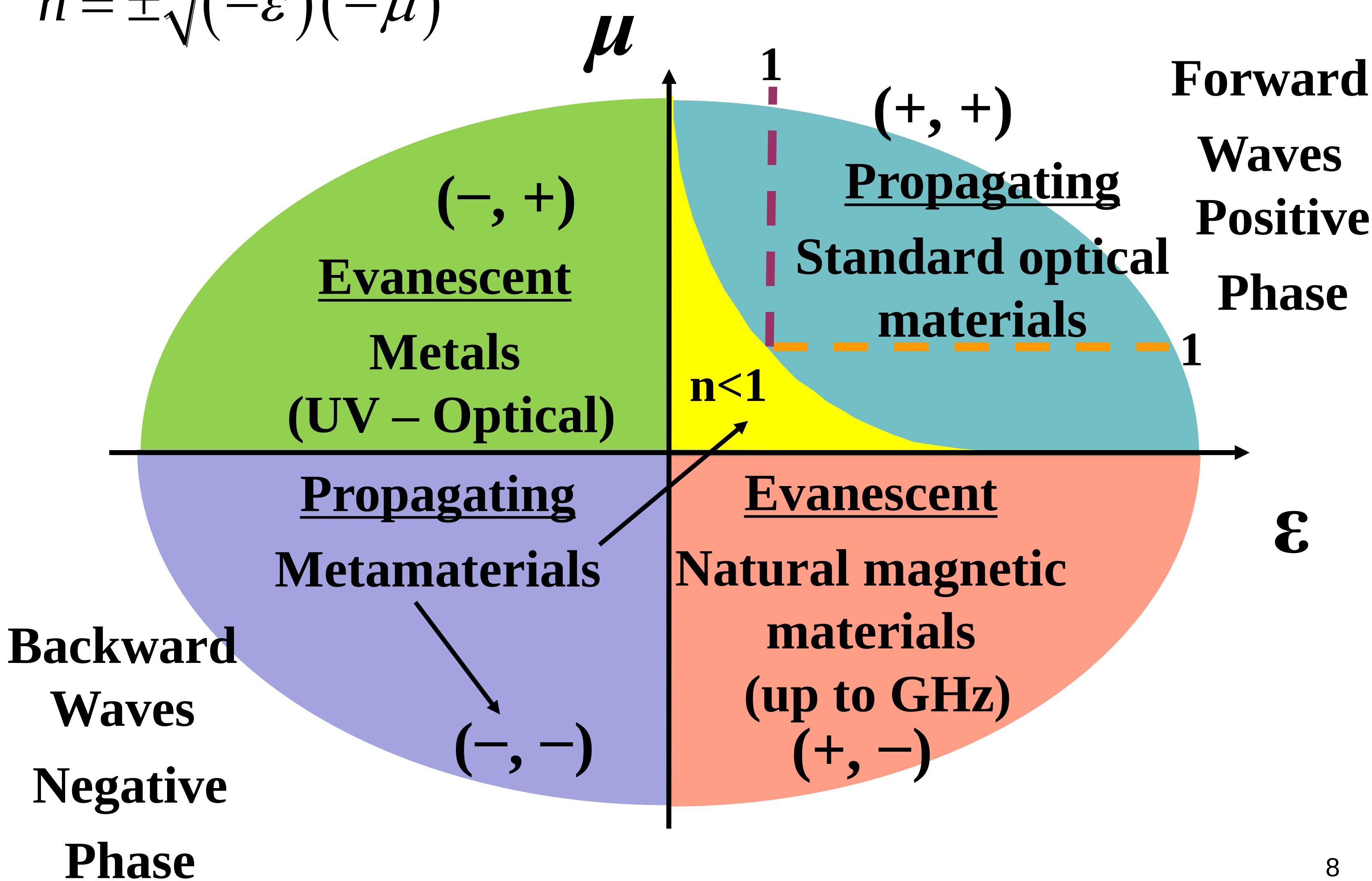
$$\nabla^2 \mathbf{E} = \varepsilon\mu \frac{\partial^2 \mathbf{E}}{\partial t^2} \qquad n = \sqrt{\mu_r \varepsilon_r} \qquad k = \omega\sqrt{\varepsilon\mu}$$

$$\sqrt{\mu_r \varepsilon_r} = \left((e^{-j\pi})(e^{-j\pi})\right)^{1/2} = (e^{-j\pi/2})(e^{-j\pi/2}) = e^{-j\pi} = -1$$

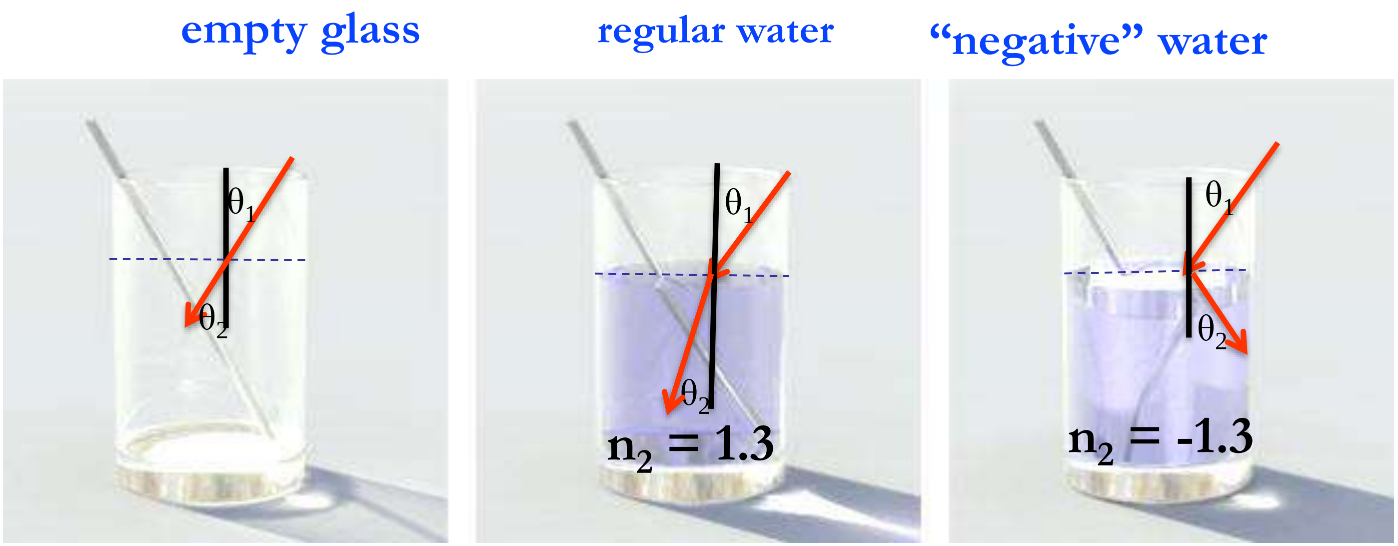
- negative refraction can be achieved when both μ_r and ε_r are negative
- negative μ_r and ε_r occur in nature, but not simultaneously
- silver, gold, and aluminum display negative ε_r at optical frequencies
- resonant ferromagnetic systems display negative μ_r at resonance

Classification of materials

$$n = \pm\sqrt{(-\varepsilon)(-\mu)}$$



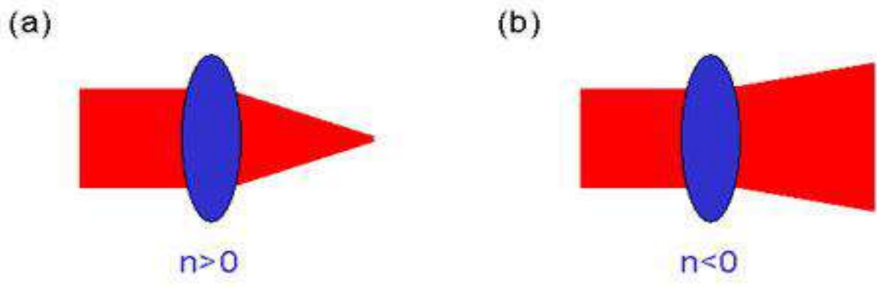
Negative refractive index

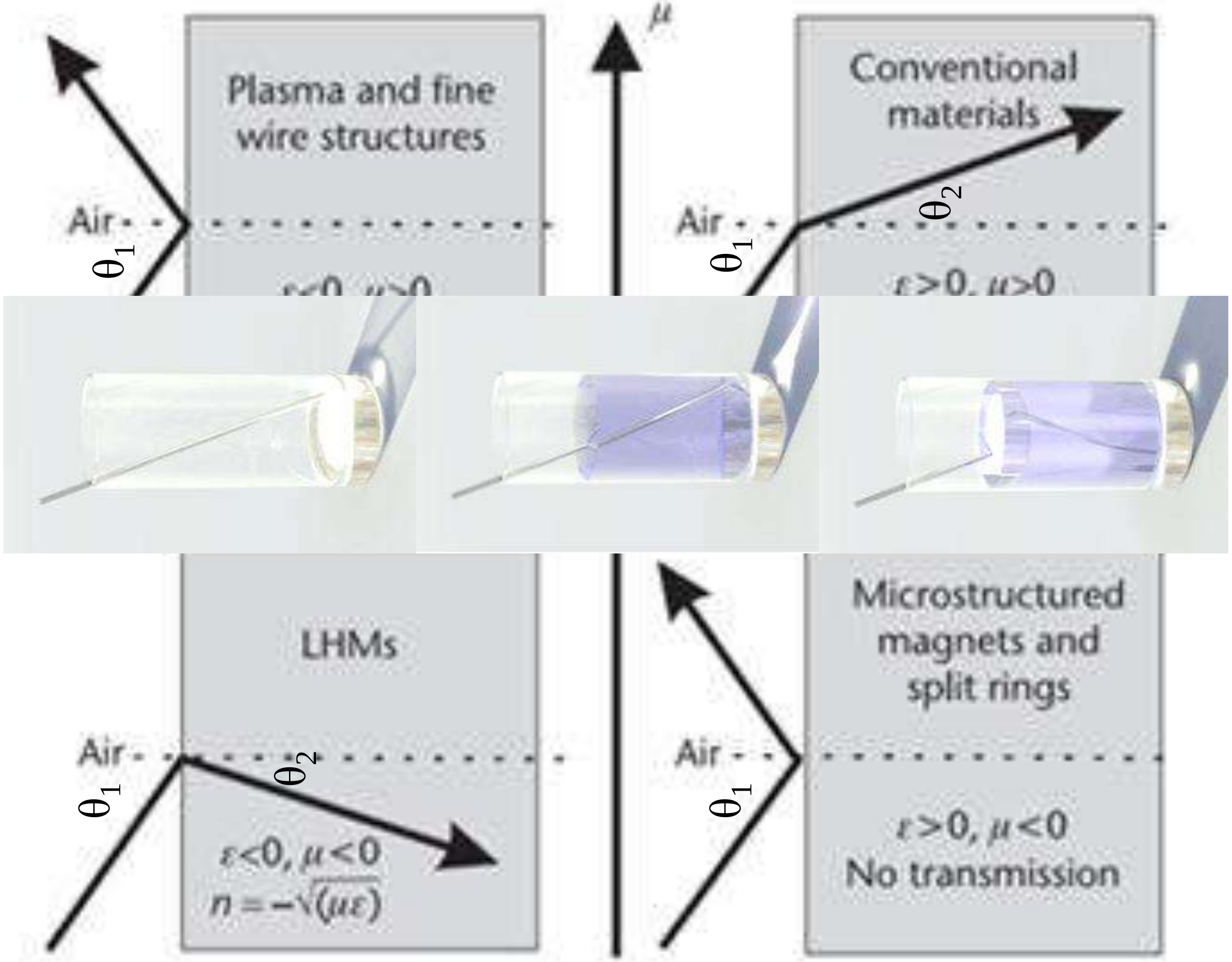


Snell's Law

$$n_2 > 0 \qquad n_1 \sin\theta_1 = n_2 \sin\theta_2$$

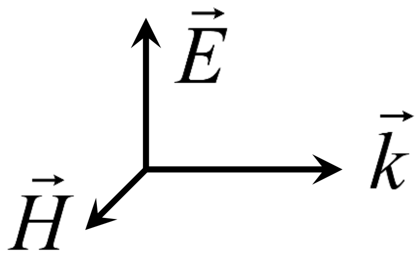
$$n_2 < 0 \qquad n_1 \sin\theta_1 = -|n_2| \sin\theta_2$$




μ
Plasma and fine wire structures
Air
θ1
Conventional materials
Air
θ1
θ2
LHMs
Air
θ1
θ2
ε<0, μ<0
n = −√(με)
Microstructured magnets and split rings
Air
θ1
ε>0, μ<0
No transmission

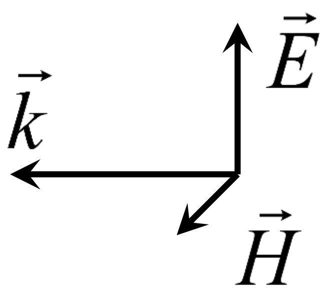
Left-Handed Waves

- If $\varepsilon > 0, \mu > 0$ then $\left(\vec{E}, \vec{H}, \vec{k}\right)$ is a ***right*** set of vectors:



$$\boxed{\vec{k} \times \vec{E} = \frac{\omega}{c} \mu \vec{H}}$$

- If $\varepsilon < 0, \mu < 0$ then $\left(\vec{E}, \vec{H}, \vec{k}\right)$ is a ***left*** set of vectors:

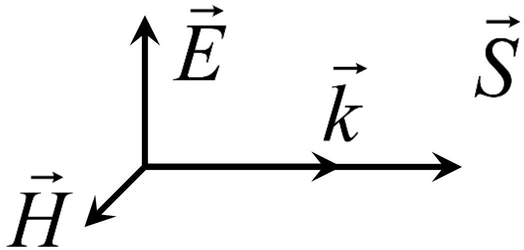


$$\boxed{\vec{k} \times \vec{H} = -\frac{\omega}{c} \varepsilon \vec{E}}$$

Energy flux in plane waves

- **Energy flux (Poynting vector):** $\vec{S} = \left[\vec{E} \times \vec{H}\right]$

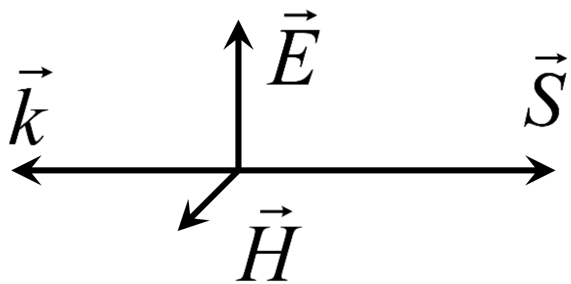
  - **Conventional (right-handed) medium**



$$\vec{S} \uparrow\uparrow \vec{k}$$

$$\vec{V}_{gr} \uparrow\uparrow \vec{V}_{ph}$$

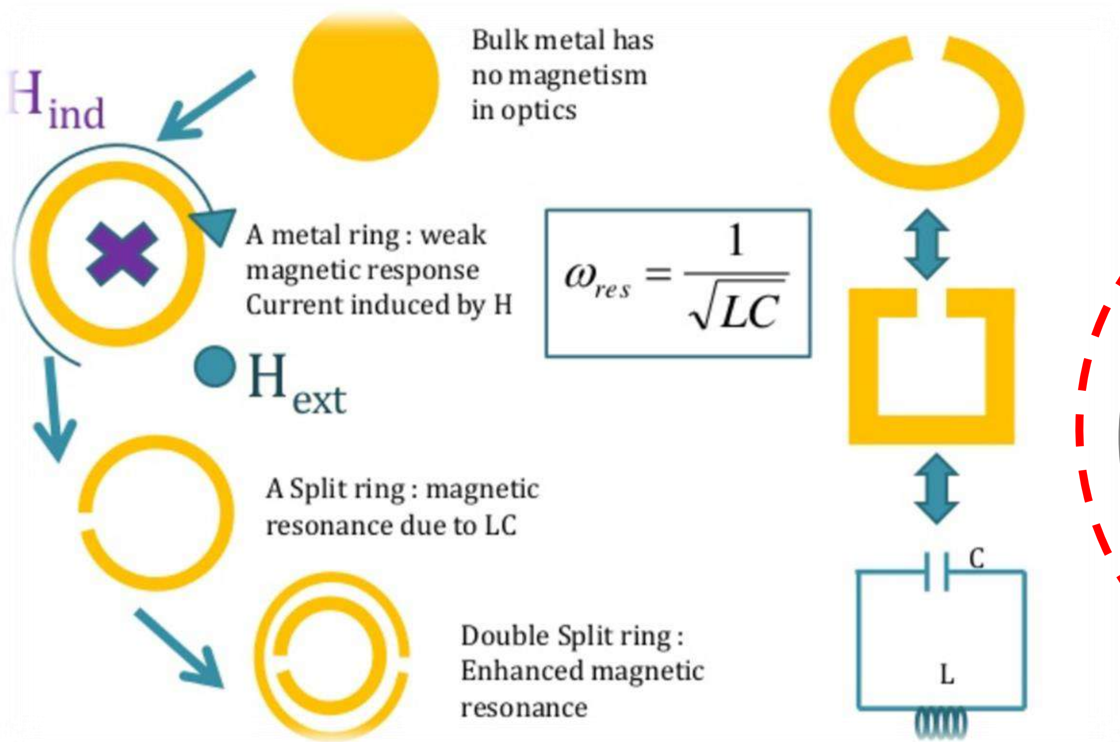
  - **Left-handed medium**

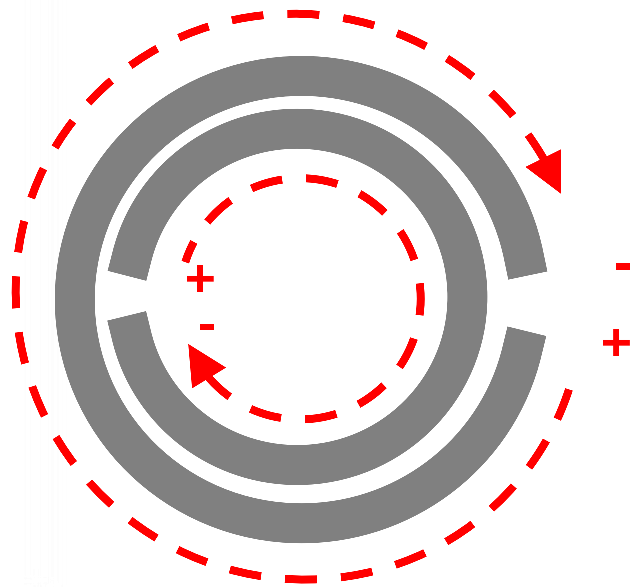


$$\vec{S} \uparrow\downarrow \vec{k}$$

$$\vec{V}_{gr} \uparrow\downarrow \vec{V}_{ph}$$

The Split Ring Resonator (SRR)

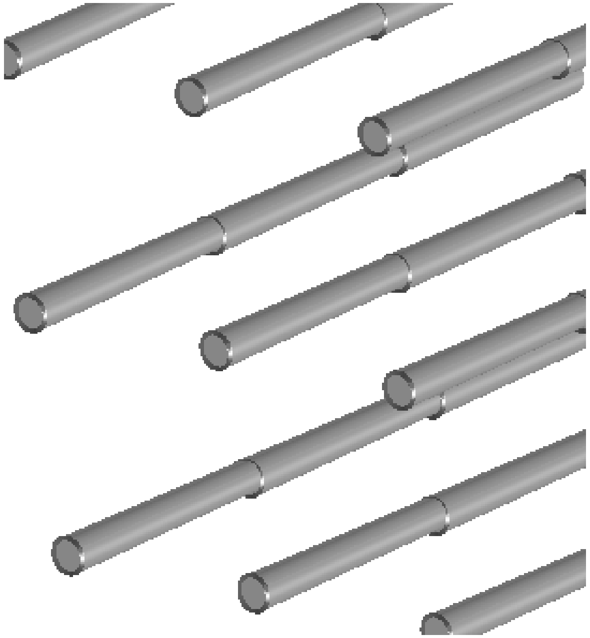




SRR resonant structure is much smaller than the resonance wavelength.

Array of Metallic Wires

Long λ, Array of metallic wires interacts with electromagnetic waves as a plasma → negative permittivity relative to the plasma frequency:



Realisation of Metamaterials

Negative ε

- Thin metallic wires are arranged periodically
- Effective permittivity takes negative values below plasma frequency

Negative μ

- An array of split-ring resonators (SRRs) are arranged periodically

(−, +)

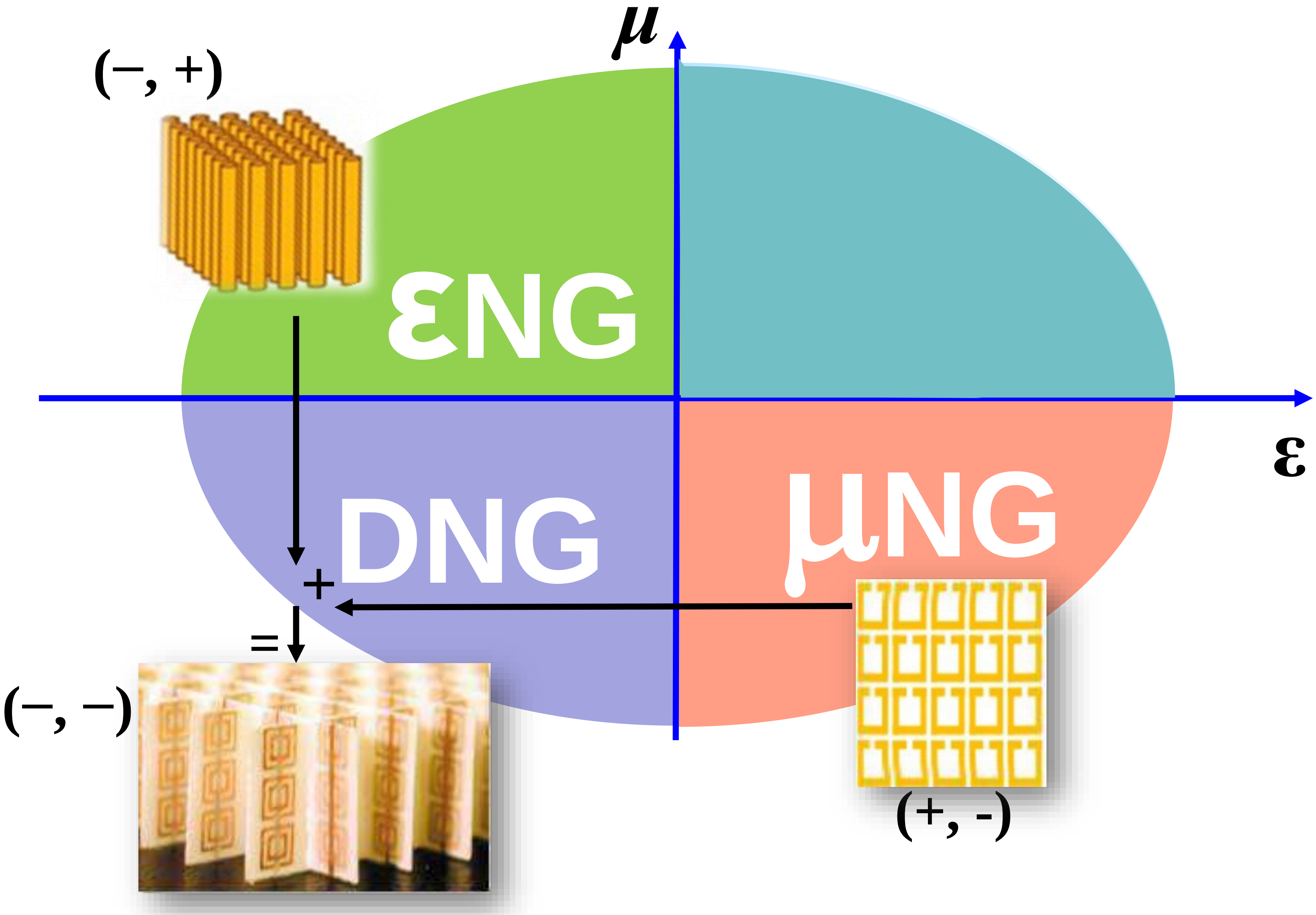
+

(+, −)

=

(−, −)

Classification of materials



UCSD, PRL 84, 4184 (2000)

Material Dispersion

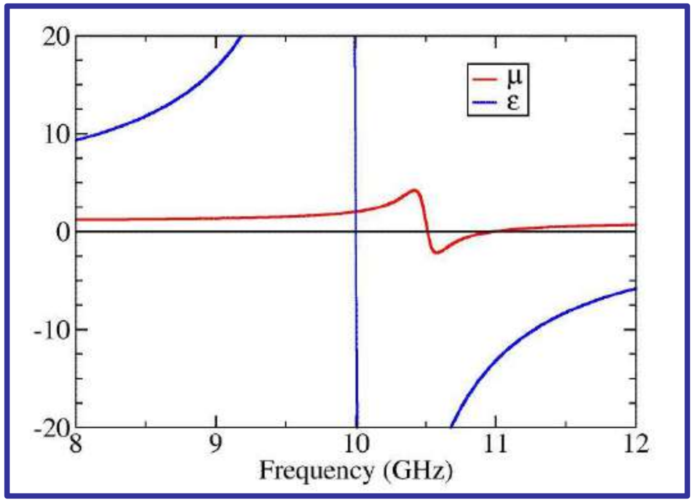
$$\frac{\varepsilon}{\varepsilon_0} = \frac{\omega_{e_p}^2 - \omega_{e_0}^2}{\omega_{e_p}^2 - \omega^2 - i\,\omega\gamma_e} \qquad \frac{\mu}{\mu_0} = \frac{\omega_{m_p}^2 - \omega_{m_0}^2}{\omega_{m_p}^2 - \omega^2 - i\,\omega\gamma_m}$$

ω_{e_p} : Electric plasma frequency

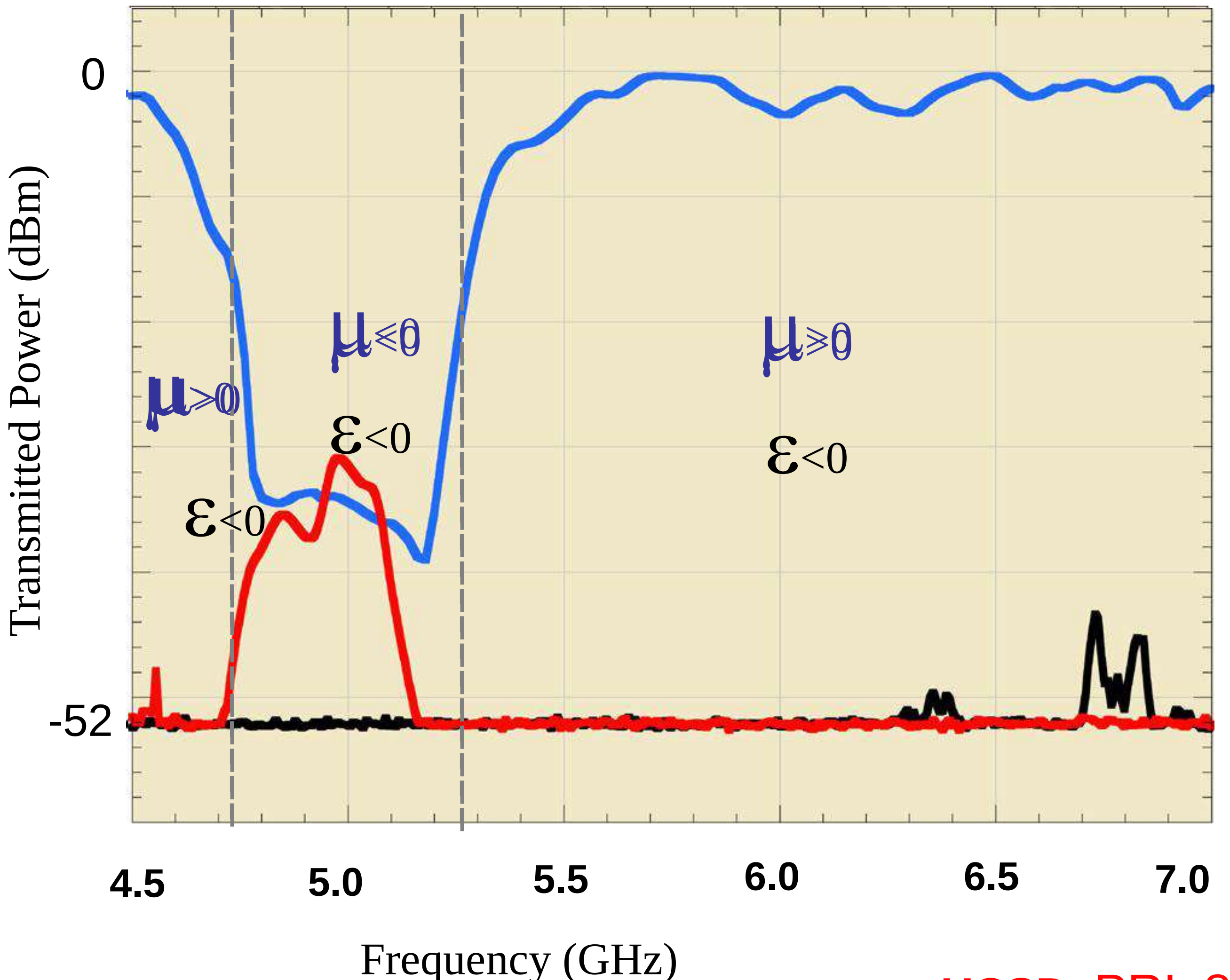
ω_{e_0} : Electric resonance frequency

ω_{m_p} : Magnetic plasma frequency

ω_{m_0} : Magnetic resonance frequency.

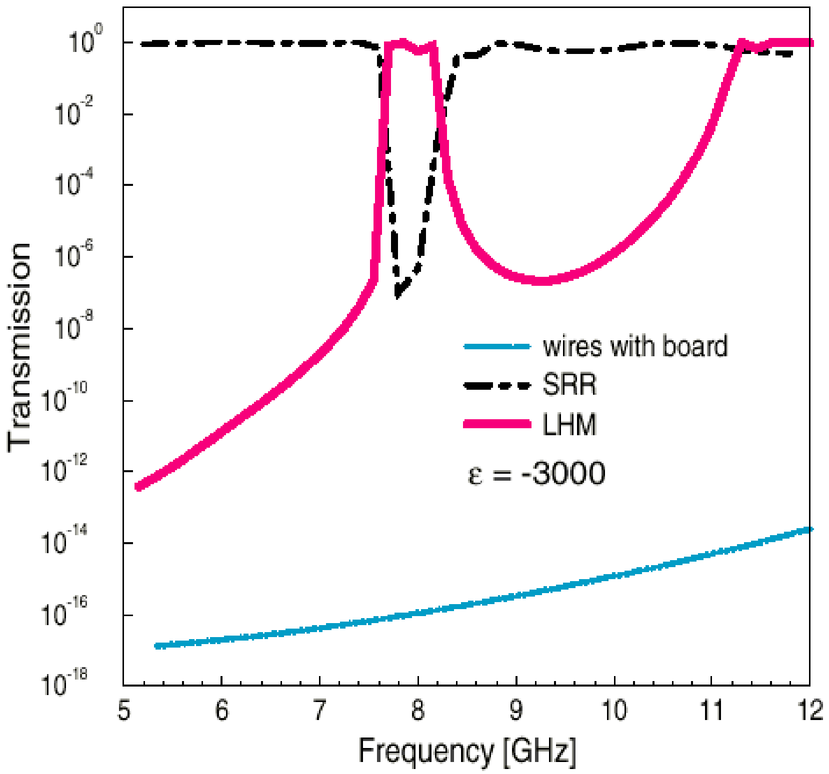


Transmission Measurements

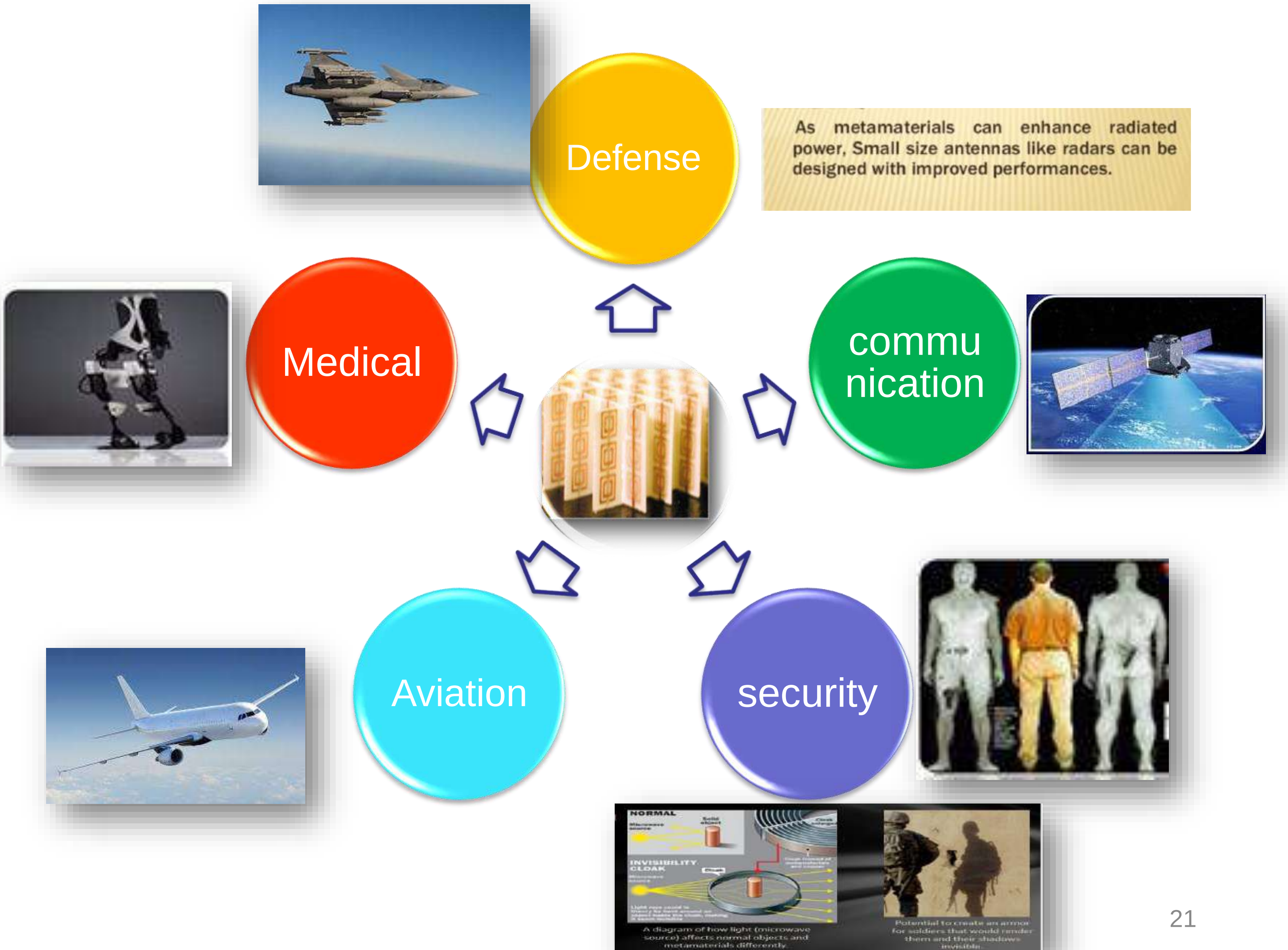


UCSD, PRL 84, 4184 (2000)

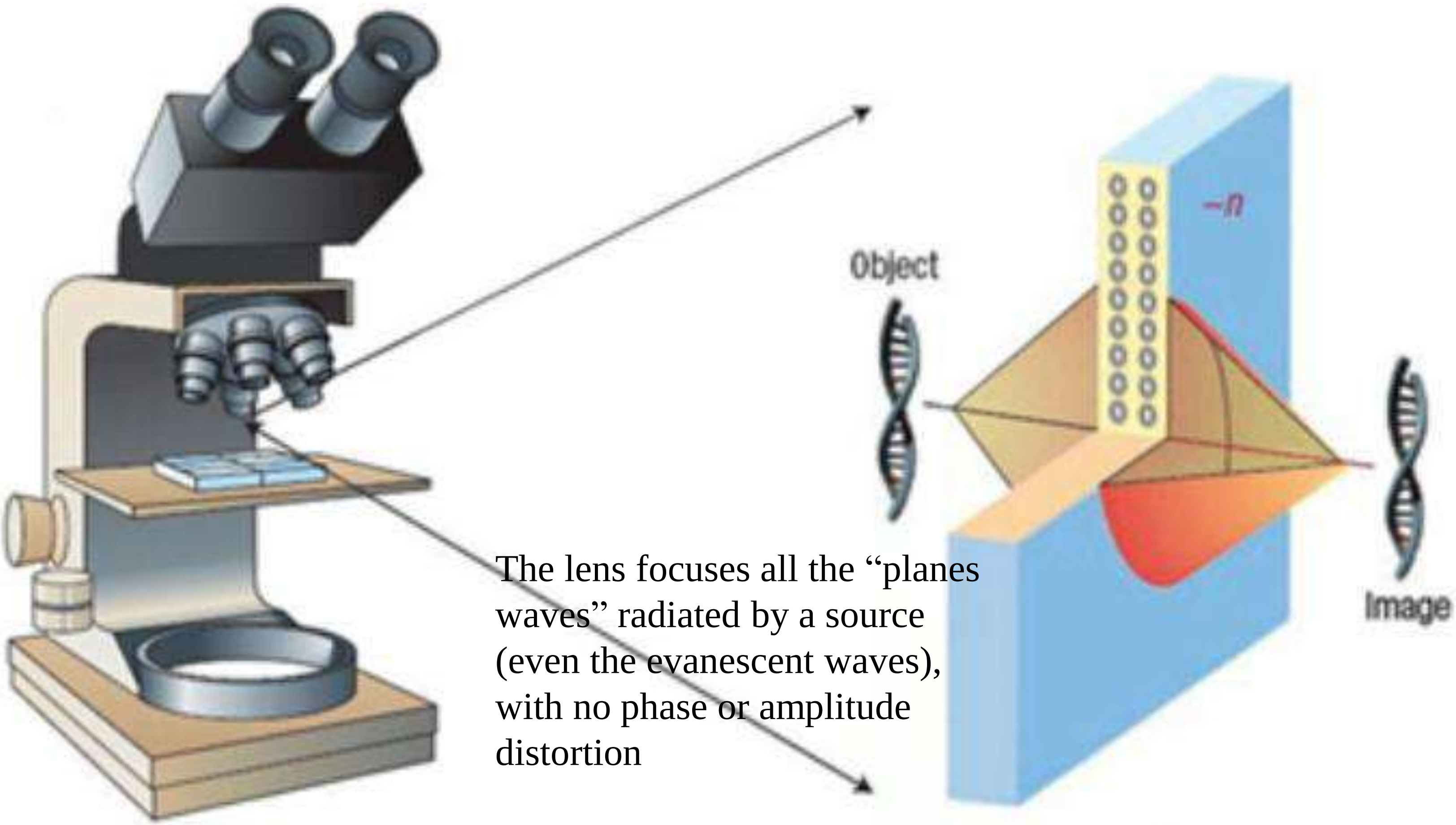
Left-handed material: array of SRRs and wires



Applications

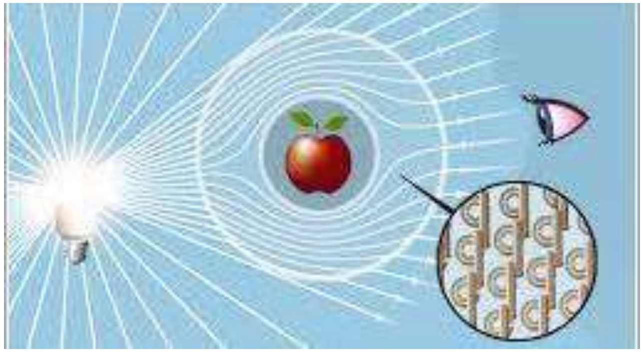


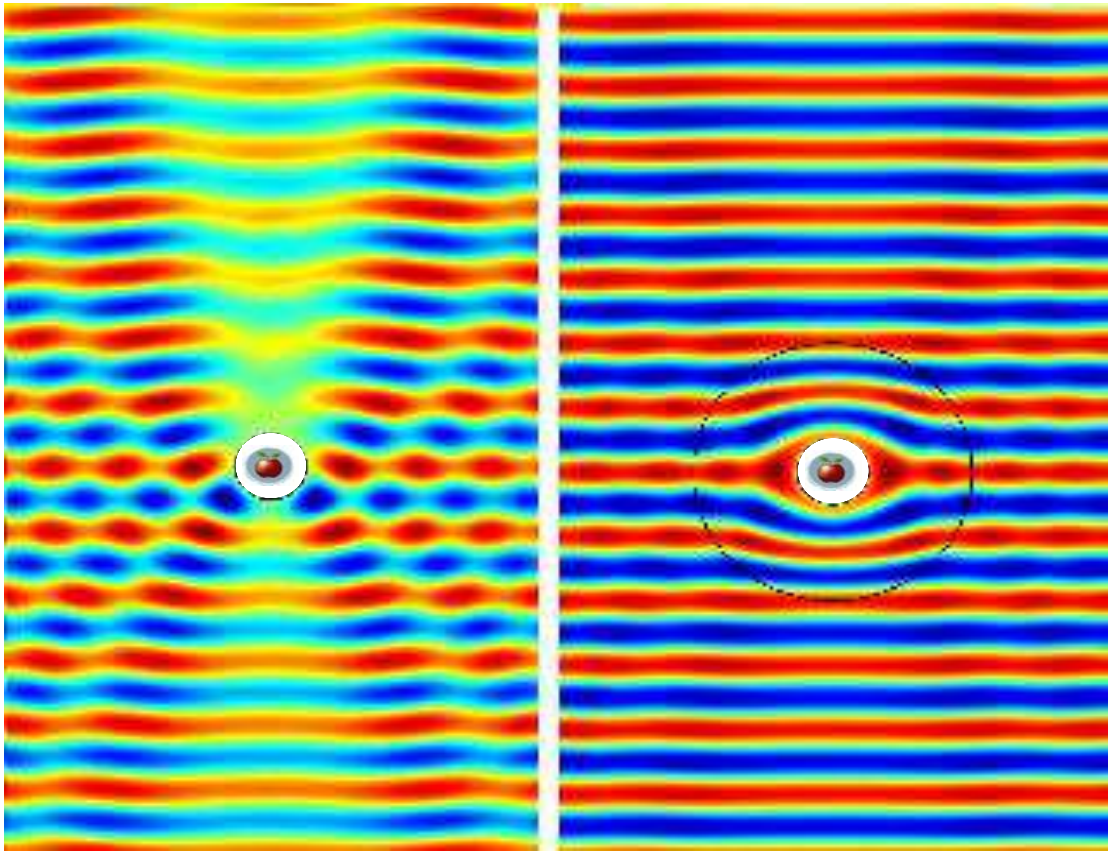
Pendry Perfect Lens, 2000



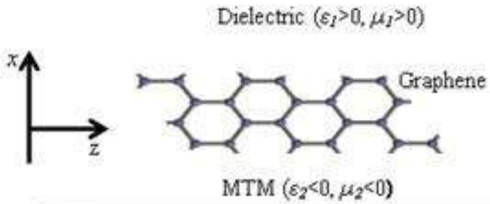
The lens focuses all the "planes waves" radiated by a source (even the evanescent waves), with no phase or amplitude distortion

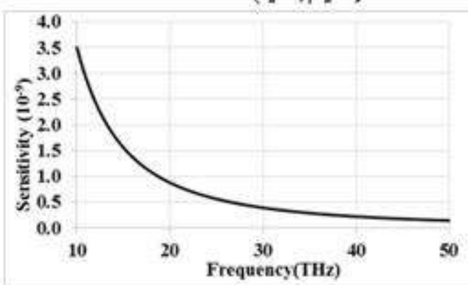
Cloaking Devices

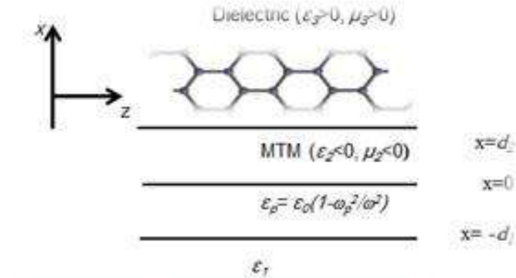


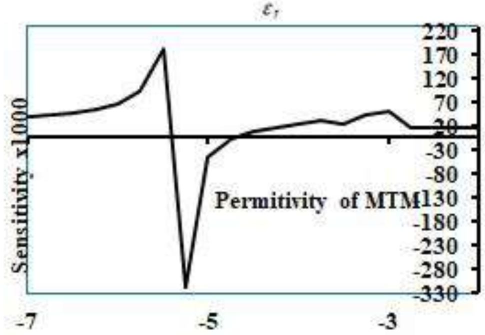


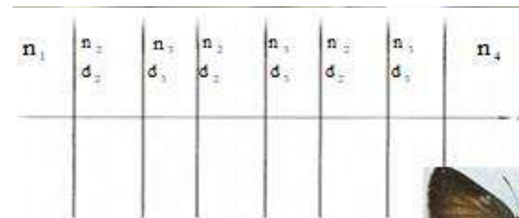
My work

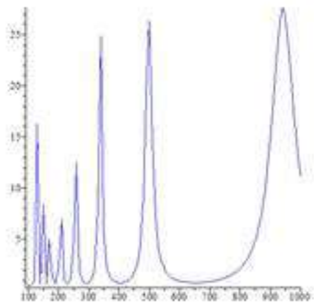


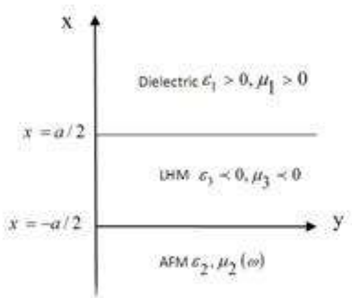


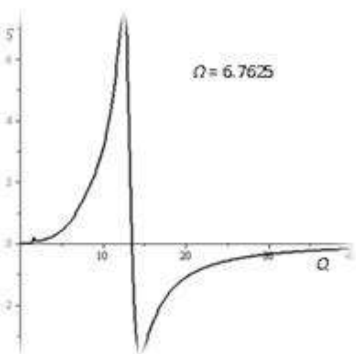


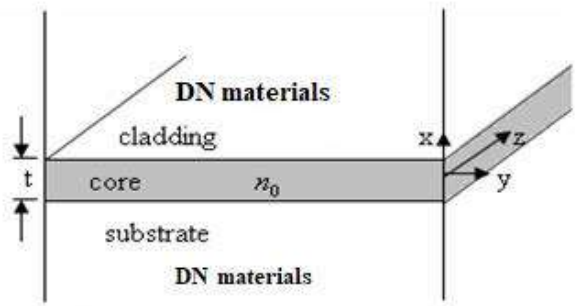


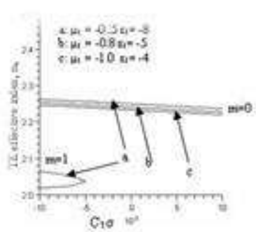




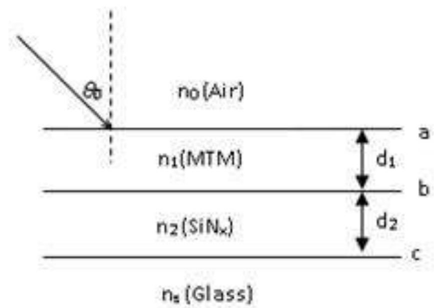


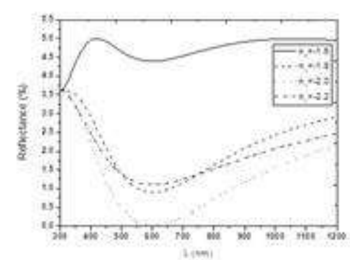


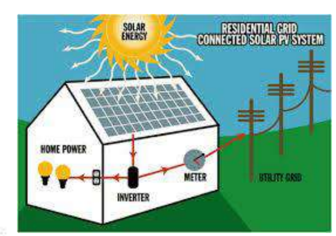




The effective refractive index for TE as a function of stress, t=1μm

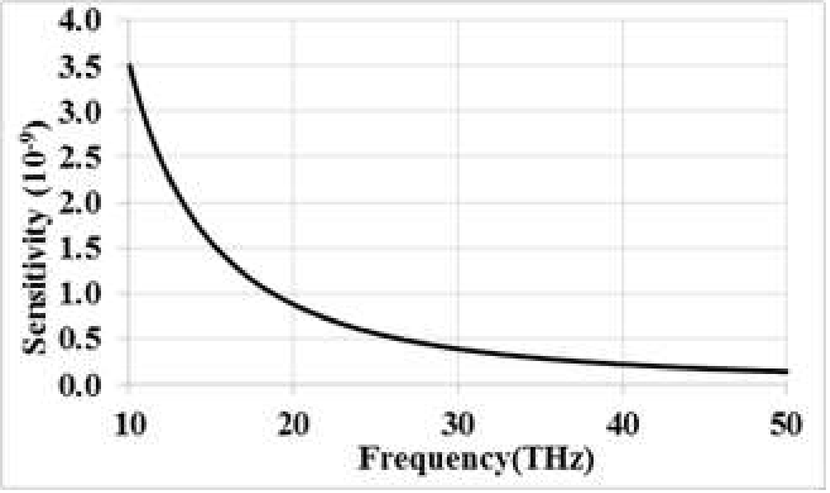






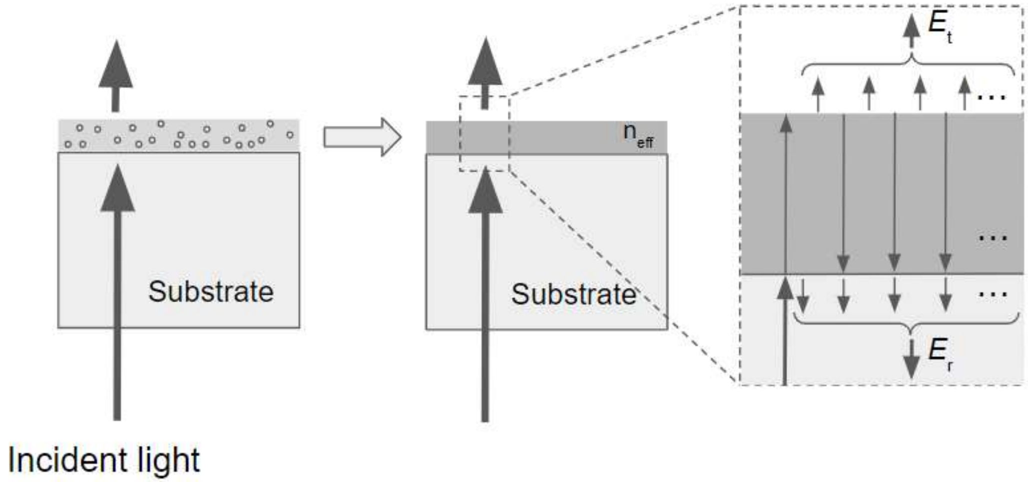
sensors

- sensor senses the changes exists of an analyte.
- discriminate among species.
- range of applications in medical, pharmaceutical, environmental, defense, bioprocessing, or food technology.



Nanoparticles thin film for sensing

homogeneous thin film formed by impurities impeded inside a dielectric host medium



Nanoparticles thin film for sensing-continue

The resulted reflection coefficient, r = |E_r|/|E_i|, is

$$r = r_{12} + \frac{t_{12} t_{21} r_{23} \exp\left(i2k_o n_{eff} d\right)}{1 - r_{23} r_{21} \exp\left(i2k_o n_{eff} d\right)}$$

$$r_{21} = -r_{12} = \left(\mu_2 n_{eff} - \mu_1 n_1\right) / \left(\mu_2 n_{eff} + \mu_1 n_1\right)$$

$$r_{23} = \left(\mu_2 n_{eff} - \mu_3 n_3\right) / \left(\mu_2 n_{eff} + \mu_3 n_3\right)$$

TE: μ_1, μ_2 , $\mu_3 = 1$

TM: μ_1, μ_2 , μ_3 --> $1/n^2$

Nanoparticles thin film for sensing-continue

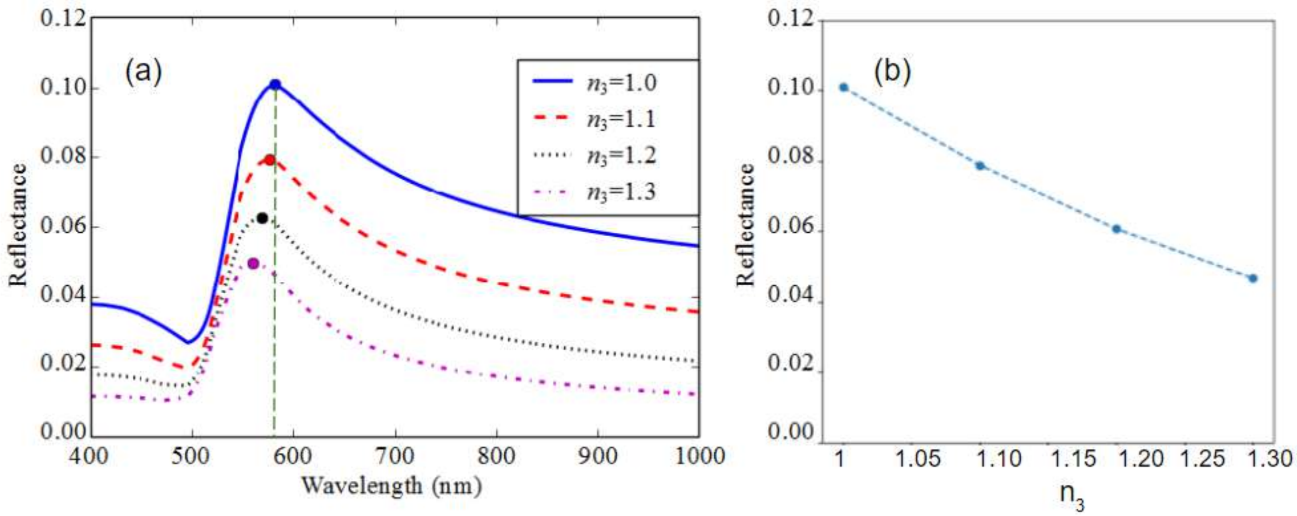
To find sensing

$$\frac{dR}{dn_3} = \frac{dr}{dn_3} \cdot r^* + r \cdot \frac{dr^*}{dn_3}$$

$$\frac{dR}{dn_3} = 2\,\mathrm{Re}\left\{ \frac{dr}{dn_3} \cdot r^* \right\} = -2\,\mathrm{Re}\left\{ r^* e^{-i\phi} \frac{\left(r - r_{12}\right)^2}{r_{23}^2\left(1 - r_{12}^2\right)} \cdot \left(\frac{2n_{eff}}{\left(n_{eff} + n_3\right)^2} \right) \right\}$$

Results

The plots are calculated for gold NPs in a polymer (n_h = 1.446) and a glass substrate (n_1 = 1.5) for f = 0.06 when TE wave is considered. glass substrate (n3 = 1.5) and varying the superstrate index from n3 = 1 to 1.3. The film thickness is set to 80 nm.

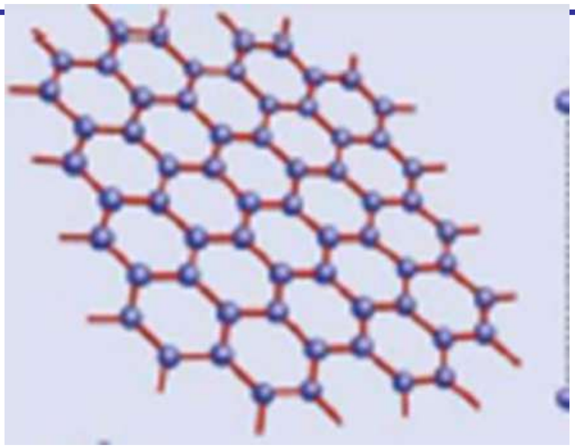


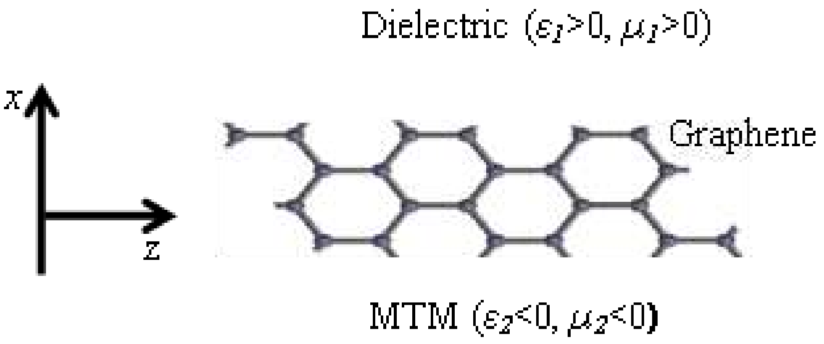
Calculated reflectance spectrum . The Reflectance at the air LSPR peak (580.6 nm) as a function of n3.

the estimated slope is

$$\frac{dR}{dn_3} = -0.181$$

Enhancing sensor sensitivity using Graphene-MTM interface



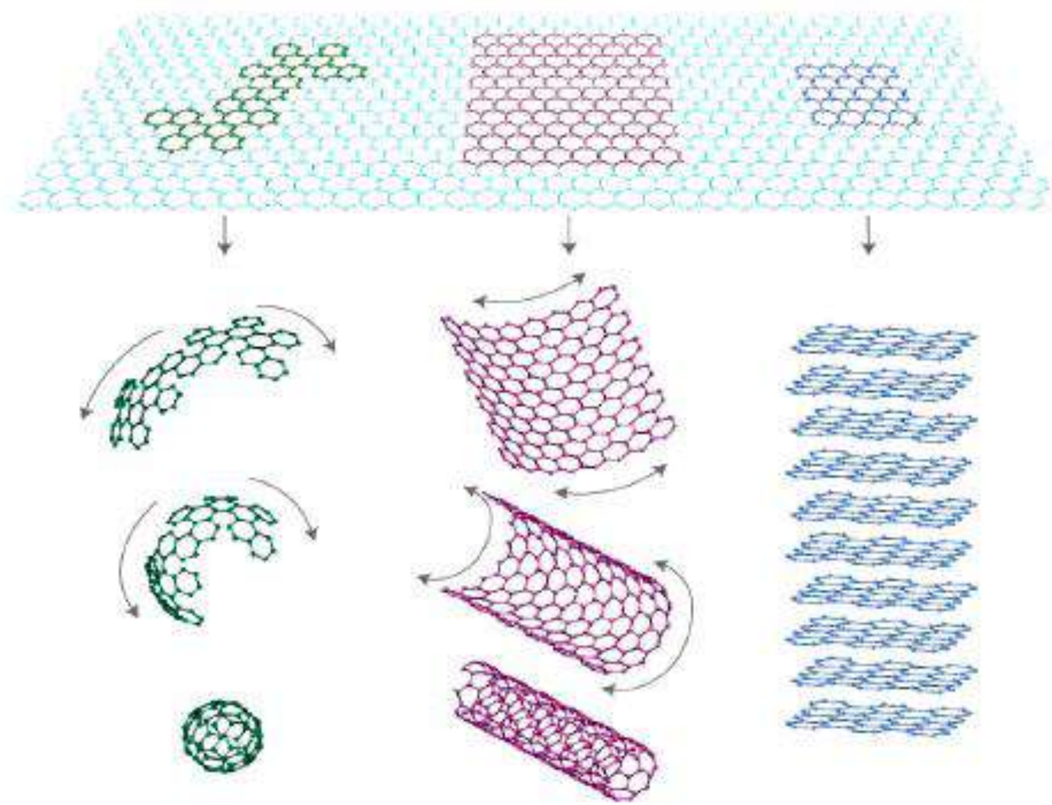


The graphene monolayer is characterized by a surface conductivity σ.

El-Khozondar et al., American Journal of Nano Research and Applications, 2016.

Graphene-Introduction

2D graphene sheet



0D bucky ball **1D CNT** **3D graphite**

*A. K. Geim & K. S. Novoselov. The rise of graphene. *Nature Materials Vol . 6* ,183-191 (2007).

Transverse Magnetic field (TM)

$$\sigma = \sigma' + j\,\sigma''$$

$$\sigma'' > 0$$

Thus, graphene can only support surface Plasmon (SP) in Transverse Magnetic field (TM) . **The graphene layer functions as a thin metal layer.**

$$H_y = \begin{cases} A_1 e^{-\gamma_1 x} & 0 < x < \infty \\ A_2 e^{\gamma_2 x} & -\infty < x < 0 \end{cases}$$

TM is a direction of the field

Sensitivity

- **Using Maxwell's equation to obtain E_x and E_z, the dispersion relation for TM modes can be written as**

$$\frac{\varepsilon_1}{\gamma_1}+\frac{\varepsilon_2}{\gamma_2}+j\,\frac{\sigma}{\omega\varepsilon_0}=0, \qquad \gamma_i=k_0\sqrt{N^2-\varepsilon_i\,\mu_i}$$

The homogenous sensitivity (*S*)

$$S=\frac{\mathrm{d}N}{\mathrm{d}\varepsilon_1}=\frac{k_o^{\,2}}{\gamma_1}\left[\frac{\varepsilon_1}{\gamma_1^3}+\frac{\varepsilon_2}{\gamma_2^3}\right]$$

Calculations

$\varepsilon_1 = 2.25$

$\sigma = 0.772 + j0.386$ μS.m

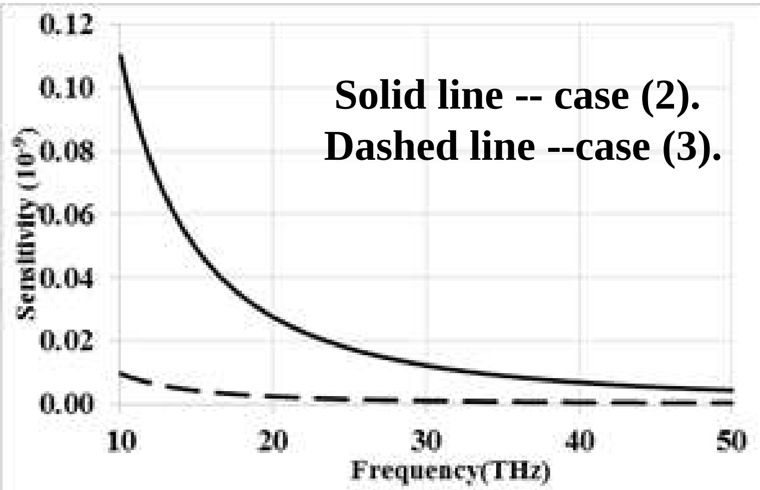
MTM parameter

case	ε_2	μ_2
1	-1	-4
2	-4	-1
3	-2	-2
4	-8	-1/2
5	-1/2	-8

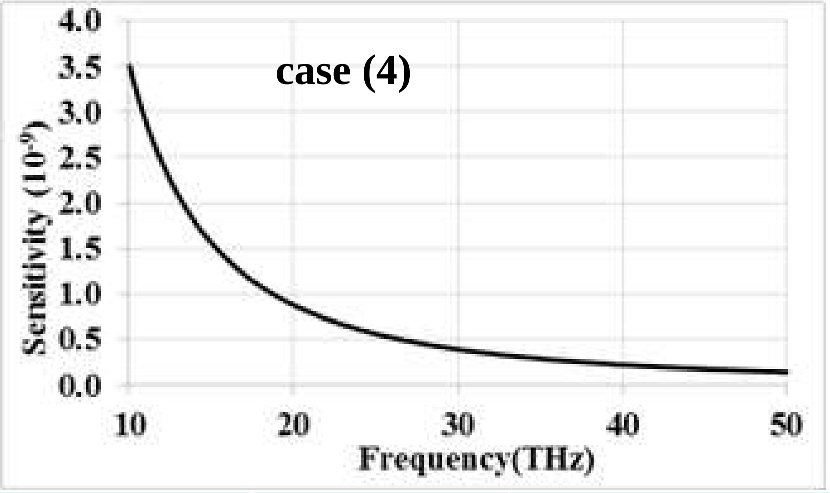
Then values of effective refractive index obtained from dispersion Equation is used to solve for the sensitivity.

***X. He, J. Tao, B. Meng, Analysis of graphene TE surface plasmons in the terahertz regime, *Nanotechnol.* 24: 345203-345208, 2013**

Results

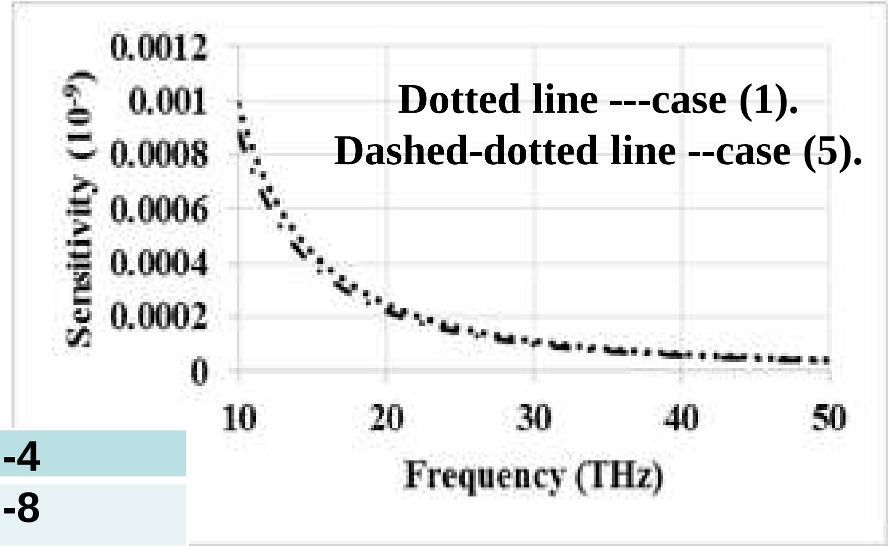


case	ε_2	μ_2
2	-4	-1
3	-2	-2



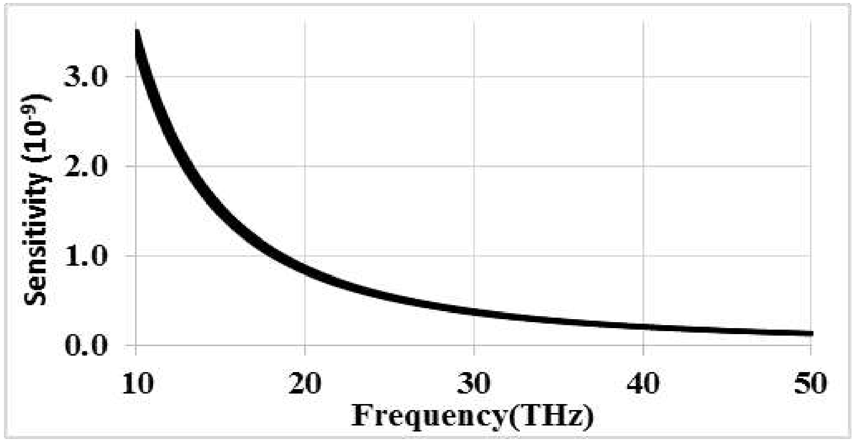
4	-8	-1/2

$\varepsilon_2 \uparrow \quad S \uparrow$



1	-1	-4
5	-1/2	-8

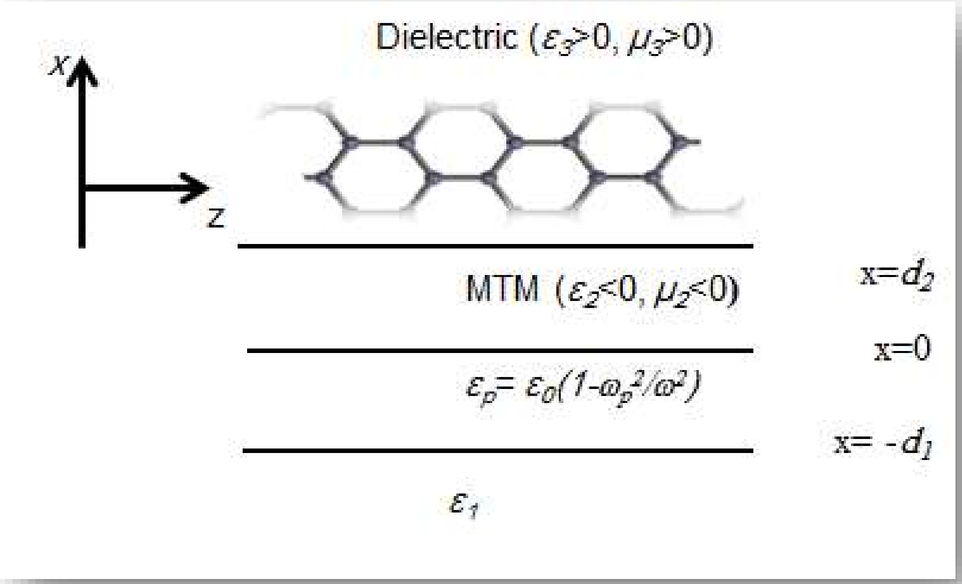
dependence on σ.



case	$\sigma(10^{-5})$
1	7.72+i3.86
2	6.72+i2.86
3	5.72+i1.86
4	4.72+i0.86

The curves from top to bottom are for cases (1) to cases (4) stated in table 2.

4-layer sensor



El-Khozondar et al., sensor letters, 2017.

The plasma layer

has permittivity constant (ε_p) that described by

$$\varepsilon_p = \varepsilon_0 \left(1 - \frac{\omega^2}{\omega_p^2} \right)$$

Where ε_0 is the vacuum permittivity and ω_p is the plasma frequency, and ω is the angular frequency of the applied field.

The nanocomposites layer

The effective permittivity for the nanocomposite layer (ε_1) is calculated using Dynamical Maxwell-Garnett theory which is an extended version of Maxwell-Garnett theory (Kitsomoboonloha et al., 2011).

The theory assume that the host (in our case is polyacrylic acid (PAA)) is the majority and the metal nanoparticles (Au and Ag) are the annexation materials with chosen metal fraction in the composite (Shi et al., 2009; Ruppin, 2000; Kitsomboonloha et al., 2011).

The permittivity ε1

$$\frac{\varepsilon_1-\varepsilon_h}{\varepsilon_1+2\varepsilon_h}=f_{Ag}\frac{\varepsilon_{Ag}-\varepsilon_h}{\varepsilon_{Ag}+2\varepsilon_h+\left(\varepsilon_h-\varepsilon_{Ag}\right)\left(1-f_{Ag}\right)\alpha}+f_{Au}\frac{\varepsilon_{Au}-\varepsilon_h}{\varepsilon_{Au}+2\varepsilon_h+\left(\varepsilon_h-\varepsilon_{Au}\right)\left(1-f_{Au}\right)\alpha}$$

The particle size effect is introduced via α (Ruppin, 2000; Kitsomboonloha et al., 2011) as follows

$$\alpha=x^2+i\left(\frac{2}{3}\right)x^3$$

Where $x=\varepsilon_h\sqrt{(\omega a)/c}$, ω is the angular frequency, a is the radius of the metal nanoparticle, and c is the speed of light. The value of *a* is assumed to be an average value which equals to 20 nm.

The dispersion Equation

Apply Maxwell's equation on each layer and solve for boundary conditions.

$$\boxed{\frac{\gamma_2\gamma_p\varepsilon_1+\gamma_1\gamma_2\varepsilon_p\tanh(\gamma_p d_1)}{\varepsilon_2\gamma_2\Gamma+\gamma_3\varepsilon_2\tanh(\gamma_2 d_2)}+\frac{\gamma_1\gamma_p\varepsilon_p+\gamma_p^2\varepsilon_1\tanh(\gamma_p d_1)}{\gamma_3\varepsilon_p+\Gamma\gamma_2\varepsilon_p\tanh(\gamma_2 d_2)}=0}$$

$$\boxed{\Gamma=\frac{\varepsilon_3}{\varepsilon_2}+i\,\frac{\sigma q}{\omega\varepsilon_2}} \qquad \boxed{q^2-\gamma_i^2=\frac{\varepsilon_i\omega^2}{\varepsilon_0 c^2}} \qquad (i=1,2,3,p)$$

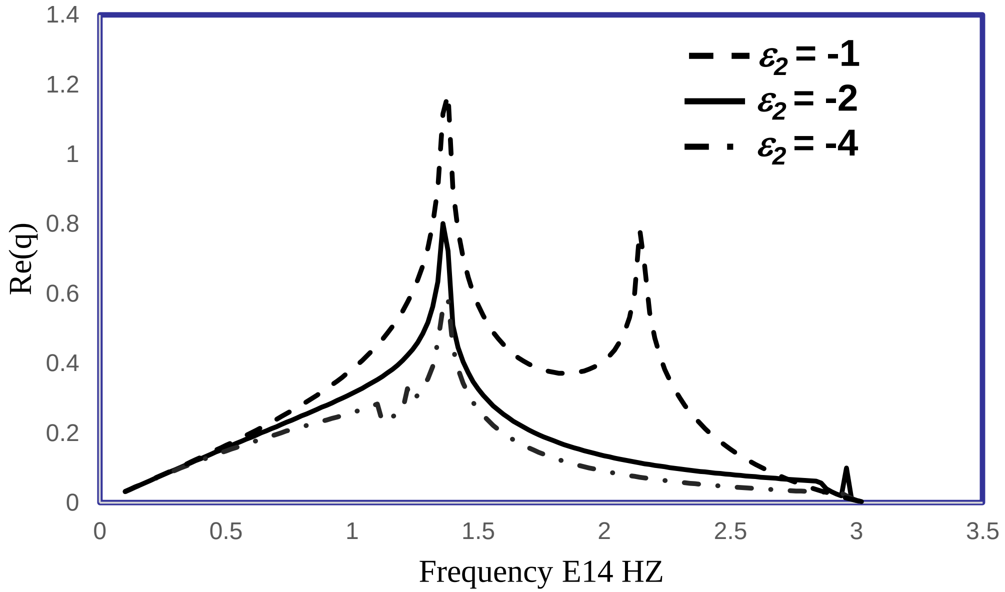
q = Nω/c is the propagation constant, N is the effective refractive index.

,

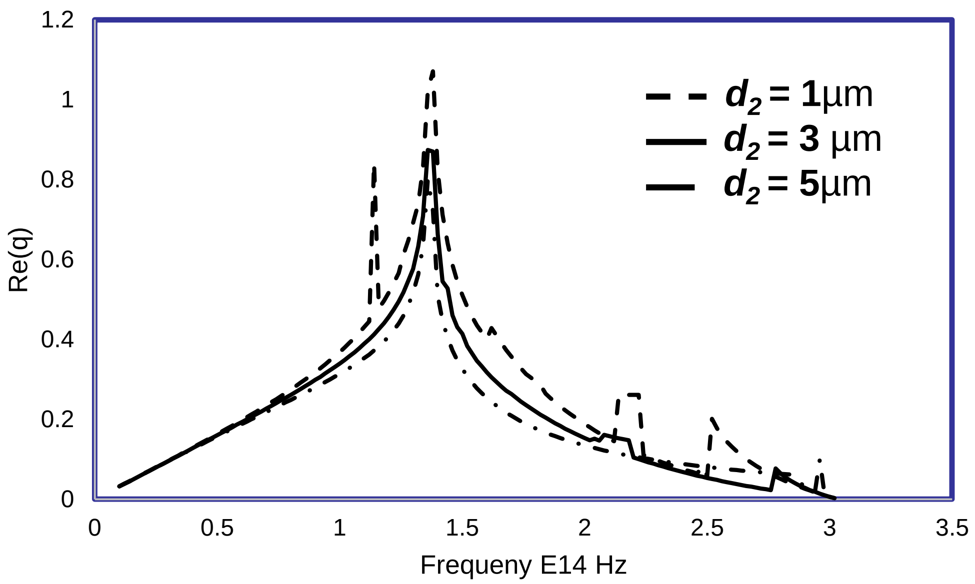
The dispersion equation can be simplified by ignoring the retardation effect as *c* is much lager than the Fermi velocity of the graphene.

$$\boxed{\varepsilon_p \frac{\varepsilon_1 + \varepsilon_p \tanh(qd_1)}{\Gamma + \tanh(qd_2)} + \varepsilon_2 \frac{\varepsilon_p + \varepsilon_1 \tanh(qd_1)}{1 + \Gamma \tanh(qd_2)} = 0}$$

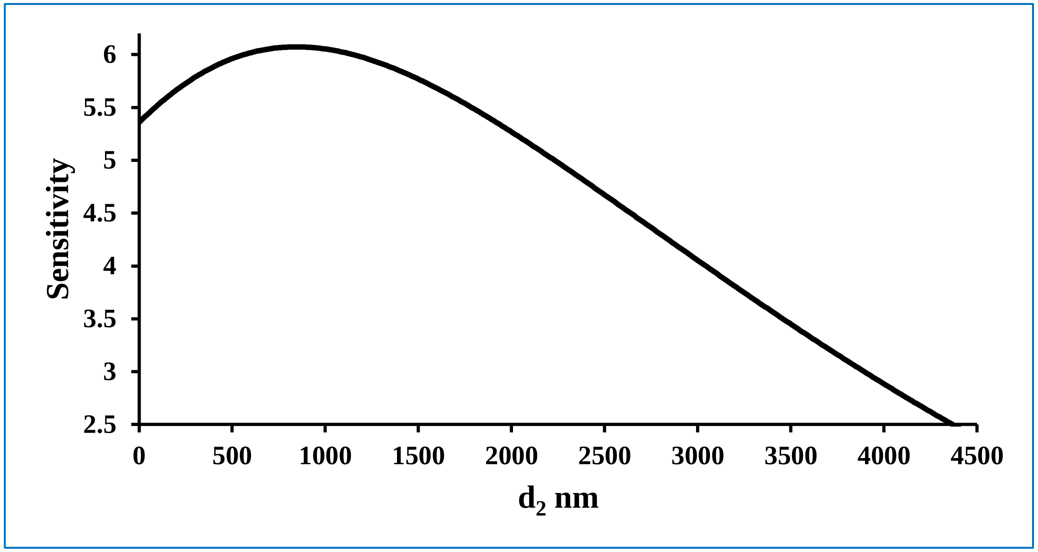
Numerical Results



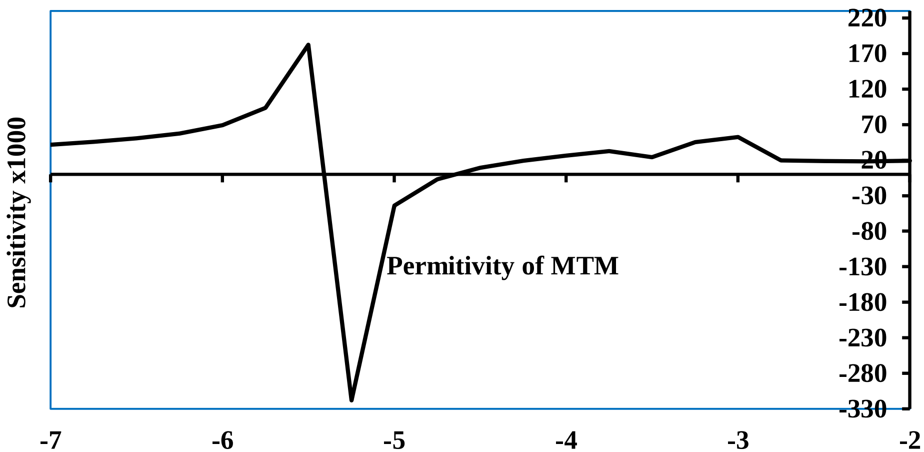
σ= 6.089E-6 and d_1=d_2=5μm



ε_2= -1, d_1=5μm

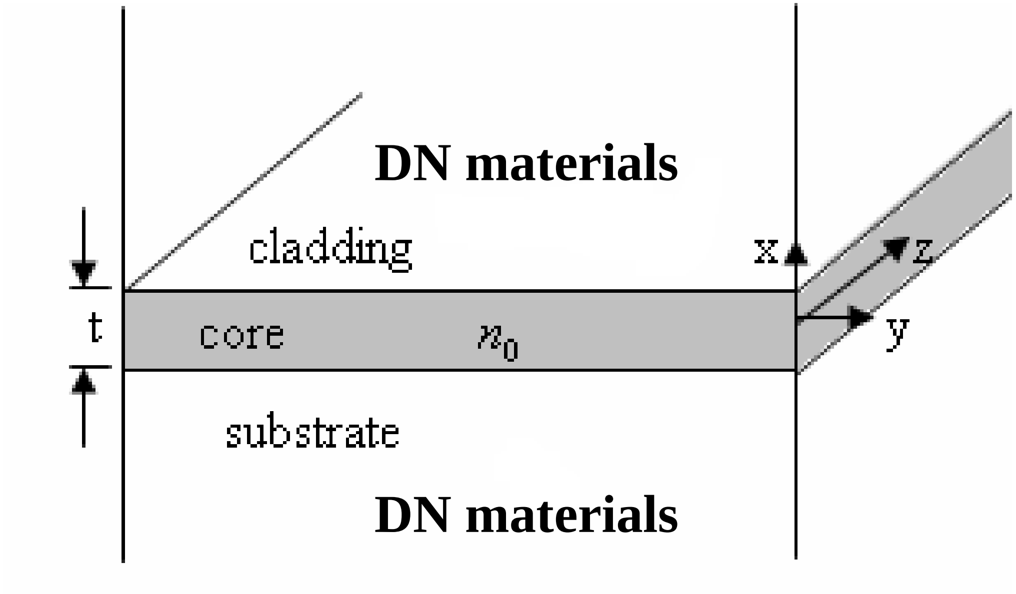


σ= 6.089E-6, ε_1= 3.9, ε_2= -1, ε_3 = 1, d_1=5µm, ω=1.36E14 Hz.



σ = 6.089E-6, ε_1= 3.9, ε_3 = 1, d_1= d_2 = 5µm, ω=1.36x10^{14} Hz.

Double-Negative (DN) material Optical waveguide Behavior Subjected to Stress



$$t \sim \lambda\ ,\ n_{core} > n_{surrounding}$$

El-Khozondar et al., Islamic university journal for natural science and Engineering, 2008.

Anisotropic and inhomogeneous media, ε

$$\varepsilon = \begin{pmatrix} n_{xx}^2 & n_{xy}^2 & n_{xz}^2 \\ n_{xy}^2 & n_{yy}^2 & n_{yz}^2 \\ n_{xz}^2 & n_{yz}^2 & n_{zz}^2 \end{pmatrix}$$

n is refractive index which depends on temperature, stress, and wavelength

By using the stress-strain relations

$$\begin{pmatrix} n_{xx} \\ n_{yy} \\ n_{zz} \\ n_{yz} \\ n_{xz} \\ n_{xy} \end{pmatrix} = \begin{pmatrix} n_0 \\ n_0 \\ n_0 \\ 0 \\ 0 \\ 0 \end{pmatrix} - \begin{bmatrix} C_1 & C_2 & C_2 & 0 & 0 & 0 \\ C_2 & C_1 & C_2 & 0 & 0 & 0 \\ C_2 & C_2 & C_1 & 0 & 0 & 0 \\ 0 & 0 & 0 & C_3 & 0 & 0 \\ 0 & 0 & 0 & 0 & C_3 & 0 \\ 0 & 0 & 0 & 0 & 0 & C_3 \end{bmatrix} \begin{pmatrix} \sigma_{xx} \\ \sigma_{yy} \\ \sigma_{zz} \\ \sigma_{yz} \\ \sigma_{xz} \\ \sigma_{xy} \end{pmatrix}$$

C's stress-optic constants

E: Young's modulus

G: shear modulus

v: Poisson's ratio

Waveguide is very long in one direction, z, the shear stresses can be ignored.

$$\varepsilon = \begin{pmatrix} n_{xx}^2 & n_{xy}^2 & 0 \\ n_{xy}^2 & n_{yy}^2 & 0 \\ 0 & 0 & n_{zz}^2 \end{pmatrix}$$

Hydrostatic stress

$\sigma_{xx}= \sigma_{yy}=\sigma_{zz}=\sigma$ and $\sigma_{xy} =0$

$n_{xx}=n_{yy}=n_{zz}=n=n_0-(C_1+2C_2)\sigma$

TE

$$\boxed{\begin{array}{l} P\tan\left(\dfrac{kt}{2}P\right) = \dfrac{q}{\mu_1};\quad \text{even} \\ \dfrac{q}{\mu_1}\tan\left(\dfrac{kt}{2}p\right) = -P;\quad \text{odd} \end{array}}$$

TM

$$\boxed{\begin{array}{l} P\tan\left(\dfrac{kt}{2}P\right) = \dfrac{q}{\mu_1};\quad \text{even} \\ \dfrac{q}{\mu_1}\tan\left(\dfrac{kt}{2}p\right) = -P;\quad \text{odd} \end{array}}$$

$$P=\sqrt{n^2-n_i^2} \text{ and } q=\sqrt{n_i^2-\mu_1\varepsilon_1}$$

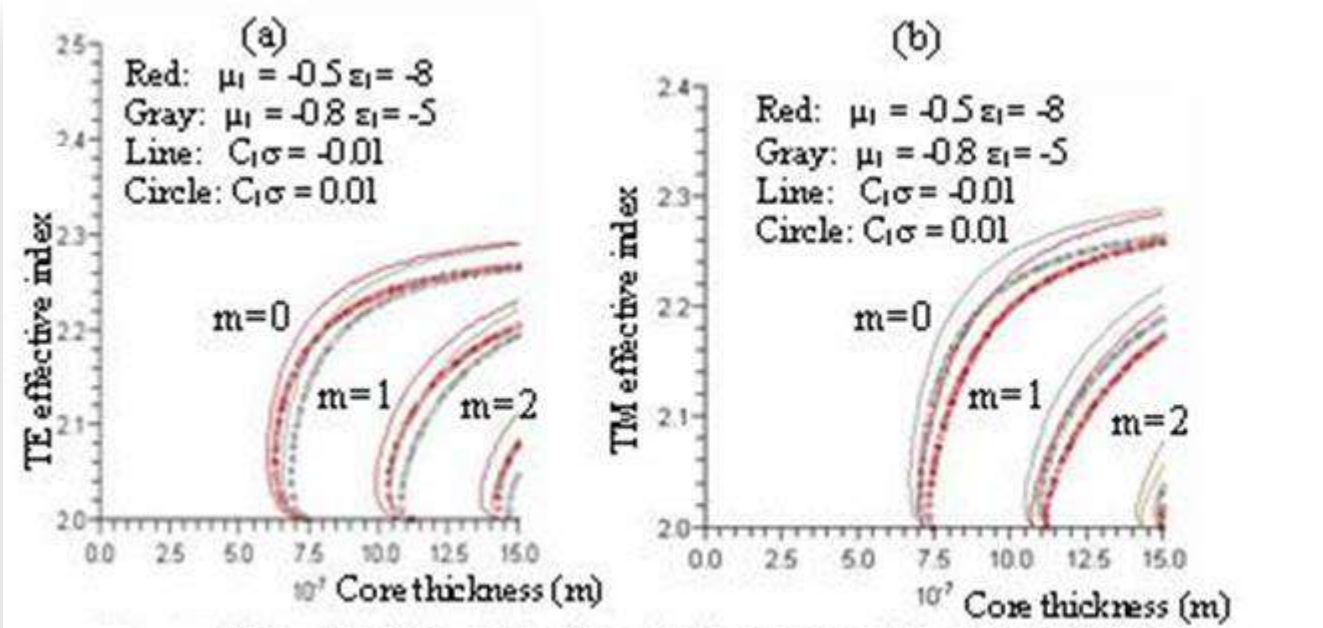
$i = e \text{ or } h$

Solving for effective refractive index

$$\varepsilon_1 \mu_1 = 4$$

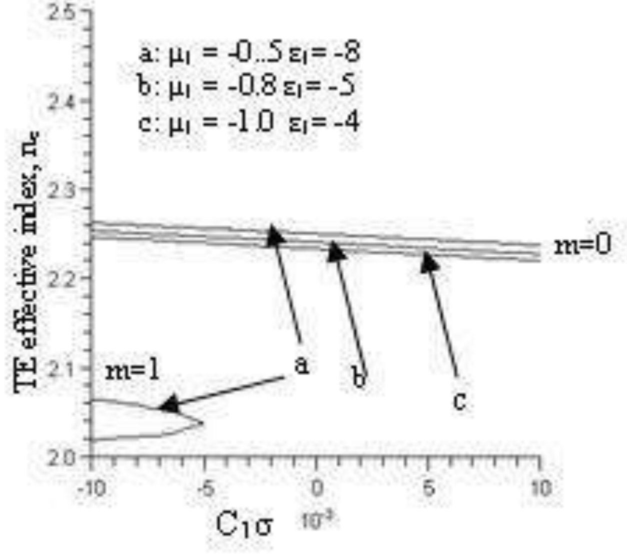
cases	ε_1	μ_1
a	-8	-0.5
b	-5	-0.8
c	-4	-1

Results

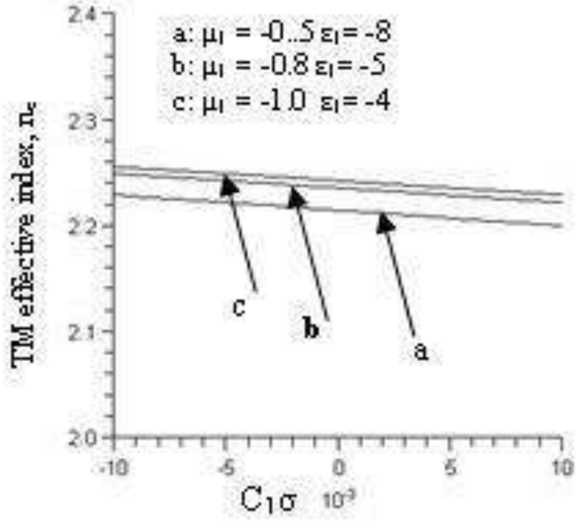


The effective refractive index versus the core thickness under different hydrostatic stresses. (a) TE and (b) TM.

Results



The effective refractive index for TE as a function of stress, t=1μm.



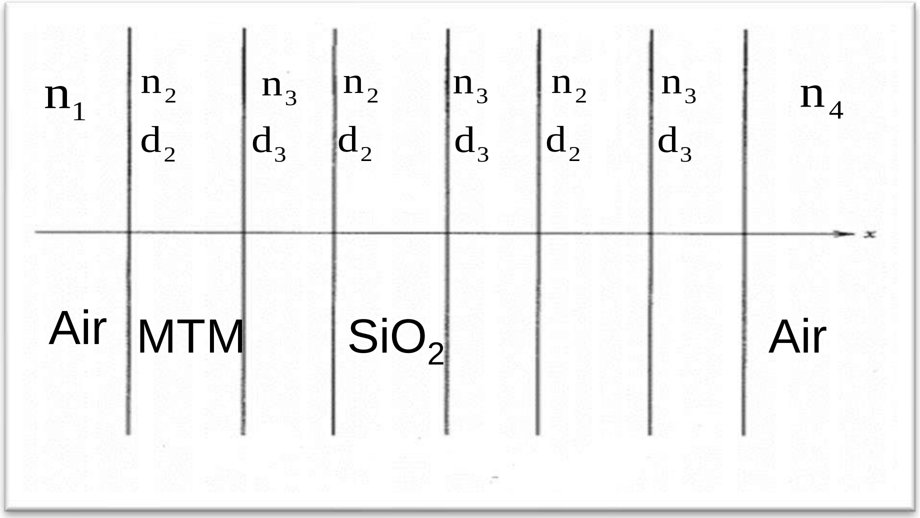
The effective refractive index for TM as a function of stress, t=1μm.

Metamaterial-dielectric photonic crystal waveguide structure

we have studied 1-D MTM- dielectric (SiO_2) photonic crystals (MTM-D-PC's). d_2= 4nm, n_3 =1.54427 and $d_{3=}$ 340nm.

d and n determine optical properties

Shift forbidden and allowed bands



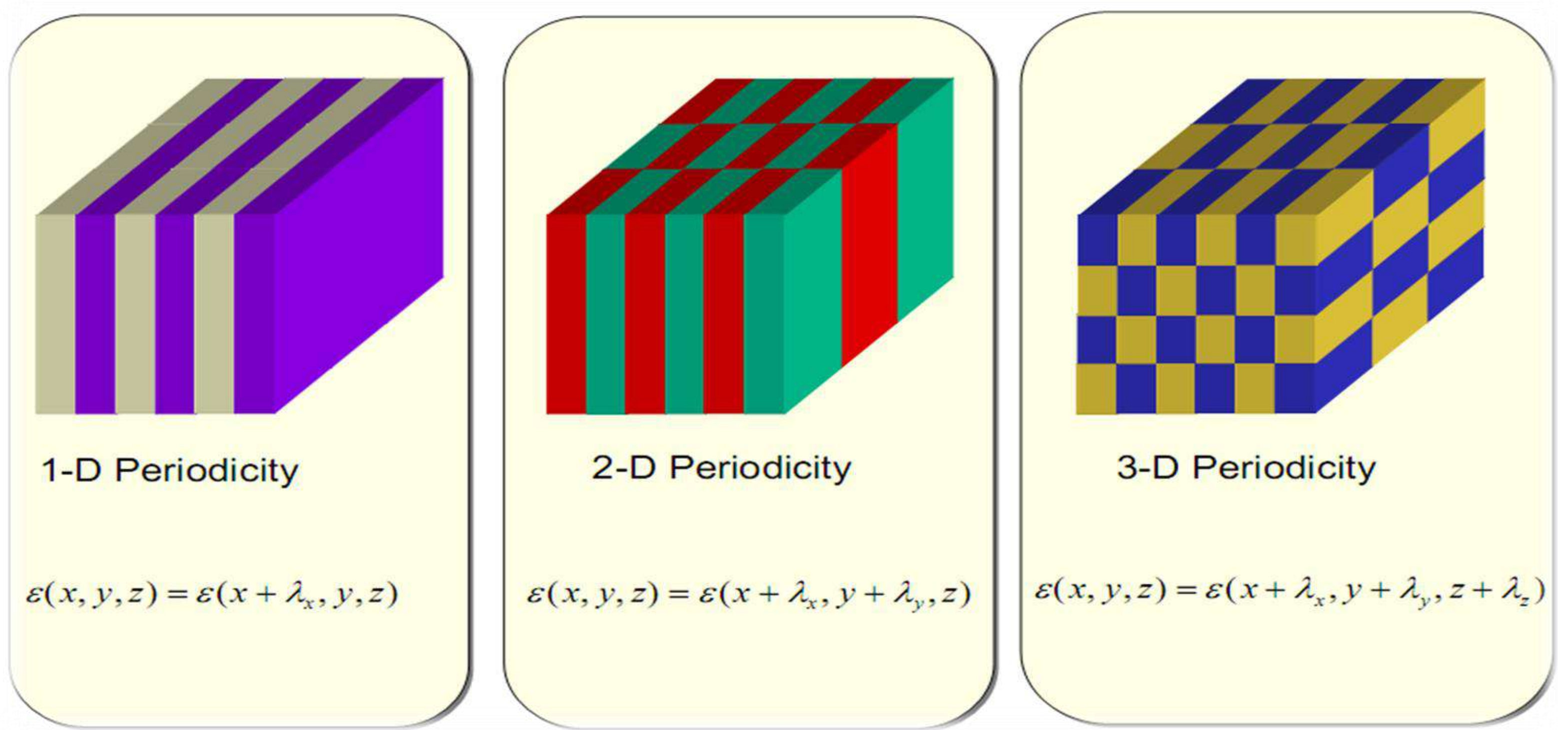
We used the transfer matrix method (TMM) to study the transmittance. Comparing the results for different refractive indices of metamaterial show that the transmittance depend on the MTMs parameters.

El-Khozondar et al., Optics, Special Issue: Optical Engineering & Applications, 2015

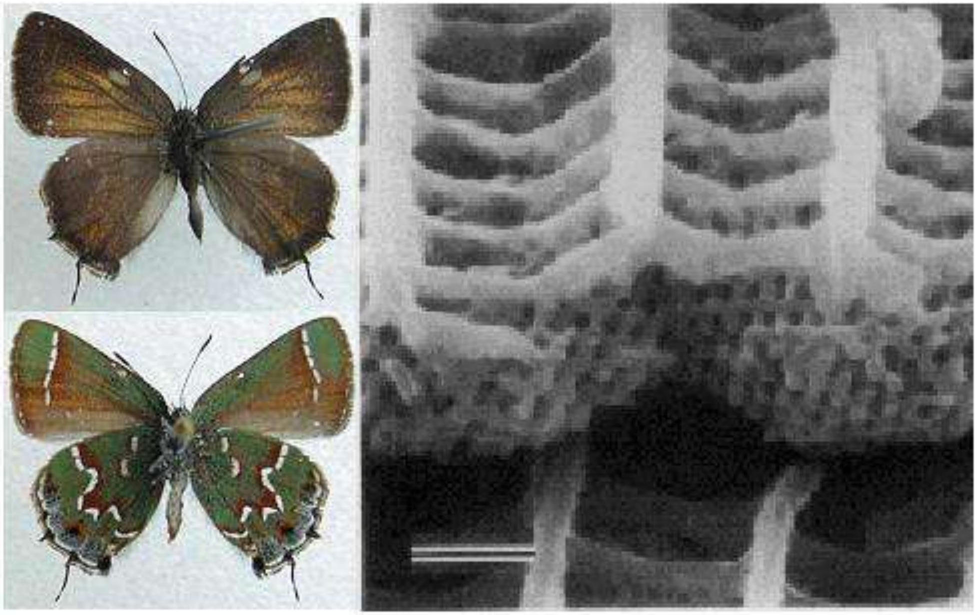
Applications

- integrated optical devices
- linear waveguides
- resonant cavities and switches

Photonic crystals are periodical structures with 1D, 2D or 3D periodic dielectric function

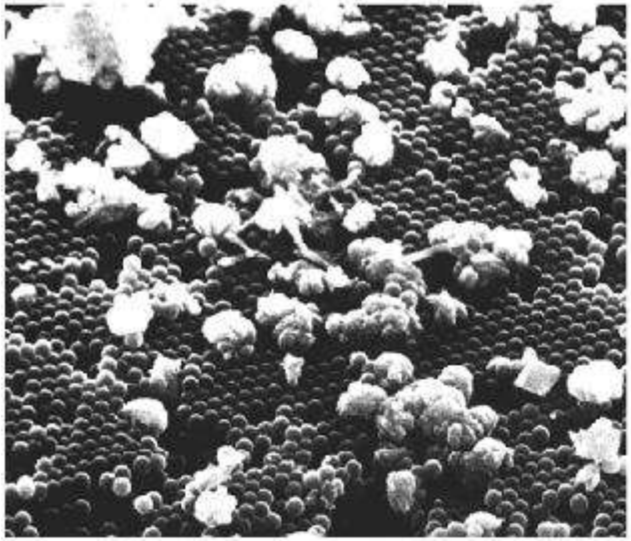


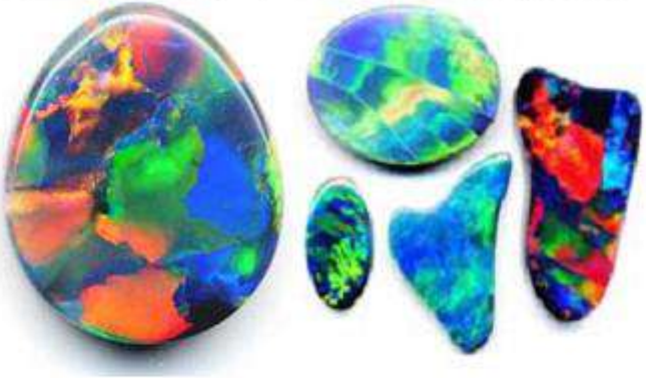
Some of the naturally occurring photonic crystals:



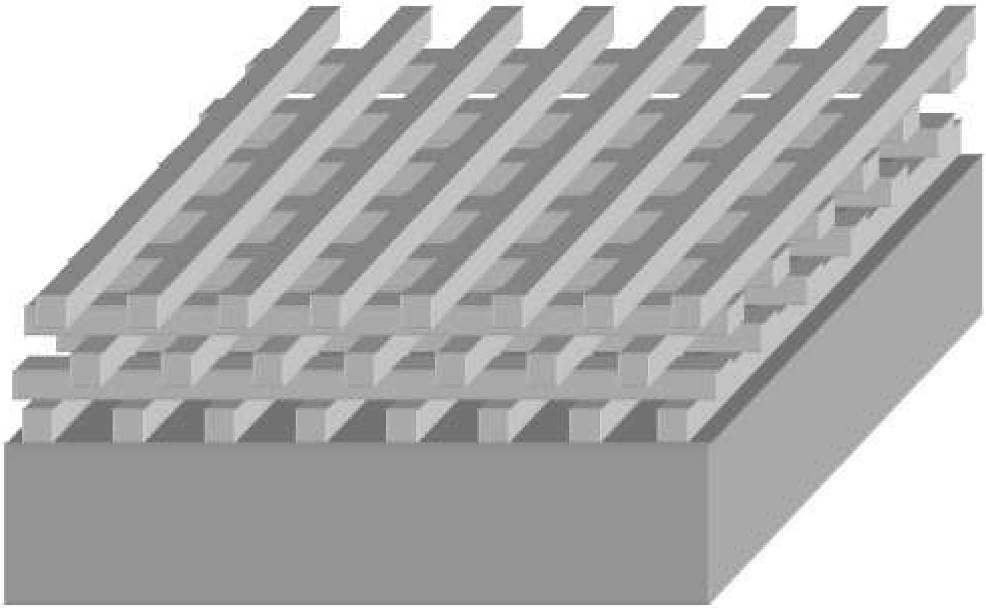
Butterfly wings

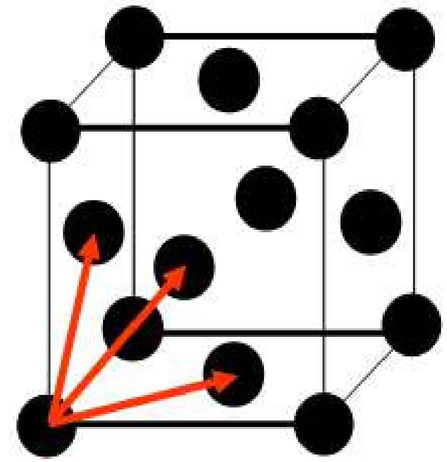
Opal



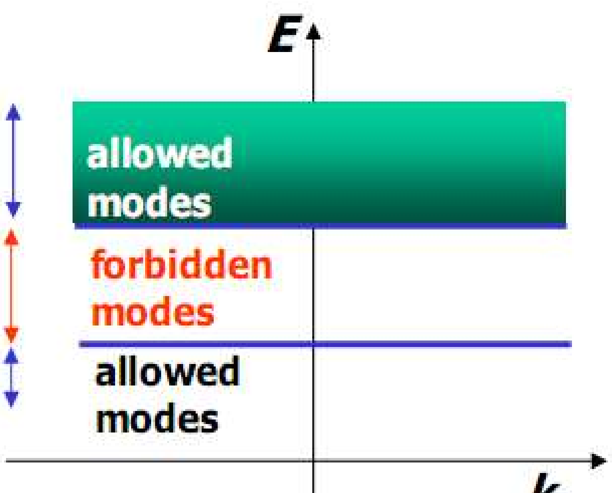


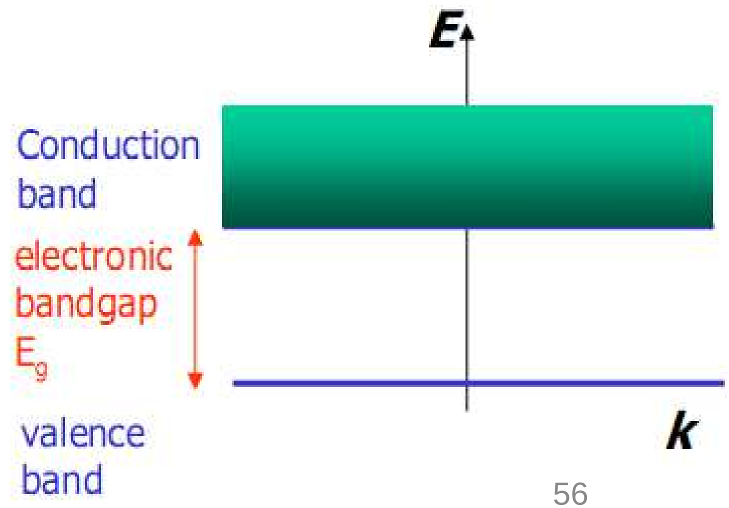
Photonic crystals are in some sense analogous to semiconductors if you replace electrons with photons



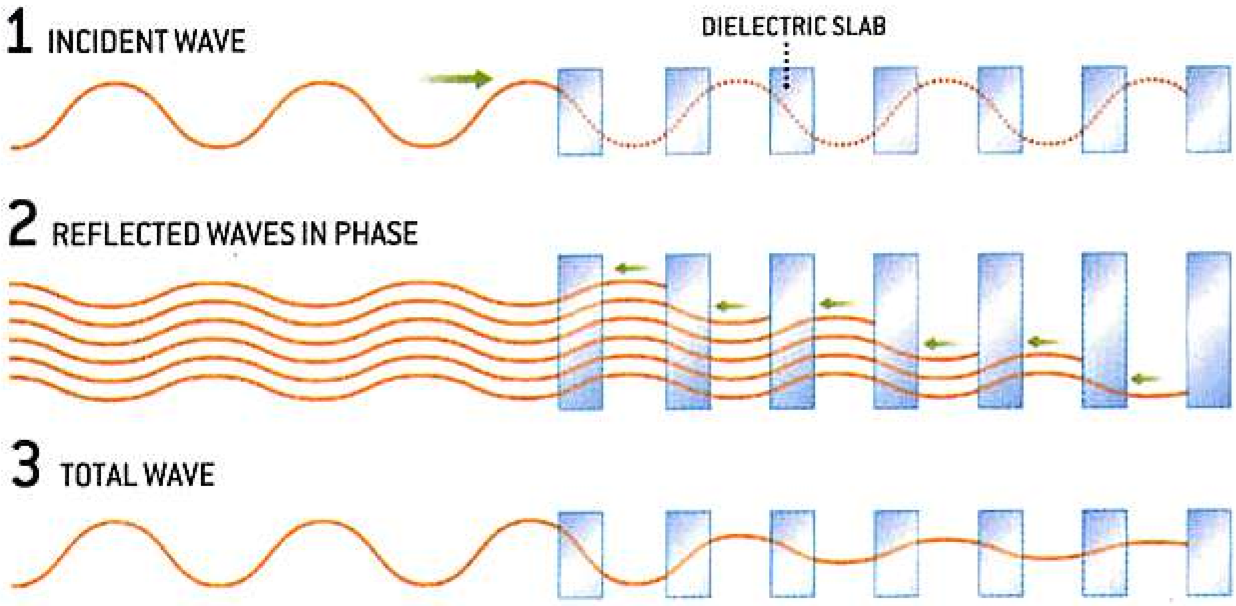


Face center cubic lattice





Simple Photonic Crystals



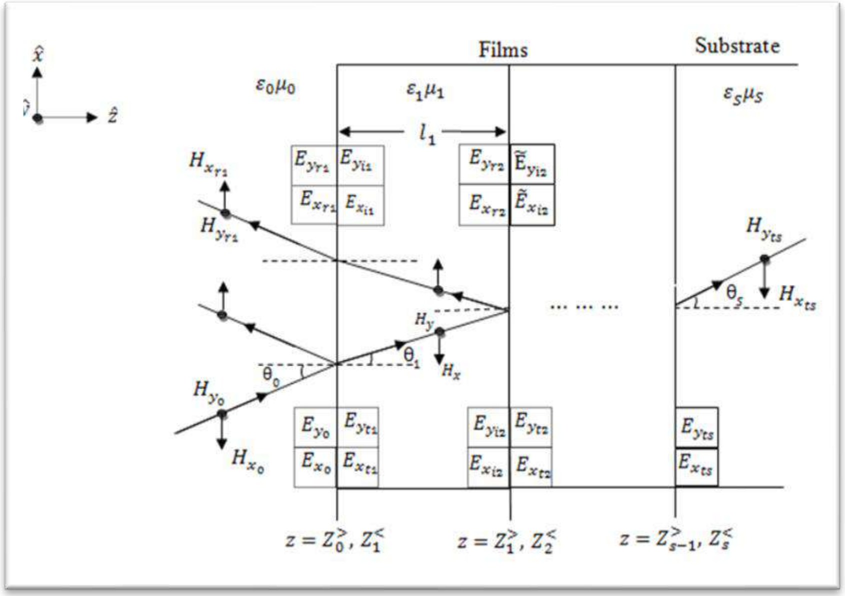
Alternating materials of higher & lower refractive indices

Periodicity: on the order of wavelength of light

Functionality: semiconductors for light

Mathematical calculations

$$\begin{pmatrix} E_{out} \\ H_{out} \end{pmatrix} = \begin{pmatrix} M_{11} & M_{12} \\ M_{21} & M_{22} \end{pmatrix} \begin{pmatrix} E_{in} \\ H_{in} \end{pmatrix}$$



Mathematical calculations

For TE

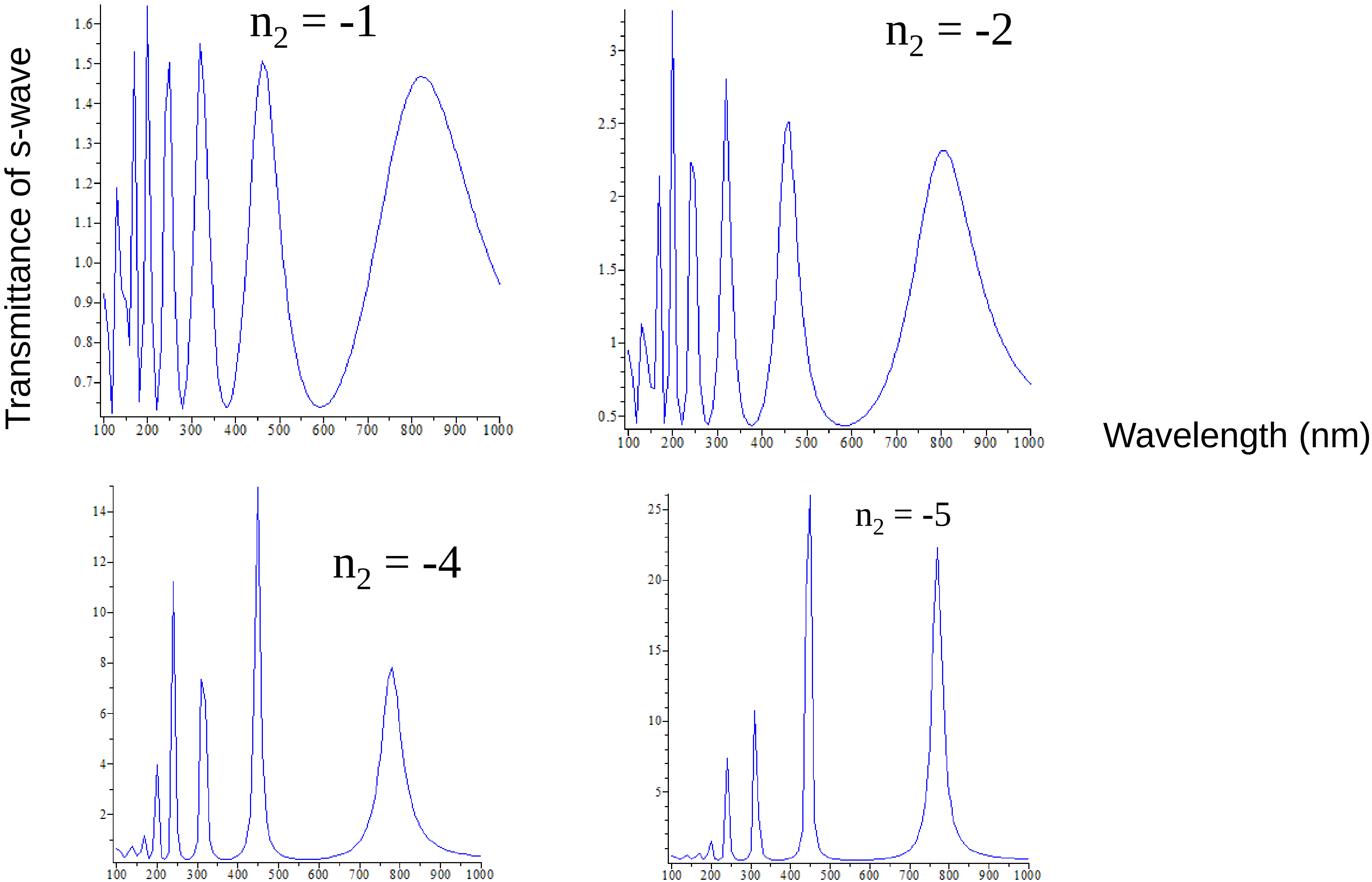
Reflectance (R)

$$R = |r|^2 = \left|\frac{M_{21}}{M_{11}}\right|^2$$

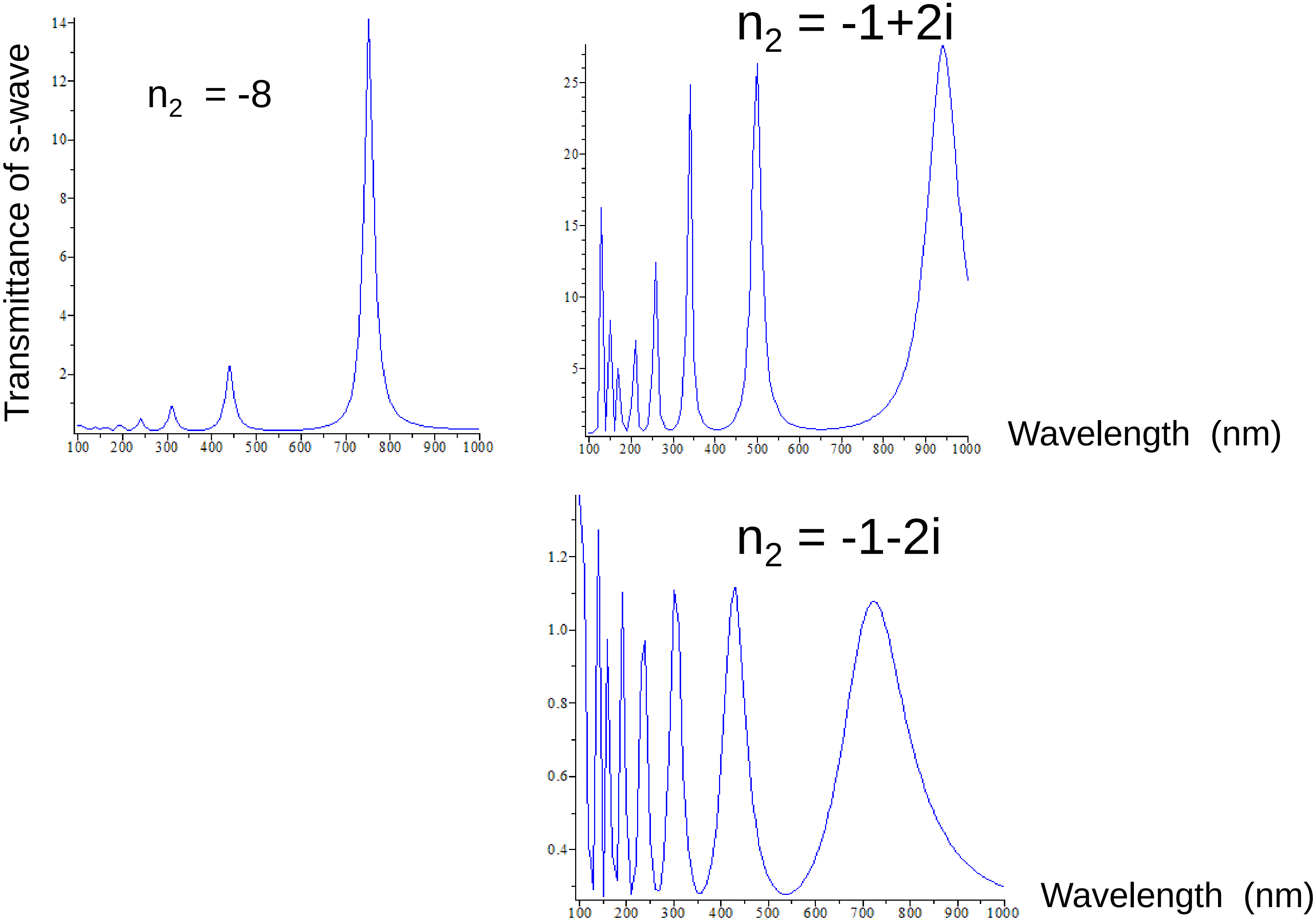
Transmittance (T)

$$T = \frac{n_4 \cos\theta_4}{n_1 \cos\theta_1}\left|\frac{1}{M_{11}}\right|^2$$

Results



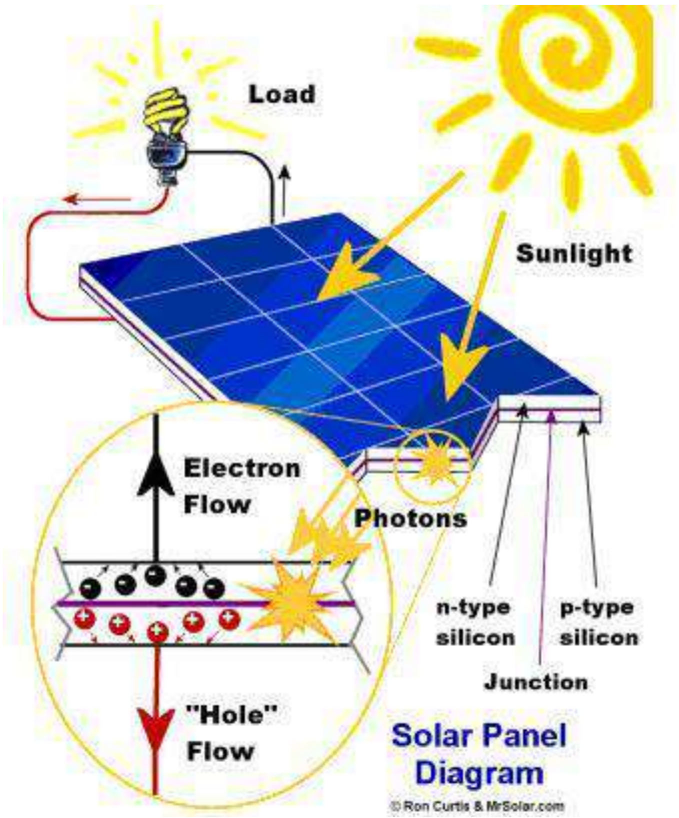
Transmittance of s-wave
Wavelength (nm)
$n_2 = -1$
$n_2 = -2$
$n_2 = -4$
$n_2 = -5$
100 200 300 400 500 600 700 800 900 1000

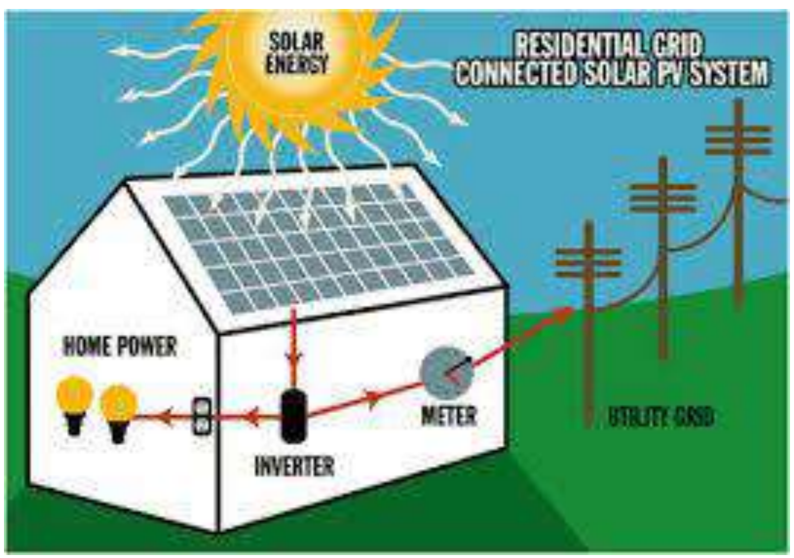


Transmittance of s-wave
n_2 = -8
n_2 = -1+2i
n_2 = -1-2i
Wavelength (nm)
Wavelength (nm)

Photovoltaic (PV) cells

A photovoltaic system is a power system designed to supply usable solar power by means of photovoltaics.





PV systems range from small, rooftop-mounted or building-integrated systems with capacities from a few to several tens of kilowatts, to large utility-scale power stations of hundreds of megawatts.

Solar cells is the building unit of the solar system convert the sunlight to electricity.

Solar cell generations

- Si (crystalline) cells : 1st generation cells
- (thin film) Cadmium telluride (CdTe), copper indium gallium selenide solar cell (CIGS), α-Si : 2nd generation cells
- Dye cells, organic cells and related ones : 3rd generation cells
- There are newer ones and ‘generation number’ becomes fuzzy at this stage

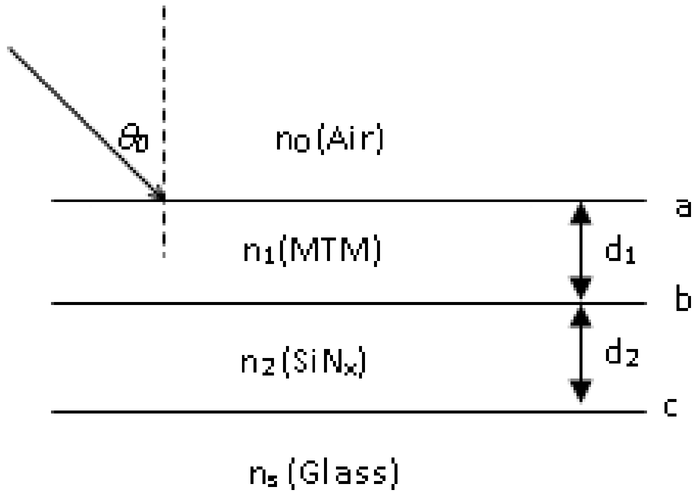
What makes PV Production interesting?

- PV addresses the energy problem which many passionately , want to solve.
- By 2050 the world will need ~ 30 TW of power.
- Some think PV could provide 20 % of that.

Thin Film Solar Cells

- A thin film of semiconductor is deposited by low cost methods.
- Less material is used
- Cells can be flexible and integrated directly into roofing material

Proposed Model PV



Glass n_s=1.47, air n_0=1. d_1 and d_2 are chosen ($d_m = \lambda_m/4$), where $\lambda_m = \lambda/n_m$, λ is the peak of the solar spectrum (λ=600nm).

The spectral response of SiN_x goes 300-1200nm.This range is taken to limit the spectrum of the incident light.

Transfer Matrix Method (TMM)

$$M_k = \begin{bmatrix} m_{11} & m_{12} \\ m_{21} & m_{22} \end{bmatrix} = \begin{bmatrix} \cos(\delta_k) & \dfrac{i\sin(\delta_k)}{\gamma_k} \\ i\gamma_k \sin(\delta_k) & \cos(\delta_k) \end{bmatrix}$$

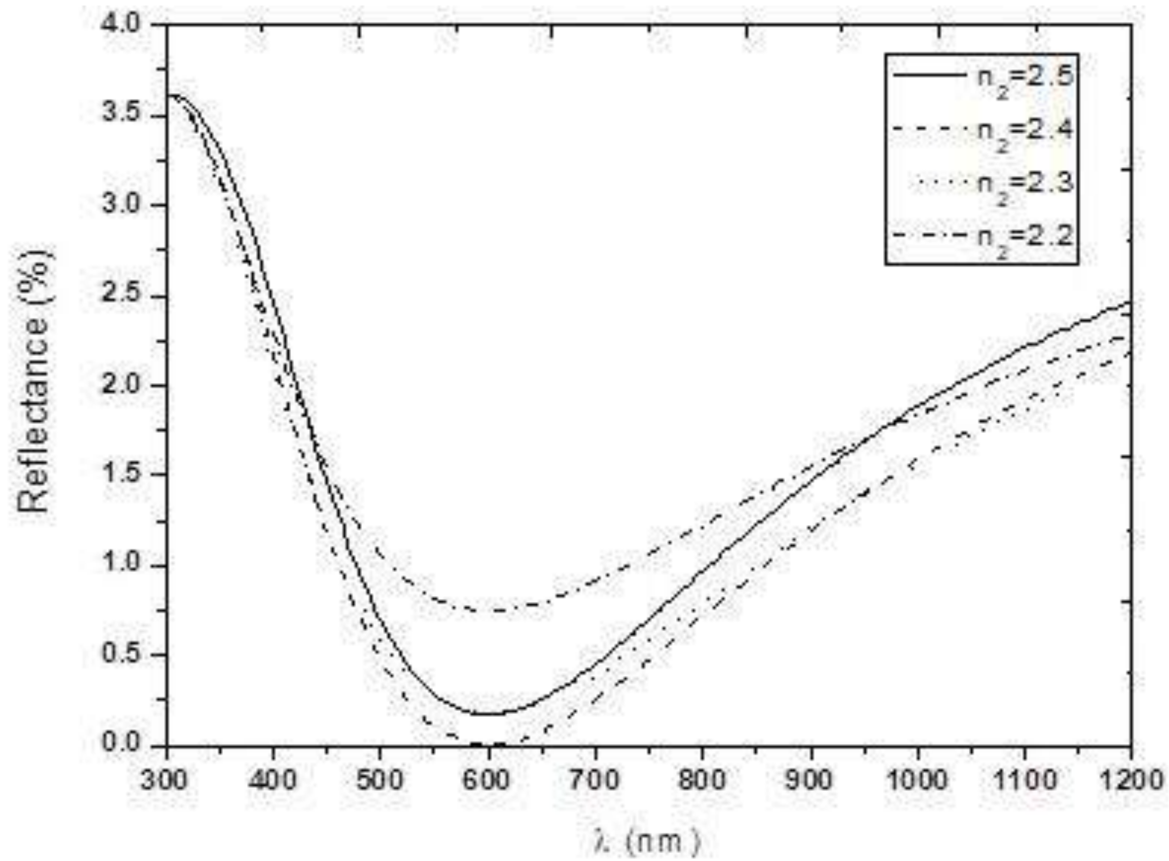
$$\gamma_k^{TE} = \frac{1}{\eta_0 \mu_k} n_k cos\theta_k \qquad \gamma_k^{TM} = \frac{1}{\eta_0 \mu_k} \frac{n_k}{cos\theta_k}$$

$$M_T = M_1 M_2 \dots M_m = \prod_{k=1}^{m} M_k$$

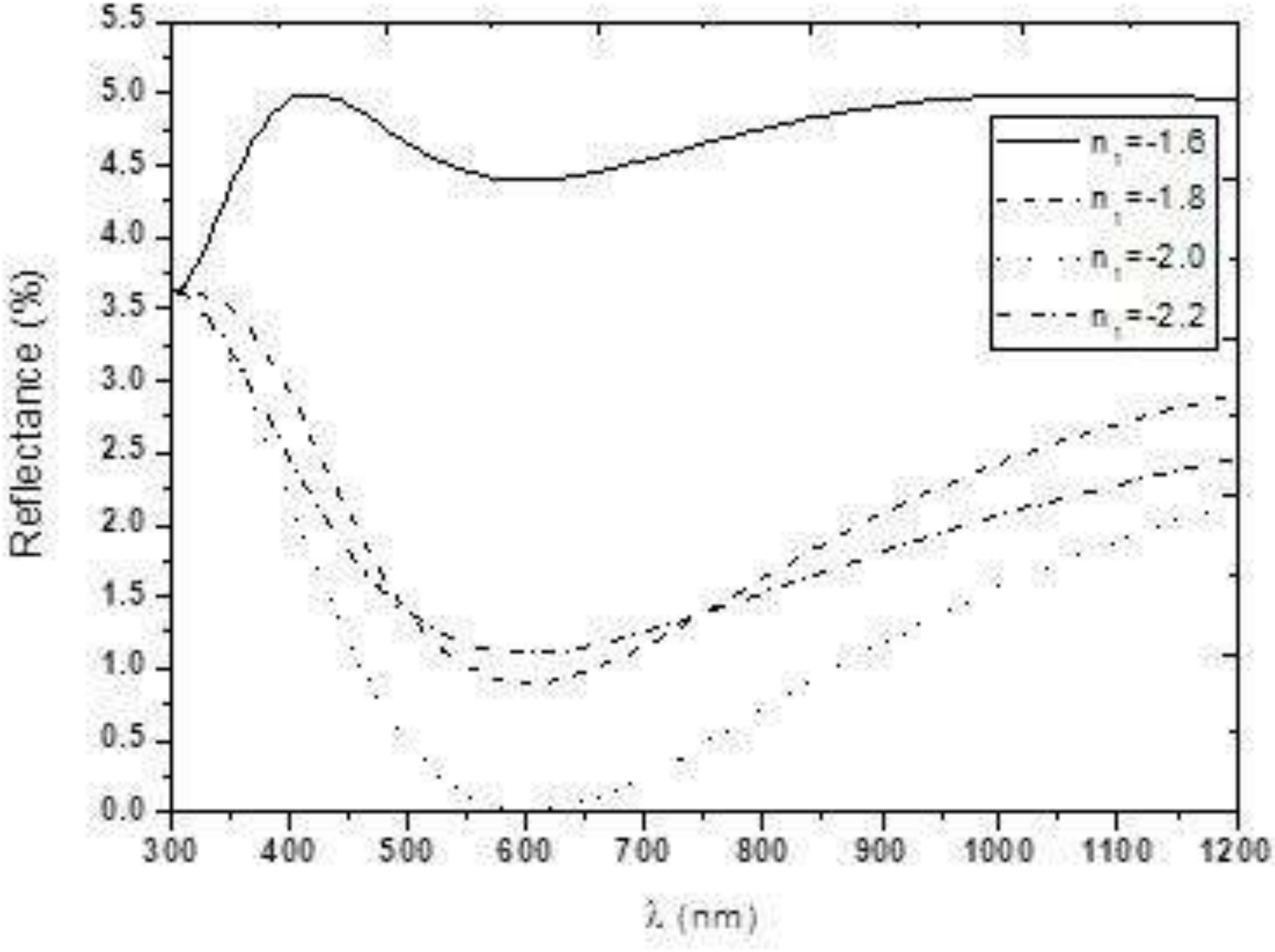
$$R = \frac{R^{TE} + R^{TM}}{2}$$

Results

Normal incidence with n_1=-2.

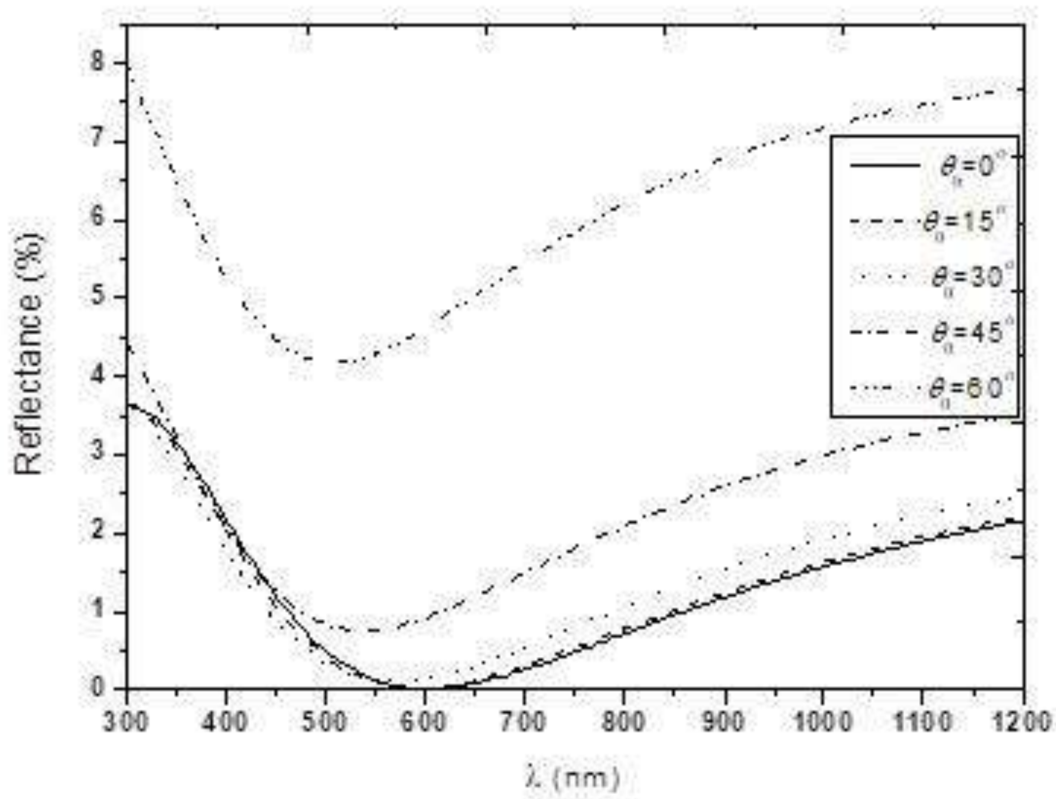


Results



The reflectance for n_2=2 and under normal incidence.

Results



Reflectance (%)
λ (nm)
θ0=0°
θ0=15°
θ0=30°
θ0=45°
θ0=60°
0
1
2
3
4
5
6
7
8
300
400
500
600
700
800
900
1000
1100
1200

A compact very wideband amplifying filter based on RTD loaded composite right/left-handed transmission lines

- A Transmission lines(TL) is a device designed to guide electrical energy from one point to another. It is used, for example, to transfer the output radio frequency energy of a transmitter to an antenna.
- The composite right/left-handed (CRLH) transmission line (TL) is presented as a general TL possessing both left-handed (LH) and right-handed (RH) natures.
- to design and analyze nonlinear CRLH-TL transmission line loaded with resonant tunneling diode (RTD).
- The main application of this design is a very wideband and compact filter that amplifies the travelling signal. We used OrCAD and ADS software to analyze the proposed circuit.

Transmission lines (TL)

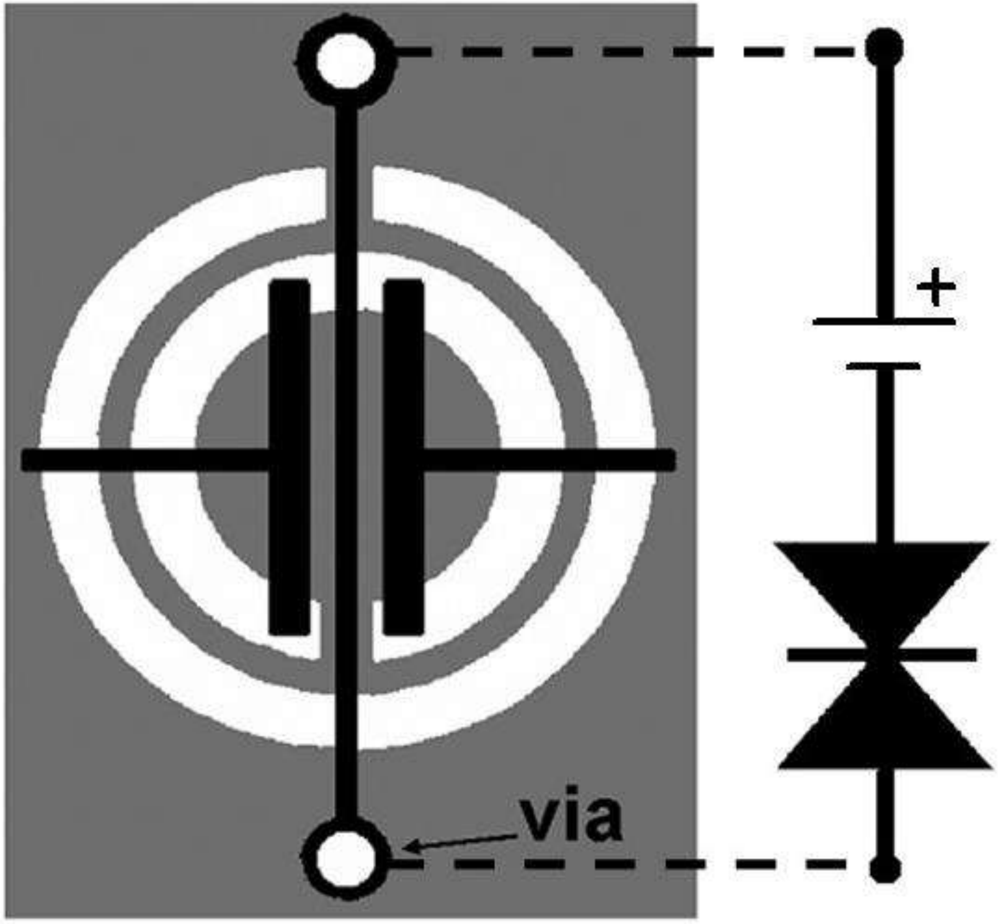
$$Z = j\omega\mu_{eff} \qquad Y = j\omega\varepsilon_{eff}$$

Impedance	admittance	Medium	Propagating
Z	Y		
>0	>0	Conventional TL. DPS	YES
>0	<0	SNG	NO
<0	>0	SNG	NO
<0	<0	Dual TL DNG	YES

Composite Left/Right handed TL

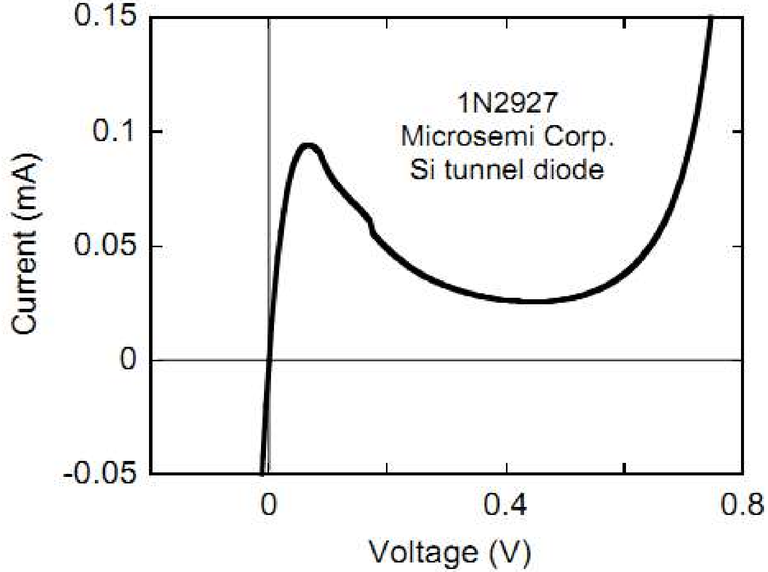
The model

- We put the RTD and DC voltage source at shunt with grounded stubs of CRLH-TL cell
- tune the DC voltage source until achieve the desired design.



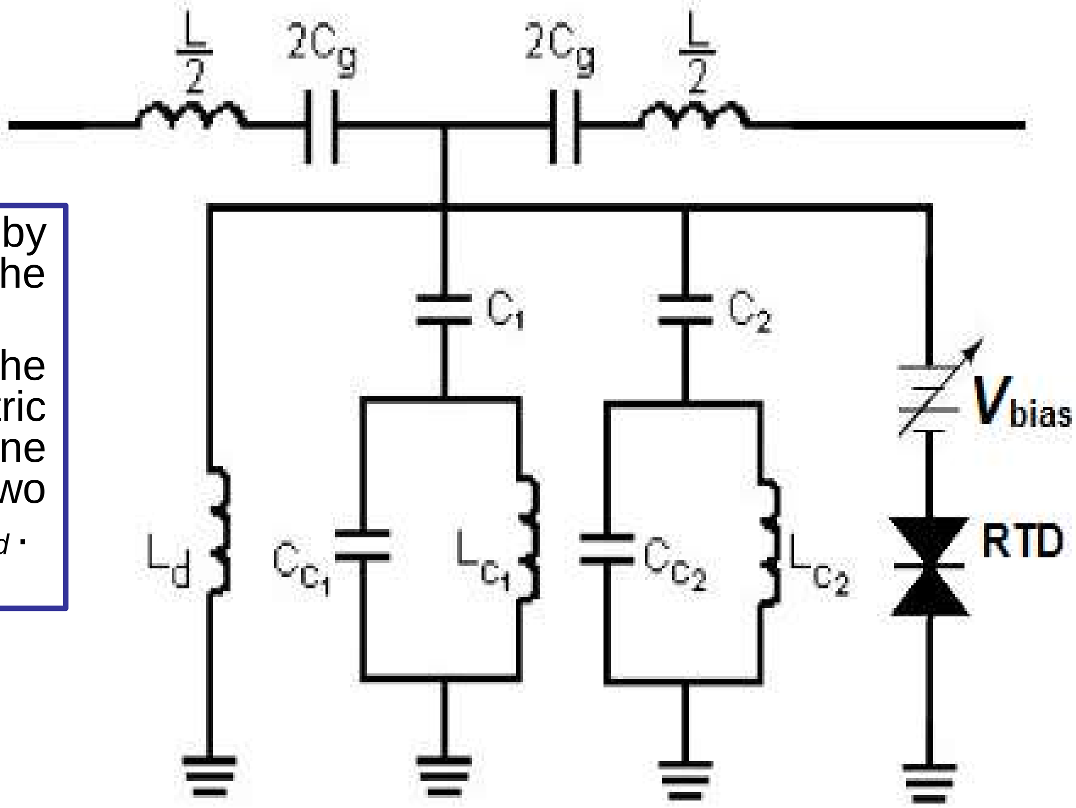
Resonant tunneling diode (RTD)

- A resonant tunneling diode (RTD) is a diode with a resonant-tunneling structure in which electrons can tunnel through some resonant states at certain energy levels

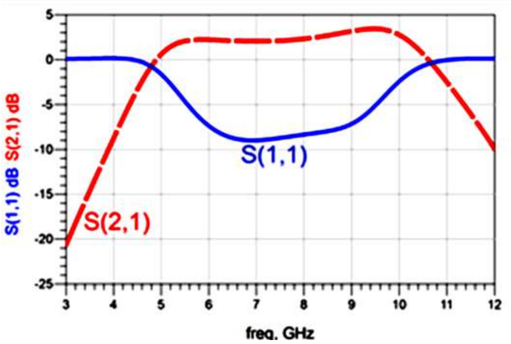


- have more interesting features referring to the high switching speed (can achieve a maximum frequency of up to 2.2 THz) and to the I-V characteristic that often exhibits negative differential resistance (NDR) regions.
- It is used in wide range of applications such as an amplifier, pulse generators, ADCs and oscillators.

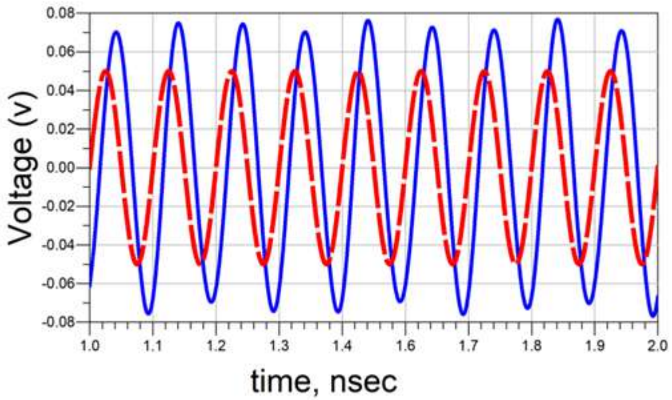
equivalent circuit model



- The CSRR is modeled by the C_c and L_c, whereas the gaps are described by C_g.
- *L* is the inductance of the line, while *C is* the electric coupling between the line and CSRR, and the two shunt stubs modeled by L_d .



Simulated reflection and transmission coefficients of a single cell loaded with RTD.

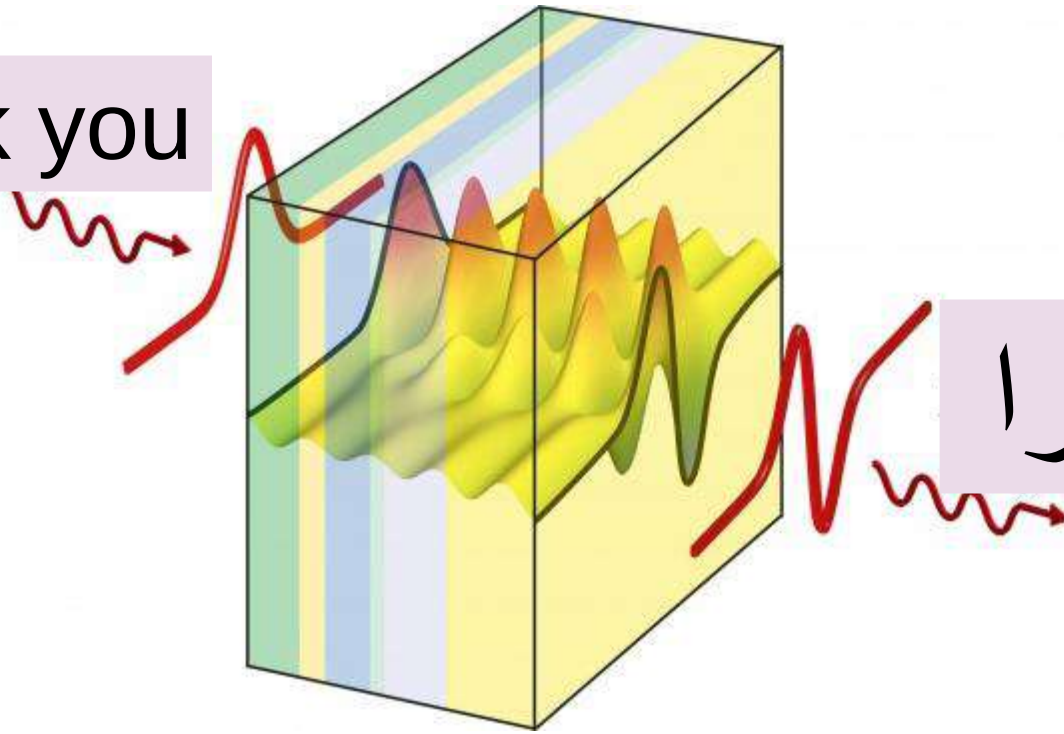


Simulation result to the equivalent circuit at 9 GHz and DC biasing equal to 1.18 V. The dash line refers to the input signal and the sold line refers to the output signal of the filter.

- Our work is an ultra-wideband filter with amplification up to 50% at frequency range form 5-10.5 GHz .

- The filter is constructed by combining the RTD with CRLH-TL based on hybrid CSRR

Thank you



شكرا

RESEARCH AND INNOVATION FOR ECONOMIC DEVELOPMENT

IRFAN AHMAD

Assistant Dean for Research, Carle Illinois College of Medicine, University of Illinois at Urbana-Champaign, USA

ABSTRACT

Research and innovation are critical to poverty alleviation and economic development to build stronger communities. The sustainability of such endeavors is mostly based on capacity building and nurturing of skills locally. To achieve these objectives a multi-pronged approach is needed involving dedicated financial support for scientific research, technology, innovation, entrepreneurship, governmental policy-making structures, the parliament, viable communication, and most importantly across board transparency. Among some of the areas, which can benefit are bionanotechnology, digital health and agriculture, artificial intelligence, and machine learning-driven applications across the broad spectrum of the economy, energy, and the environment. It is argued that innovation-based entrepreneurship is a precursor to a healthy economy.

For example, approximately 80% of the global R&D expenditure is spent by developed countries, of which 33.5% is by the USA, 23.5% by the EU, and 13.4% by Japan. Whereas, the OIC countries account for only 1.8% of the world's total Gross Domestic Expenditures on R&D; and according to the World Bank, Pakistan spends a measly 0.2%.

The federally funded research and development at the University of Illinois System in the U.S. is an engine for statewide and regional economic development, which contributes $19 billion annually to the state's economy, and supports nearly 164,200 jobs, or one out of every 46 jobs in Illinois. Is this a model for the OIC countries to follow? What will it take to put the process in place? We will discuss this during the session with co-panelists Dr. Munir Nayfeh and Dr. Bulent Aydogan.

Irfan S. Ahmad

Research and Innovation for Economic Development

March 7-8, 2023
Islamic World Academy of Sciences
ICCBS, Karachi, Pakistan

ILLINOIS
Holonyak Micro & Nanotechnology Laboratory
GRAINGER COLLEGE OF ENGINEERING

Presentation Outline

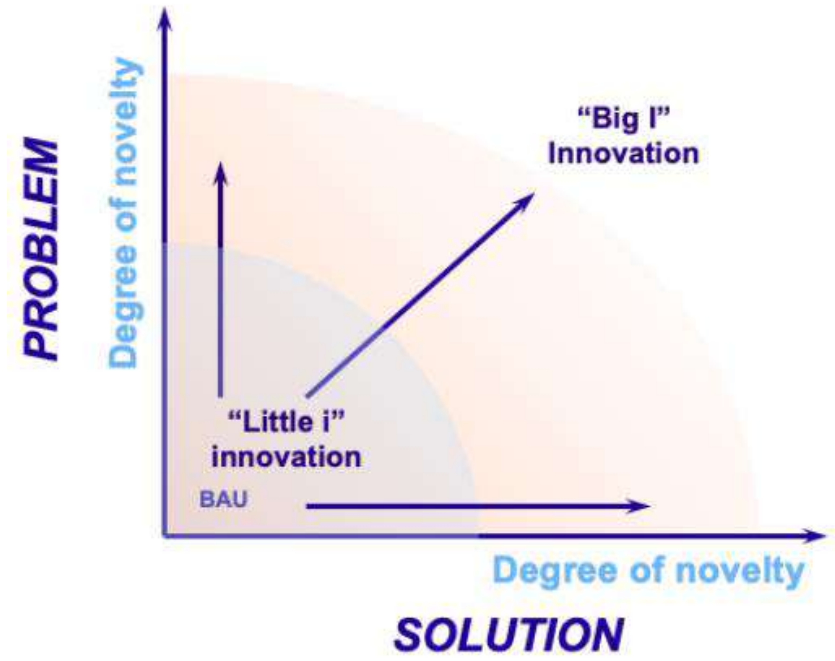
- Perspective
- Innovation Campus
- Benchmarking
- IUCRCs
- Summary and Conclusions
- Recommendations
- Acknowledgments

Defining Innovation

How do you Define Innovation?

"process of taking ideas from inception to impact"

- MIT's Innovation Initiative (MITii)



Innovation Campus

Discovery Partners Institute; Cornell Tech; Virginia Tech Innovation in Washington D.C.; U Mich in Detroit; Northeastern in Maine; USA

US and UK-wide Innovation Hubs

- Silicon Valley
- Boston
- New York
- Triangle Park
- Austin, TX

UK

- London
- Golden Triangle

Economic Development

- Innovation-based Entrepreneurship: a Bedrock for Economic Development
- Knowledge Transfer and the free flow of ideas among OIC Countries- is the key to innovation
- Basic Research across borders with Translational Research in Developing Countries
- Basic Research Generates New Knowledge and Scientific Research Peaks at 8 years in comparison to 3 years (patents/licensing) for translational research
- Tech campuses solve two major needs: talent and technology (Collins, L.)

From Rural-Urban to Metropolitan

DPI, Cornell Tech, Virginia Innovation Campuses

What it Takes

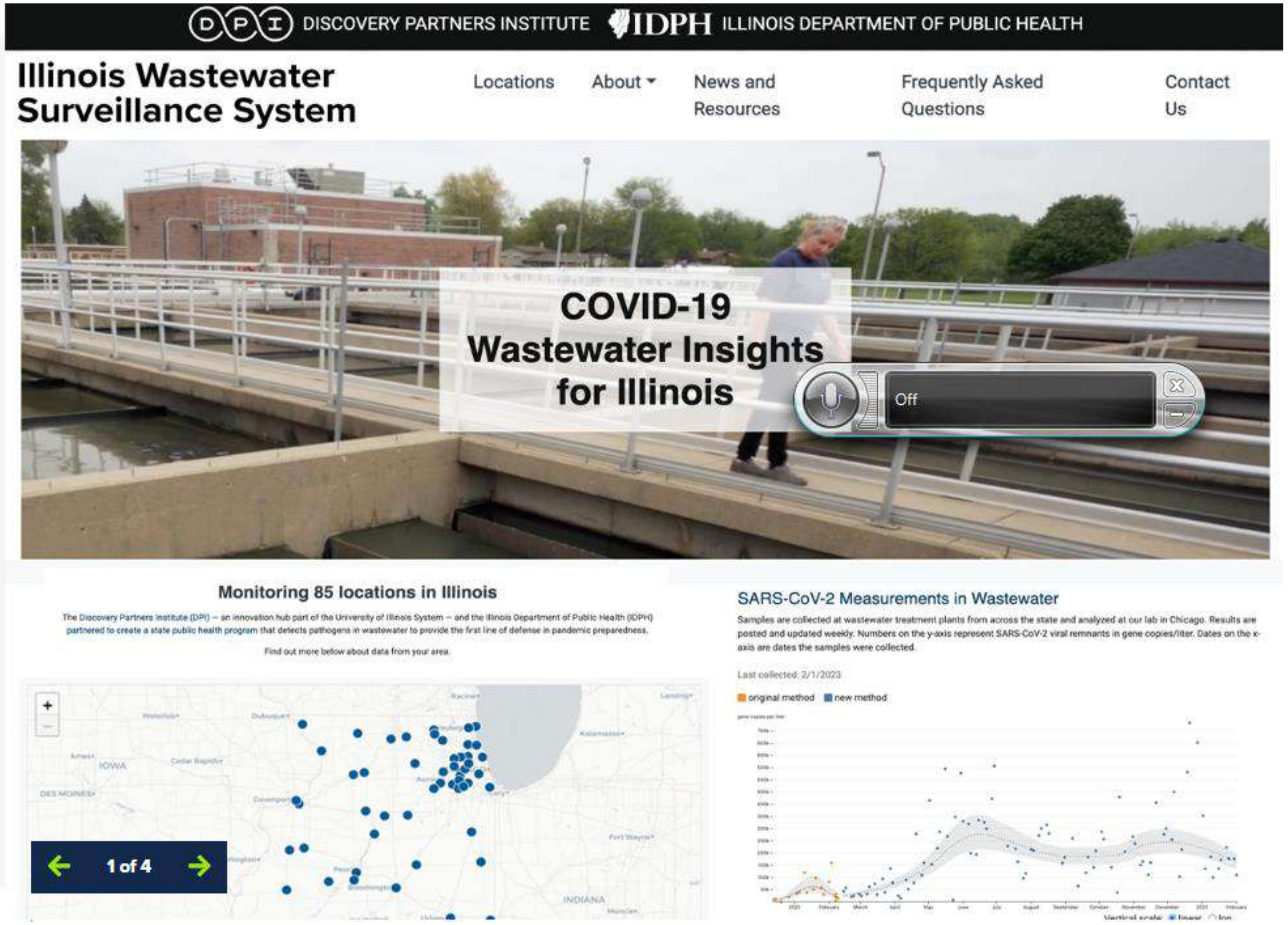
- Bold Ideas
- Willingness to take Risks
- Outward Facing
- Action-oriented Culture
- Innovation

DISCOVERY PARTNERS INSTITUTE
PART OF THE UNIVERSITY OF ILLINOIS SYSTEM

DPI Vision | Tech Talent Development | Applied Research | Business Building | News | Event:

Wastewater data in real time

Check out the new online COVID-19 dashboard from IDPH and DPI



Discovery Partners Institute receives $2.36 million disease-control contract from Chicago Department of Public Health ›

The two-year extension will enable real-time monitoring of contagious diseases beyond COVID-19 February 21, 2023 (CHICAGO) —The ...

Chan Zuckerberg Biotech Center in Chicago

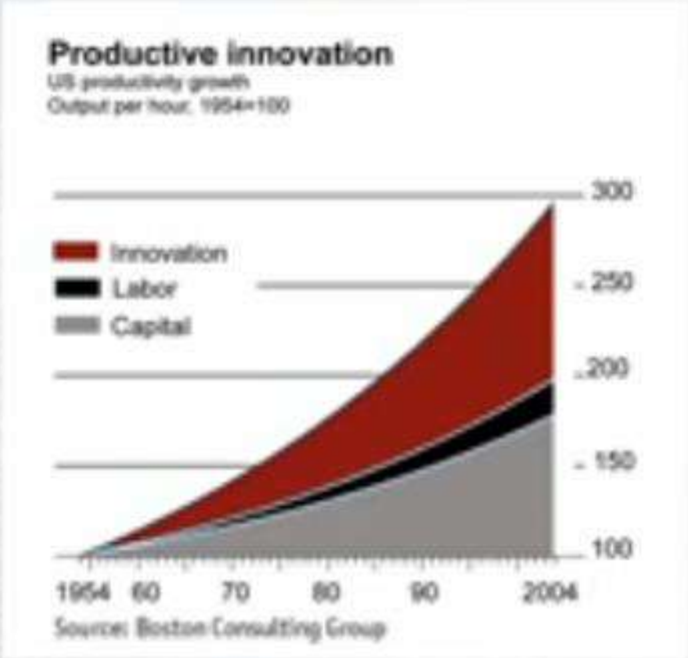
In March 2, 2023:
The Chan Zuckerberg Initiative (CZI) announced the launch of a new biomedical research hub in Chicago

CZI that will bring together the University of Chicago, Northwestern University and the University of Illinois Urbana-Champaign, with the goal of solving grand challenges in science on a 10- to 15-year time horizon.


Bay Area

In the 21st Century innovation will be key to unlocking economic growth…

Growth in productivity is increasingly driven by innovation…



…and innovation is strongly linked with academic research.

"US employment and income growth over the next decade will depend critically on educational attainment in STEM fields."

- Goldman Sachs Global Markets Institute, June 2010

Cornell Tech in NYC

Collins, Lance, 2023

Collins, Lance, 2023

Collins, Lance, 2023

Driving a new era for the greater Washington, D.C. region's technology ecosystem.

INNOVATION CAMPUS

PURPOSE-DRIVEN RESEARCH

- Cybersecurity
- Artificial Intelligence and Machine Learning
- "Next G" Wireless Communication
- Cloud/Edge computing
- Quantum Information Science and Technology (QIST)

- Human-Machine Frontier
- Immersive Technology (Virtual Reality, Augmented Reality)
- Technology Policy, Business & Entrepreneurship
- Human-Centered Technology Design

Ref. Lance Collins, 2023

International Science, Research, Innovation, Technology Systems (SRITS)

Univ-Industry Collaboration in Asia

VinhU TSMC

EXAMPLE FROM UIUC

Research and Innovation

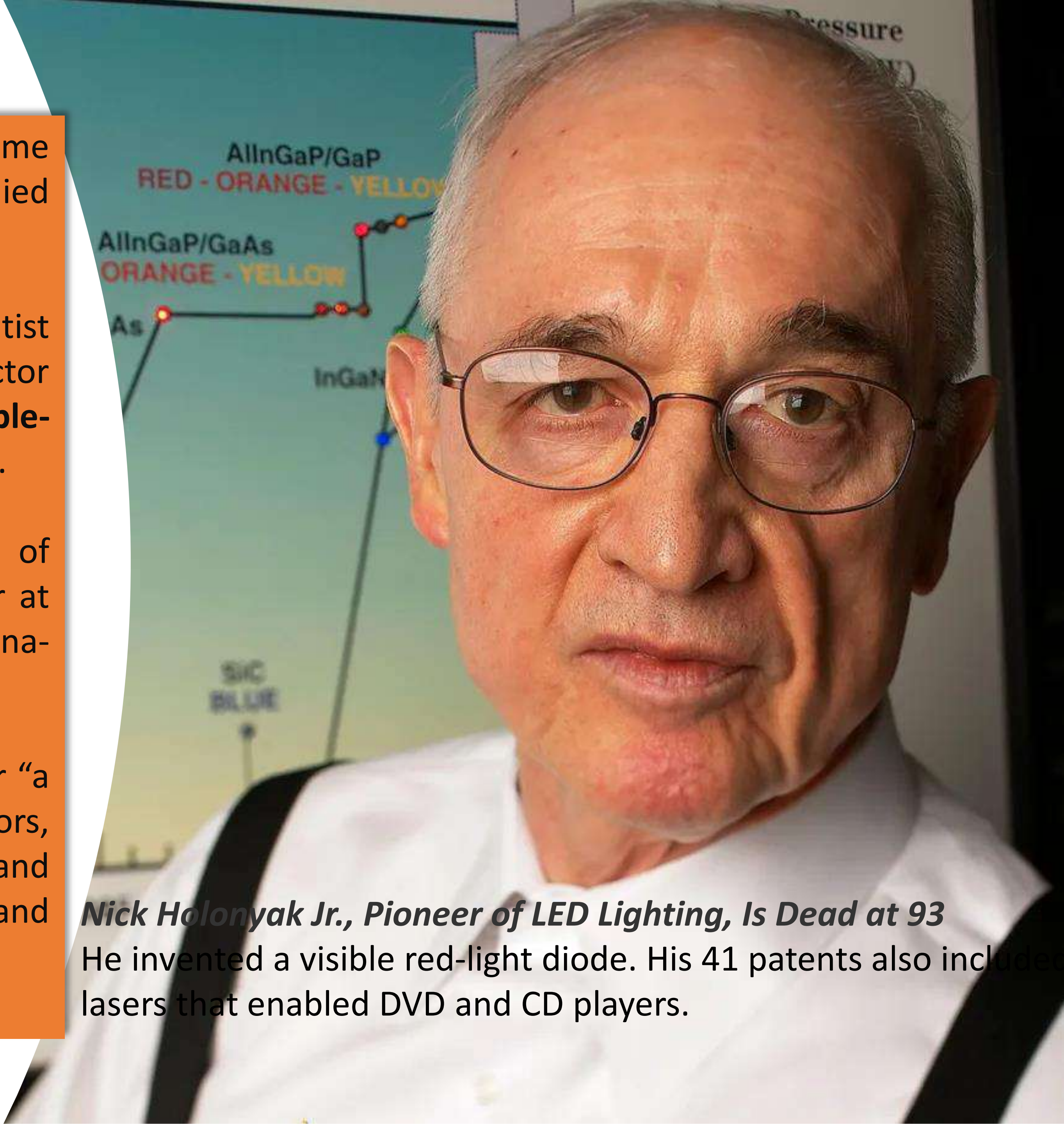
University of Illinois at Urbana-Champaign

Nick Holonyak Jr., a prolific inventor and longtime professor of electrical engineering and computing, died on 17 September at the age of 93.

In 1962, while working as a consulting scientist at [General Electric]'s Advanced Semiconductor Laboratory, **he invented the first practical visible-spectrum LED**. It is now used in light bulbs and lasers.

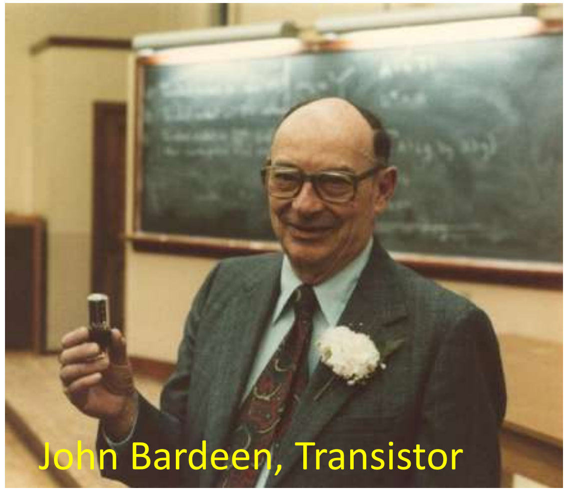
Holonyak left GE in 1963 to become a professor of electrical and computer engineering and researcher at his alma mater, the [University of Illinois] Urbana-Champaign. He retired from the university in 2013.

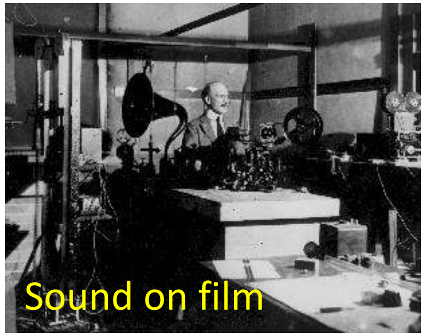
Holonyak received the 2003 [IEEE Medal of Honor] for "a career of pioneering contributions to semiconductors, including the growth of semiconductor alloys and heterojunctions, and to visible light-emitting diodes and injection lasers."



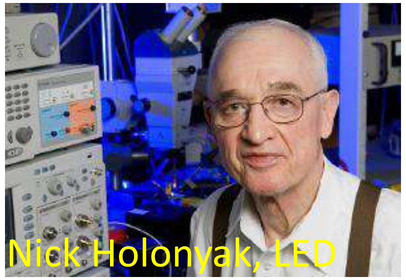
Nick Holonyak Jr., Pioneer of LED Lighting, Is Dead at 93
He invented a visible red-light diode. His 41 patents also include lasers that enabled DVD and CD players.

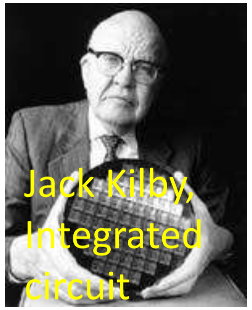

Illinois Pedigree
Excellence in Science, Technology, and Engineering
and its broad societal impact
John Bardeen
1908-1991
Two-time Nobel Laureate,
1956, 1972
Transistor, and Superconductivity
Worldwide market $17B, 2021
Jack S. Kilby
1923-2005
Nobel Laureate, 2000
Integrated Circuit
Worldwide market $480B, 2022
Paul Lauterbur
1929-2007
Nobel Laureate, 2003
Magnetic Resonance Imaging
Worldwide market $7.3B MRI equipment, 2021
Anthony J. Leggett
1938-
Nobel Laureate, 2003
Superfluidity
Set research directions to test the foundations of quantum mechanics
Nick Holonyak
1928-2022
National Medals of Science, and Technology,
1990, 2002
Light Emitting Diode and Compact Disc
Carl R. Woese
1928-2012
National Medal of Science, 2000;
Crafoord Prize in Biology, 2003
Phylogenetic taxonomy of 16S ribosomal RNA
Excellence
Innovation
Leadership
and the tradition continues...
CNST University of Illinois Center for Nanoscale Science and Technology
www.cnst.illinois.edu

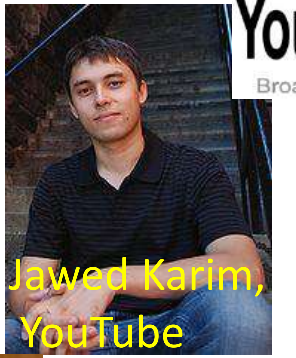




PayPal

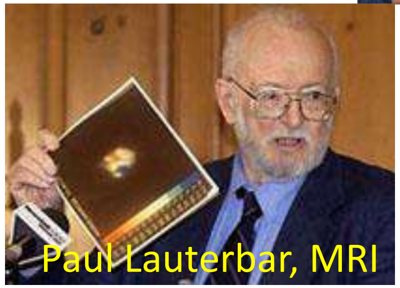


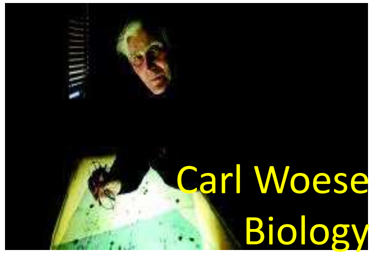




You Tube
Broadcast Yourself

Graphical web browser (Mosaic)





Innovations and Technology

- Transistor (John Bardeen, Nobel Prize is the single most important invention of the last half of the century.

- A paradigm shifting- transformative phenomenon, and the building block for the microchip.

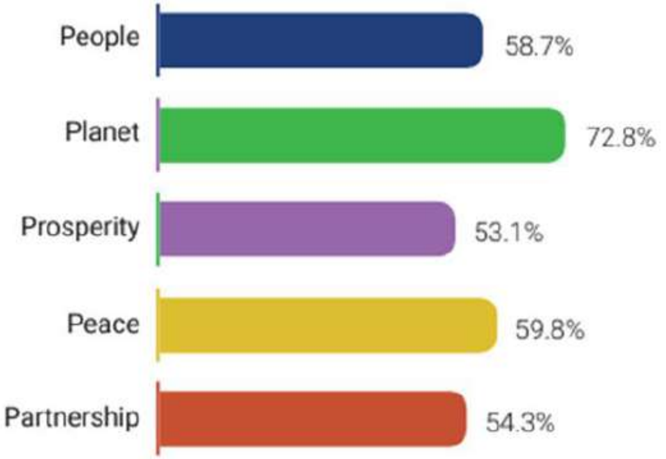
- We do take it for granted the modern day devices such as cellular phones, ipads, laptops, computers, ATMs, microwave ovens, automobiles, satellites and the list goes on.

- I say, if there was a single switch, and if it were turned off, the world will literally stop as we know it.

Figure 5: IsDB MCs SDGs Achievement by 17 Goals, 2021

Source: IsDB Institute "Reaching the SDGs: Progress of the IsDB Member Countries, 2021"

Figure 6: IsDB MCs SDGs Achievement by the Five Dimensions (5Ps), 2021



Source: IsDB Institute "Reaching the SDGs: Progress of the IsDB Member Countries, 2021"

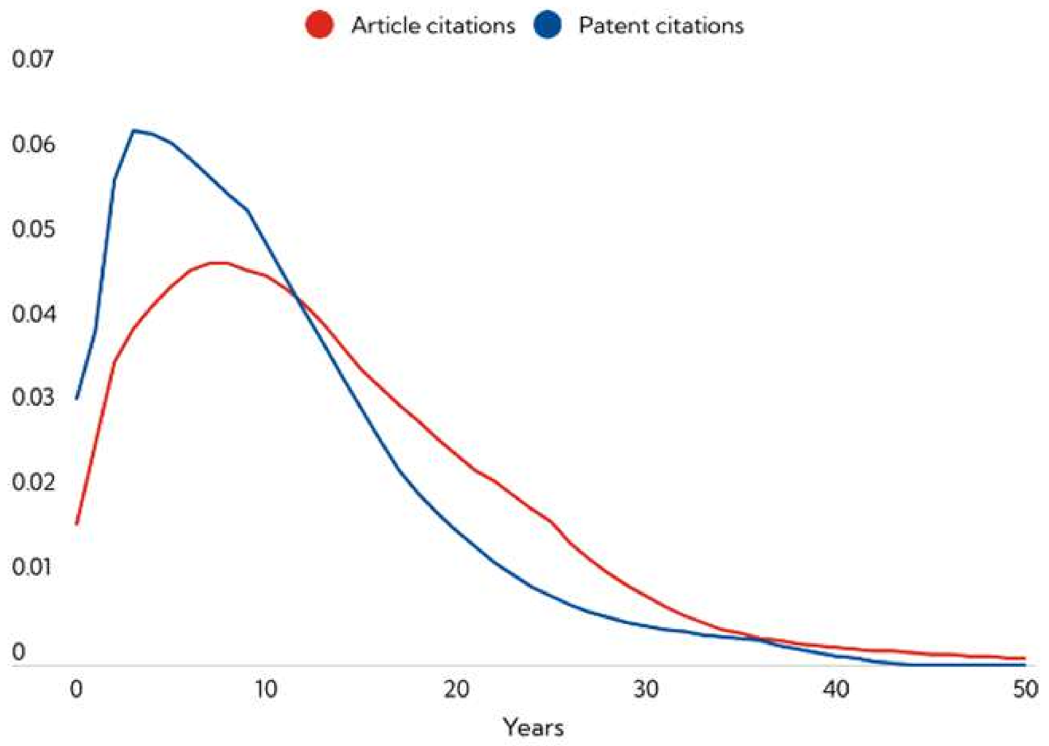
Science and Technology Investments

- Have systemic implications and complementarities that,
- Invested thoughtfully, could enhance opportunities to succeed across multiple objectives.

Relevant for longer

Scientific articles continue to be cited years after publication, suggesting basic research has a longer-lasting influence than applied research.

(density)



Sources: PATSTAT; Reliance on Science; and IMF staff calculations.

Note: Shows the temporal distribution of citations to basic (patent to article citations) and applied research (patent to patent citations) as a way to measure the influence of respective research in time. Basic research is found to be relevant for a longer time than applied research. The sample is restricted to patents from 2010–19. Axis truncated at 50 years.

IMF

Engagement

- *"Engaging the public through art and the humanities is a powerful way to foster appreciation for the impact of science and critical and innovative thinking,"*
- *- Marcia McNutt, President, National Academy of Sciences*

US innovation ecosystem’s mix of mission-based agencies helped create a revolution in computing:

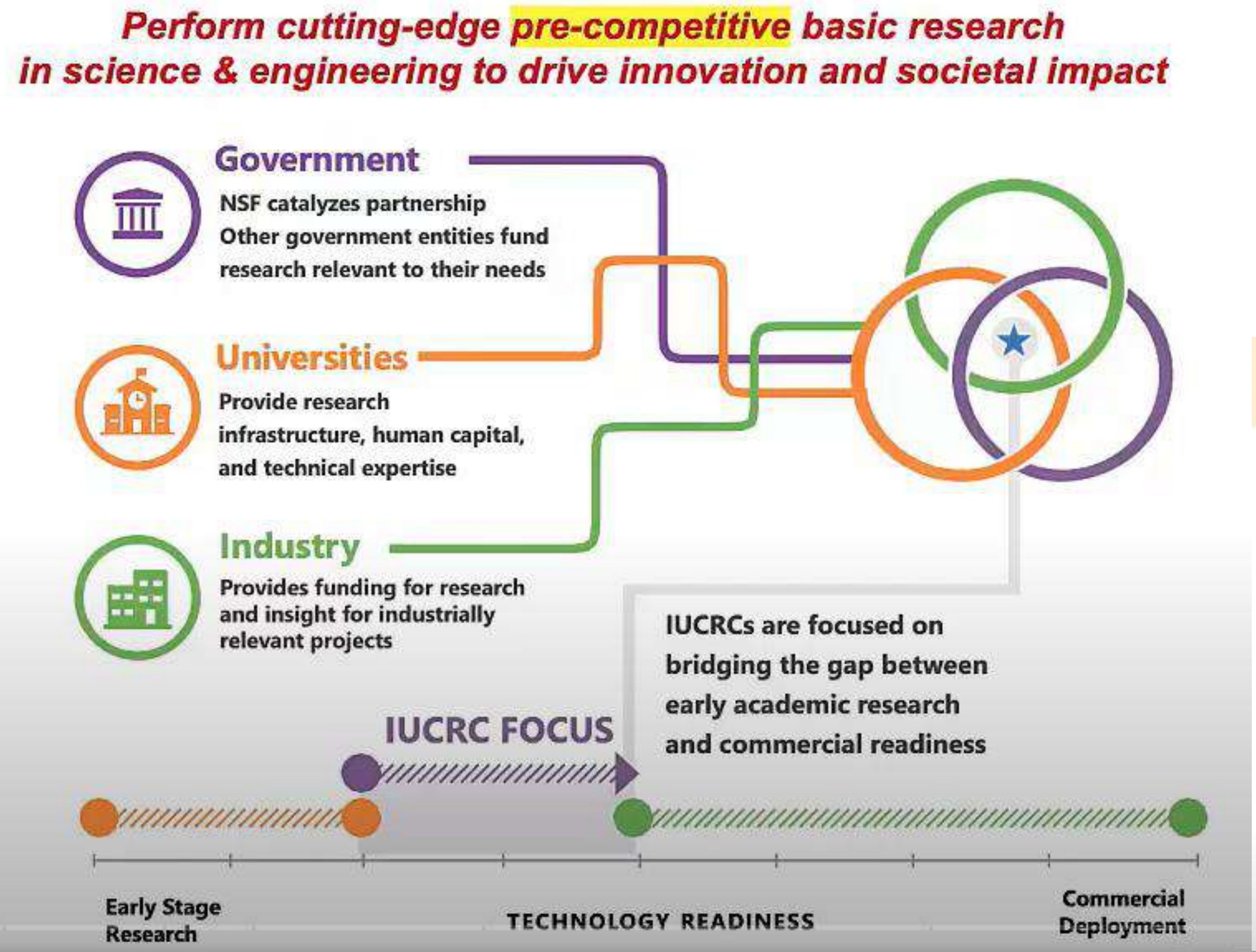
“By funding a mix of work in universities and industry, [the United States] was able to marry long-term objectives to real-world problems. And, by channeling its funding through a variety of federal agencies, it was able to ensure broad-based coverage of many technological approaches and to address a range of technical problems.”

-US National Research Council

Industry University Cooperative Research Centers

A Model for Industry-driven Translational Research for Economic Development

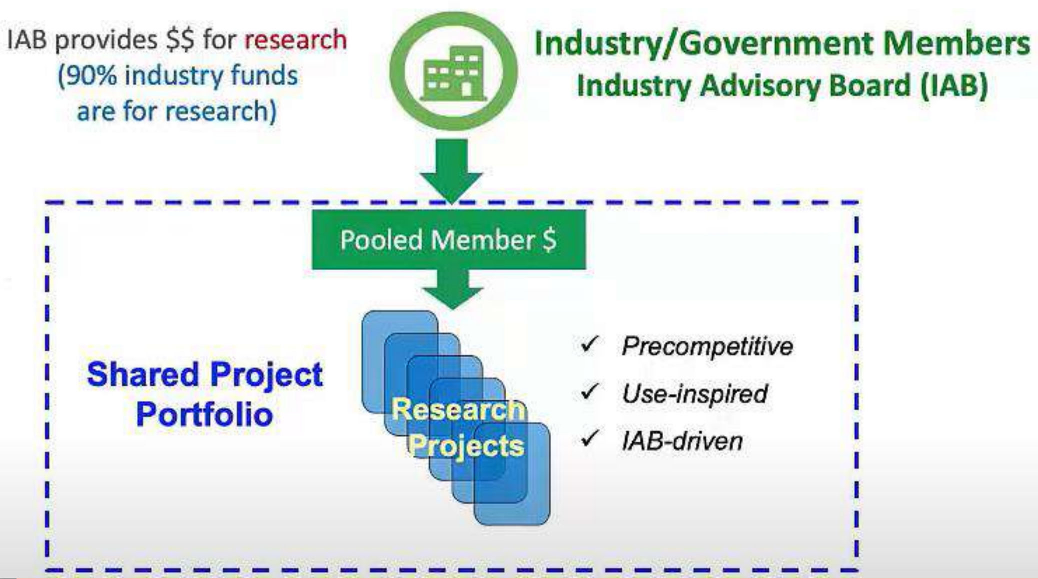
IUCRC – A Collaborative Partnership



Every year, more than 2,000 students engage in industrially-relevant research at Centers nationwide, giving them on the job training for a career in the private sector. About 30% of these student researchers are hired by the member companies.

NSF created the IUCRC program in 1973 to foster long-term partnerships among industry, academe and government. These partnerships support research programs of mutual interest, contribute to the nation's research infrastructure base, promote workforce development, and facilitate technology transfer.

IUCRC – Program Framework



Industry University Cooperative Research Center

Vision:

- To expand the innovation capacity of the nation's competitive workforce through partnerships between industries and universities (and government)

Mission:

- To contribute to the nation's research infrastructure base by developing long-term partnerships among industry, academe and government
- To leverage federal funds with industry to support graduate students performing industrially relevant research

The Economic Benefit: Research to Innovation

- For over four decades the IUCRC Program has catalyzed partnerships among industry sectors, academe, and government.
- Until 2015, there were over **77** active centers involving approximately **180** universities and **775** industry partners
- The NSF Directorates invested a combined total of approximately 20 million dollars in the IUCRC program; while the industry invested in excess of $130 million dollars - primarily in the form of center memberships.
- The vast majority of industry funds were used to provide direct research support.

VR. Simulation
https://vimeo.com/772895813

Microsoft Google amazon

SONY gig XR HEALTH 2047 FDA

BRAINLAB MAYO CLINIC AI NEXUS jump SIMULATION CENTER

smartlens apoQlar

HYPERFINE AirV LABS

COOK ADVANCED TECHNOLOGIES ISS

Affiliate Members

MHUB ILLINOIS SCIENCE & TECHNOLOGY COALITION

Center for Medical Innovations in eXtEnded Reality

MIXR

MIXR CENTER FOR MEDICAL INNOVATIONS IN EXTENDED REALITY

NSF

Carle Illinois Students Perform Holographic Clinical Simulation with Asthmatic Patient, View Impact on the Lung, and Debrief

https://vimeo.com/772895813

Medicine.ilinois.edu

CARD
CENTER FOR ADVANCED RESEARCH IN DRYING

WPI | ILLINOIS

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CARD Advances Energy-Efficient Drying Innovation for Industrial Competitiveness. For the past five years, the Center for Advanced Research in Drying (CARD) has established itself as a vibrant and critical research center impacting industrial drying. As a National Science Foundation (NSF) Industry University Cooperative Research Center (IUCRC), CARD is a "gateway" program designed to open up university research to member companies.

With projects focused on novel drying technologies, innovative sensor development, and smart oven technologies, CARD has the knowledge, resources, and creativity to make a significant impact on businesses worldwide.

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Past Members

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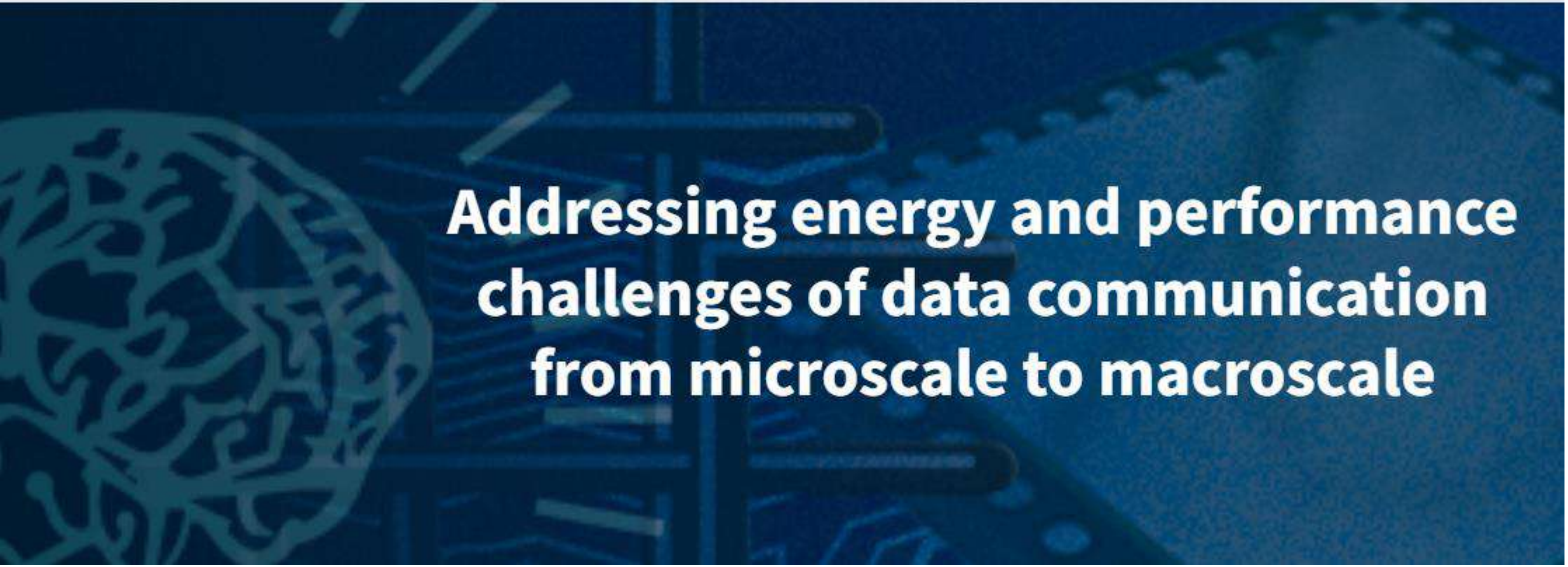
UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

An NSF Industry-University Cooperative Research Phase 1 Center

Center for Advanced Semiconductor Chips with Accelerated Performance (ASAP)

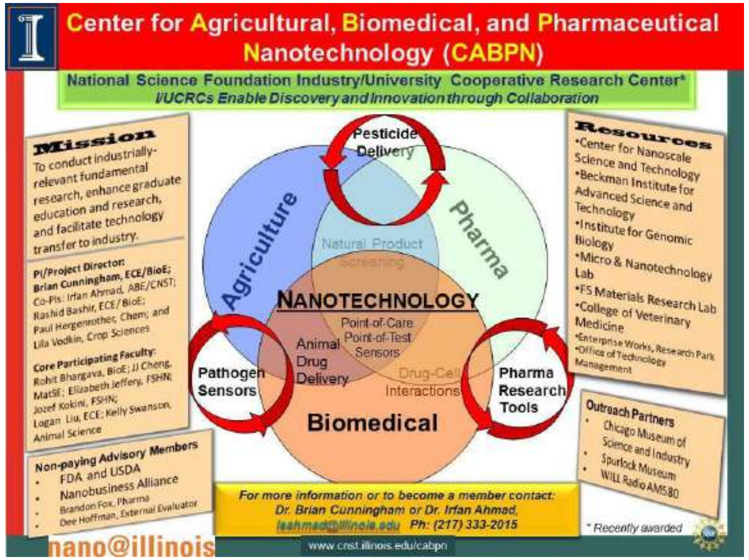
Research | Industry Engagement | News | Events | Diversity and Outreach | People



CiiT Industry / University Cooperative Research Center
Center for Innovative Instrumentation Technology

What is an Industry/University Cooperative Research Center?

- **NSF funds operations,** IAB members fund research areas of their interest
- **Industry Advisory Board Members** pay **$50k** annually at **10%** overhead
- Over **1000** I/UCRC memberships across ~**70** centers
- Level of Interest and Feedback Evaluation (**LIFE**) Process
- NSF I/UCRC Program has been running for **40 years**



CiiT Recently completed

Sensor Platforms	Nanosensors	Applications
• Optical Chem/Biosensors	• Diagnostics	• Life Science Tools
• Microelectronic Sensors	• Food Safety	• Agricultural Systems
• Imaging Modalities	• Process Analytical	• Food Safety Sensors
• Smartphone-Based	• Pharma Screening	• Mobile Systems
• Micro/Nanofluidics	• Point of Use/care	• Water Quality Monitoring
	• Agricultural Sensors	

instrumentation.illinois.edu

CiiT Industry / University Cooperative Research Center
Center for Innovative Instrumentation Technology

Facilities

Micro and Nanotechnology Lab

Beckman Institute for Advanced Science and Technology

Veterinary Medicine small and large animal clinics

Frederick Seitz Materials Research Lab

College of ACES

Institute for Genomic Biology

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MatSE

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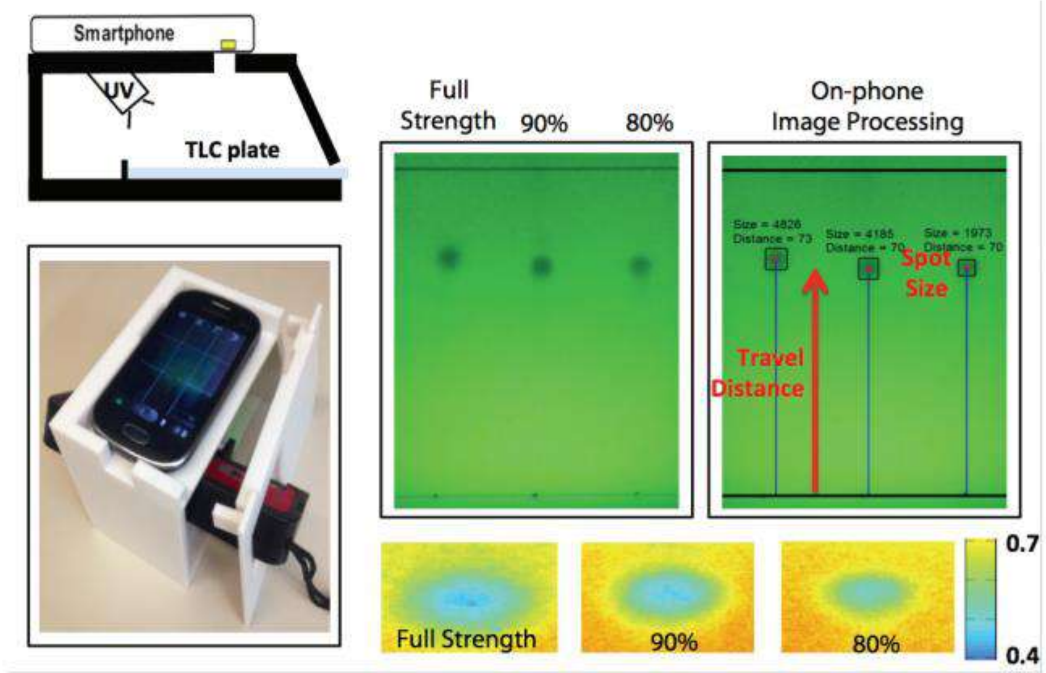
- **Center for Innovative Instrumentation Technology (CiiT)**

Smartphone Platform for Determining Prescription Drug Authenticity

Twenty-five percent (25%) of drugs distributed in Africa are counterfeit. CiiT researchers developed an innovative system that uses Thin-Plate Chromatography, a smartphone cradle, and a smartphone calibrated camera that determines the authenticity of drugs. This is a novel device/instrument for the life sciences. In addition to fabricating devices, the CiiT research group is also focused on the design, prototyping, and testing of biosensor instrumentation for high sensitivity, portability, and resolution.

Advanced instruments enable high resolution imaging of biochemical and cellular interactions. They provide the ability to monitor images of biochemical interactions as a function of time. Using the sensors and instrumentation, researchers are exploring new applications for optical biosensor technology including protein microarrays, biosensor/mass spectrometry systems, and microfluidics-based assays. All of these use nanoliter quantities of reagents. The methods and systems developed in the laboratory are then applied in the fields of life science research, drug discovery, diagnostic testing, and environmental monitoring.



Smartphone Thin Layer Chromatography. An example of testing Amodiaquine, a malaria therapy. Image provided by Brian T. Cunningham, University of Illinois at Urbana-Champaign.

Berkeley Sensors and Actuators (BSAC)

Berkeley Sensors and Actuators (BSAC)

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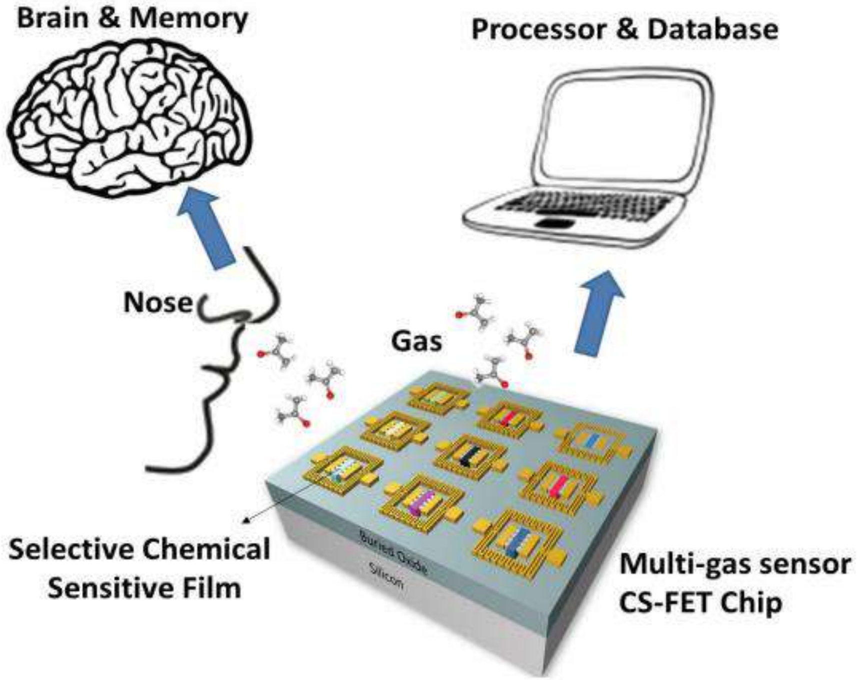
University of California, Berkeley, Michael Cable, 510.643.5663, mdcable@berkeley.edu
University of California, Davis, David Horsley, 530.341.3236, dahorsley@ucdavis.edu

Chemical Sensitive Field Effect Transistor

Chemicals are all around us all. Sometimes they are toxic to our health. Knowing information about the chemical composition of our surrounding environment can allow us to take safety measures in attempts to protect our health; thus enabling preventive health-care to be practiced when needed more deliberatively. Current research on wearable technology indicates that vital information about our physiological state can be ascertained by measuring and quantifying specific chemicals in our breath and sweat. Because of this, there are increasing demands for sensitive, selective and low power chemical sensors that can be integrated with personal mobile consumer electronics.

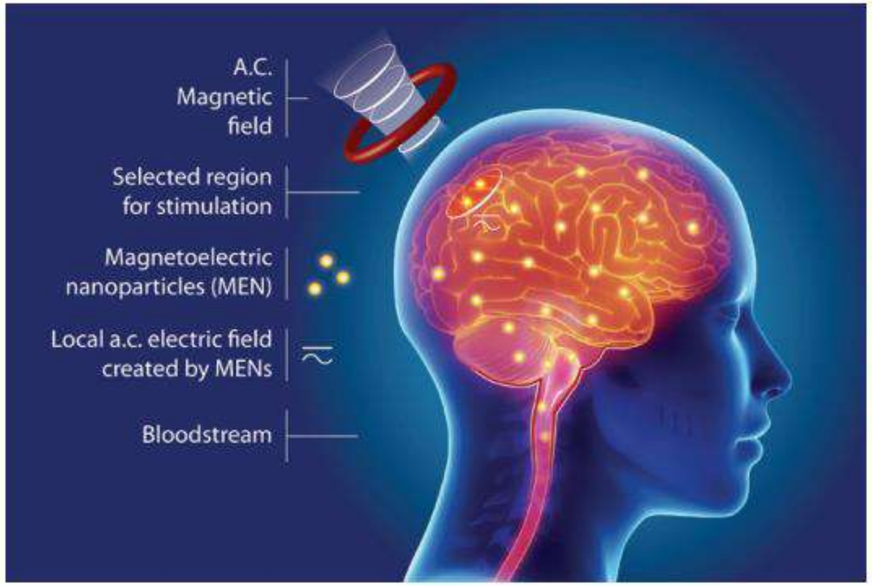


The CS-FET is a low power gas sensor technology platform providing sensitive and selective multi-gas detection in a miniaturized, scalable single chip form-factor. Enabled by conventional silicon processing techniques, the CS-FET is a biomimicry of the human nose. Image provided by Ali Javey, EECS, UC Berkeley.

Wireless Deep-Brain Stimulation With Magnetoelectric Nanoparticles

The brain is a complex bio-electric circuit made of billions of neurons that are inter-connected through chemical and electrical synapses. The ability to remotely stimulate selective neurons deep in the brain remains a major challenge. Overcoming it will enable highly personalized "pin-point" treatments for neuro-degenerative diseases such as Parkinson's and Alzheimer's Diseases, Essential Tremor (ET), Epilepsy, and others. Furthermore, by the law of reciprocity, this nanotechnology can pave a way for reverse-brain engineering.

This FIU team has invented and patented a technology (S. Khizroev and M. Nair, "Wireless brain stimulation," U.S. Patent application 13/900,305, filed 05/22/2013, granted 01/26/2016) to answer the above challenge by using a novel class of multifunctional nanoparticles known as magnetoelectric nanoparticles (MENs). Because of MENs capability to couple magnetic and electric fields at the sub-neuronal level, they enable a unique way to combine the advantages of both the high efficacy stimulation by the electric fields and the external-control capability of the magnetic fields. They therefore open a novel pathway to control the brain.



Wireless deep-brain stimulation with Magnetoelectric Nanoparticles administrated into the brain via an IV injection. Image provided by CAKE.

This study, conducted on mice, demonstrated for the first time the feasibility of using MENs as externally controlled "smart" nanoparticles for wireless navigation and selective control of specific functions deep in

Economic impact: According to the 2011 technology assessment by experts at the California Institute of Technology, the deep-brain stimulation (DBS) market was around $360 million. Conservative projections indicate that the technology can impact the multi-billion-dollar medical and information processing market segments

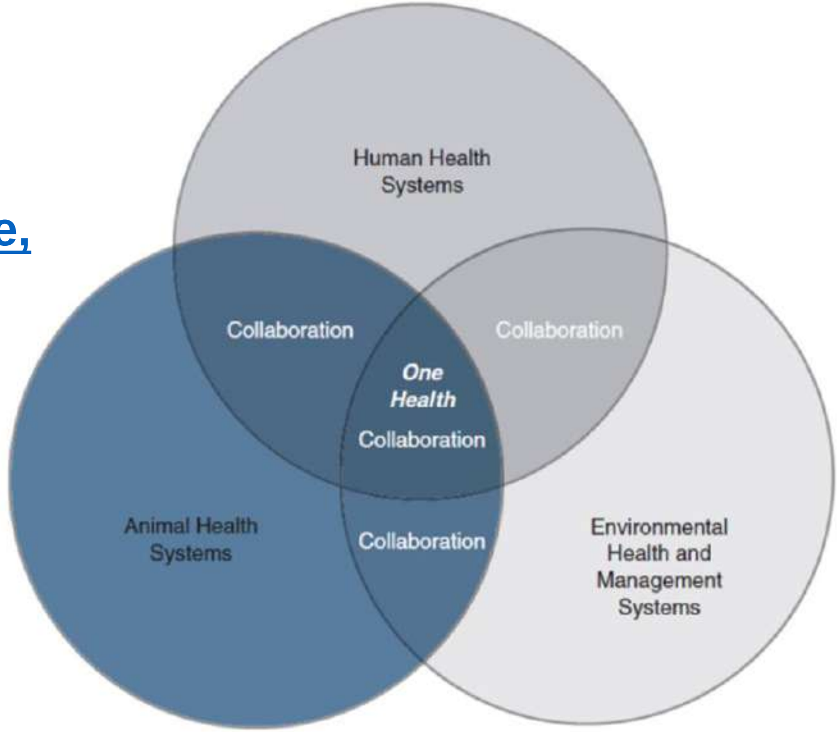
Role of AI/ML in Digital Health, Agriculture, Cybersecurity

- **Pandemic-driven digital transformations**
  - Telehealth
  - Adaptive and Agile Technologies
  - Work Flexibility
  - Decentralization
- Digital Trust
- Trustworthy Technologies/Systems
- Deploying AI as a Strategic Approach
- Scalability through AI
- Optimization of solutions through Multidisciplinary Teams

One-Health

- Climate-Smart Agriculture. Or Environment-Friendly Agriculture
- One Health: Animal, Human, and Ecosystem Health

• **The "One Health" approach proactively engages different disciplines, such as human medicine, veterinary medicine, and environmental health sciences, to attain optimal health for people, animals and our environment**



Advancing Local Economic Development Universities

- Outside of major metropolitan areas have the potential for promoting economic development due to their scope and scale of resources, which are often abundant in comparison to other relevant public and private entities in their region.
- Universities in this context often surpass other organizations in spending power, talent generation, technical expertise, and the creation of knowledge-based companies.
- Many universities are not aware of local government or economic development groups that could help them to increase their local impact. They may be missing out on opportunities, such as using empty industrial space for colocation space or startups. At the state level, they may be missing out on procuring monies through third-party tax credits.

https://uidp.org/wp-content/uploads/2020/08/U-I-Engagement-Outside-Major-Metropolitan-Areas-and-Megacities-Identifying-Issues-and-Finding-Solutions.pdf

Digital Transformation

Agriculture, Health, E-Governance

The World Bank Data Speaks for itself

India	2020	474
Indonesia	2020	1,889
Iran, Islamic Rep.	2020	2,331

Norway	2020	39,030
Oman	2020	262
Pakistan	2020	72
Palau	2020	946

"The real promise of AI is unlocking that 97% of the data that goes underutilized. AI technology is a tool. It is not an answer, but it's a tool to help you get to the answer."

Director
Platforms and Technologies in Health and Life Sciences
International Tech Company

Economic growth is the systematic

- A defining feature of modern economic growth is the systematic application of science to advance technology.
- Many innovations that spurred economic growth in the twentieth century, including synthetic fibers, plastics, integrated circuits, and gene therapy, originated from advances in the natural sciences, engineering, and medicine.
- Science, by producing “a potential for technology far greater than existed previously,” clearly distinguishes modern economic growth from previous economic epochs (Kuznets 1971).

The Old Innovation Ecosystem: 1850–1940

- Late nineteenth and early twentieth centuries independent inventors were the primary source of American inventions, the locus of innovation shifted during the interwar years from such inventors and small firms to large corporations and their labs.
- After World War II, corporate labs reached their zenith, with corporate scientists winning a number of Nobel Prizes.
- By the 1980s, however, small firms (often founded by university scientists) regained their advantage because the postwar period also saw the rise of the research university. Universities went from merely being the producers of human capital to becoming the dominant producers of scientific knowledge.

The Innovation Ecosystem in Transition: 1900–1940

The Beginnings of Corporate Research

- Several pushes and pulls propelled American corporations to create large R&D laboratories. First, the German precedent of industrial research in chemical firms allowed for firms such as BASF, Bayer, and Agfa to thrive in organic synthetic dyes in a highly competitive international market (Reich 1985, 41).
- Second, the strategy of acquiring patents was becoming difficult to implement because of the rising complexity of technologies. For example, DuPont had repeatedly failed in its attempt to use the Bevan, Cross and Topham patents from the United Kingdom to start a viscose rayon process in the United States in the 1910s. It lacked the internal technical and scientific capability to understand these patents and the know-how to use them. Eventually, a joint venture with Britain's Samuel Courtauld & Company (which had the know-how and manufacturing expertise) was necessary to start viscose rayon production in America (Hounshell 1988). Third, American inventions were challenged by science-based competition across the Atlantic. General Electric's (GE) control over electric lighting in the 1890s, for instance, was solely based on the carbon-filament high-vacuum incandescent variety, first invented by Thomas Edison in 1879. German chemists Carl Welsbach and Walther Nernst, the 1920 Nobel Laureate in Chemistry, respectively, invented incandescent mantels for gas lamps (a substitute product) and a glower that required no vacuum to operate that was 50% more efficient. Patent rights to the Nernst glower in turn were first sold to the German firm AEG for $1 million and then sold to GE's rival, Westinghouse, in 1894 (Wise 1985). GE management took notice of this "pandora effect" of innovative activity that was difficult to circumscribe and control and thereby approved electrochemist Charles Steinmetz's proposal to establish the GE Research Laboratory (GERL) in 1900. The payoffs were not long in coming: William Coolidge in 1906 developed a method using tungsten instead of carbon filaments to increase bulb life, and Irving Langmuir in 1913 invented the inert gas-filled lightbulb to reduce blackening, which became the industry standard.

Policy-driven Innovation

- Government Regulation is key to nurturing of the innovation ecosystem
- Lot of discovery
- Particularly meaningful to fail fast, and failure should be seen as a learning experience, most investors actually value that!

Think Globally Act Locally

- The issue is not being like the Silicon Valley or the Triangle Park
- But to be uniquely local
- So what can we do within OIC countries, within Pakistan

Science and Engineering

- Science is the foundation for facts and arriving at the truth
- Universities are the foundations for generating scientific knowledge
- Scholarship
- Truth
- Integrity
- Reputation
- Culture

Aspects to be Considered

- Technical competence
- Expertise in the organization and management of large scale enterprises
- Financial Institutions and Markets capable of mobilizing capital at a large scale
- Honesty and integrity
- Political stability of the government and its effectiveness in promulgating rules and enforcing them

What are we talking about

- Invention (patents, copyrights)
- Innovation – generally not patentable
- Therefore, the innovation output/capability is hard to measure, in Pakistan it is called “jugadh”

Measuring Capabilities

Table 1. Measuring capabilities

Dimension	Measure
Science, research and innovation	Scientific publications, patents, R&D (total/business), innovation counts
Openness	Openness to trade, foreign direct investment, research cooperation/alliances with foreign partners, technology licensing, immigration
Production quality/standards	International (ISO) standards, total quality management (TQM), lean production, just-in-time
ICT infrastructure	Telecommunications, internet, computers
Finance	Access to bank credit, stock-market, venture capital
Skills	Primary, secondary and tertiary education, managerial, and technical skills
Quality of governance	Corruption, law and order, independence of courts, property rights, business friendly regulation
Social values	Civic activities, trust, tolerance, religious ethics, attitudes towards technology and science

Adapted from Fagerberg and Srholec (2008),

Funding Resources

- Research and Innovation for Global Health Transformation (RIGHT) program funds interdisciplinary applied health research in low and middle-income countries (LMICs) on areas of unmet need where a strategic and targeted investment can result in a transformative impact.
- https://www.nihr.ac.uk/explore-nihr/funding-programmes/research-and-innovation-for-global-health-transformation.htm

Using the Crowd as an Innovation Partner

Corporate or Academic Model

- Well-coordinated environment
- Generating and organizing specialized knowledge

Crowd Model

- Loose and decentralized
- Problem is exposed to:
- diverse individuals, w/
- varying skills
- experience
- perspectives
- Can operate at a scale much bigger than a complex corporate structure

Policy Impetus

- Bayh-Dole Act 1980: Requiring univ to translate research to tech
- Each agency contributes ??% to SBIR/STTR
- Setup office s of Technology Management (OTM), IP, Trademarks
- Innovation Park
- Tech Campus
- Computing
- Local Needs/Strategy

Benchmarking

Muslim Countries

Eye Opener Statistic from IsDB

- The pandemic is estimated to have dropped 51 million additional people into extreme poverty in the IsDB MCs.
- While IsDB MCs constitute about 25 percent of the world population, they account for approximately 40 percent of the people in extreme poverty around the world.
- Based on the available data, extreme poverty in IsDB MCs is highly concentrated in the rural areas where about 91 percent of the extremely poor reside.

AI-driven COVID-19 Research in Tajikistan

IsDB Transform Fund supported Tajrupt, a 2018 Transform Fund winner from Tajikistan focusing on computer science education and artificial intelligence (AI) research capacity, has recently partnered with Microsoft to build a machine-learning algorithm for healthcare amidst the COVID-19 pandemic. He has launched Tajrupt.ai (TAI) which is Central Asia's first artificial intelligence lab that trains machine learning (ML) education and entrepreneurship to high-school and engineering students through its supervised ML curriculum incorporating statistics, calculus, and programming.

TAI has also partnered locally to implement AI to minimize financial sector shocks: Use of machine learning can "better predict losses and defaults than traditional models in the presence of a negative shock to the aggregate credit supply," – a context indicated by Bank of International Settlements, that matches Tajikistan's current situation with economic effects of COVID-19. In this regard, TAI has partnered with two leading financial institutions in Tajikistan to deploy AI

A Broad Perspective


SUSTAINABLE DEVELOPMENT GOALS
17 GOALS TO TRANSFORM OUR WORLD
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

UN, 2015

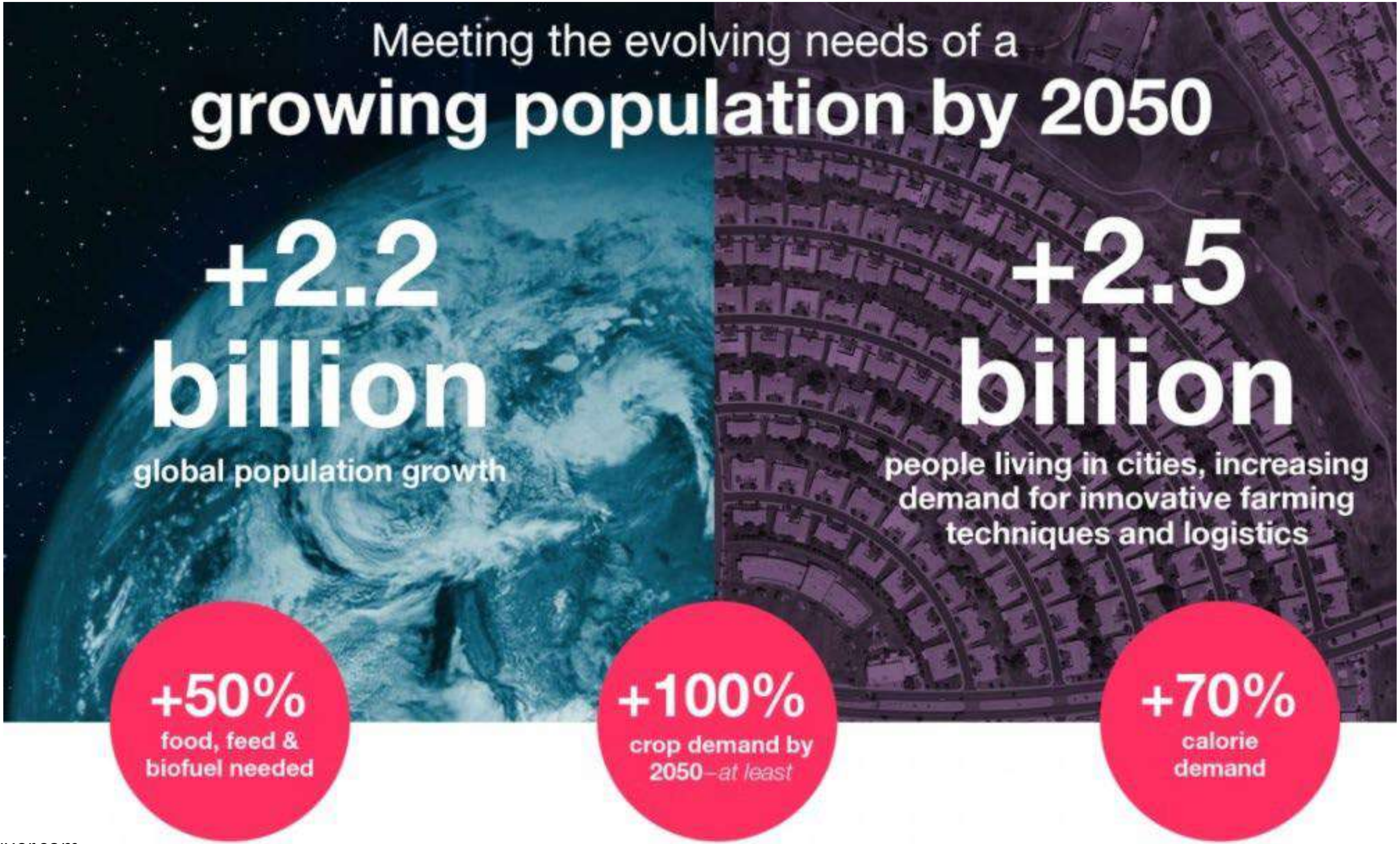
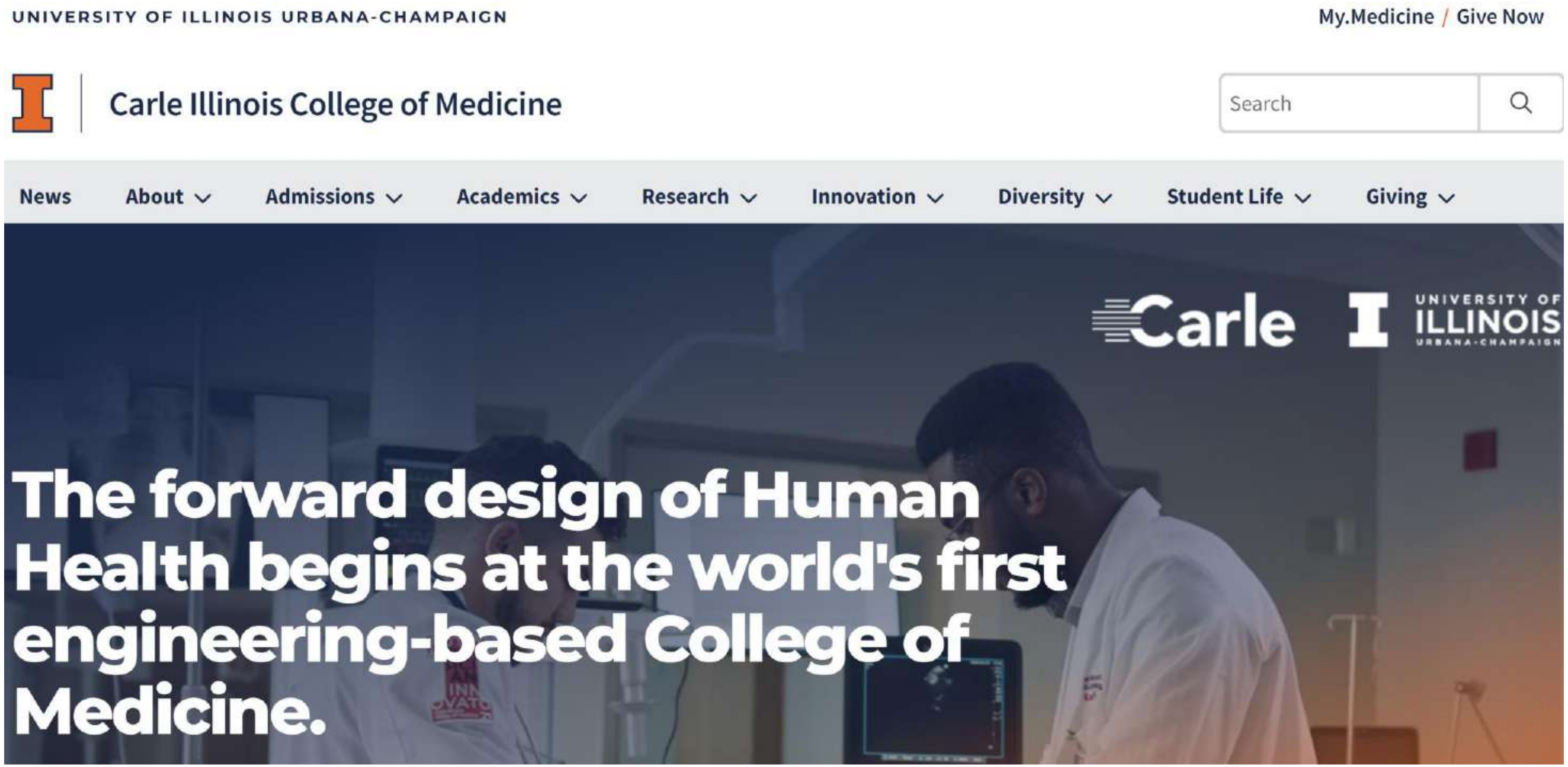


Image: Bayer.com

Training of Physician Innovators



HEALTH MAKERLAB

Health Innovation at the Intersection of Engineering and Medicine

Irfan S. Ahmad
Assistant Dean for Research
Executive Director, Health Maker Lab; and
Executive Director Interdisciplinary Initiatives,
Grainger College of Engineering

February 19, 2021
Livingston Securities
Experts Webinar Series

HEALTHMAKERLAB
dream it. make it.

Carle Illinois
COLLEGE OF MEDICINE

Carle ILLINOIS

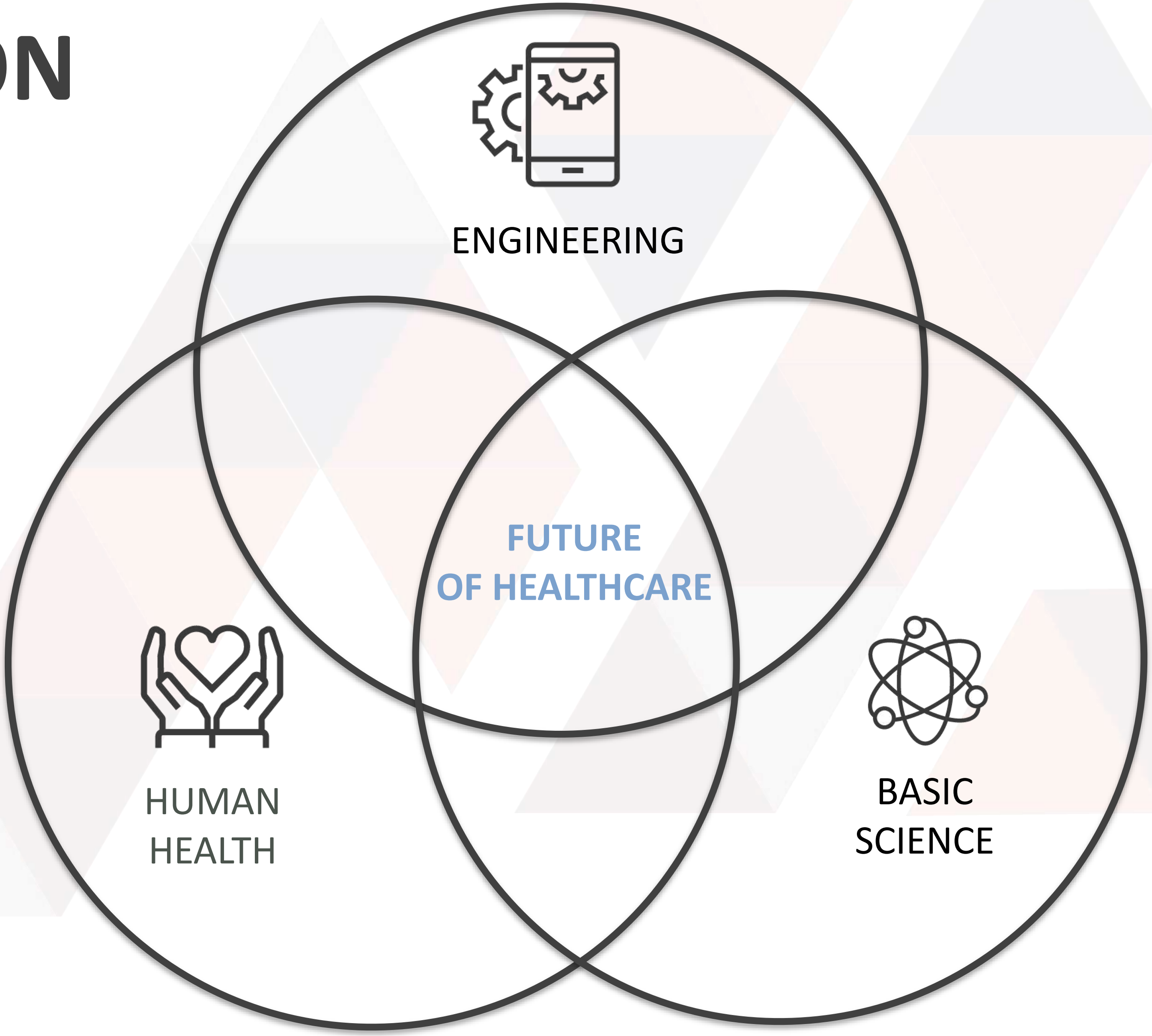
HEALTH **MAKER**LAB

OUR MISSION

Enable better healthcare for more people at lower cost by ***democratizing innovation*** at the intersection of engineering, basic science, and human health.

OUR CHARGE

Find a problem, make an impact



HEALTH **MAKER**LAB

GOALS FOR CARLE ILLINOIS **COLLEGE OF MEDICINE RESEARCH**

1. **CREATE** a disruptive medical research culture
2. **ESTABLISH** a global presence from the start
3. **BUILD** *Health Disparities* and *Data Analytics* into pervasive research threads
4. **PIONEER** the field of *Progenerative Medicine*
5. **PIONEER** the *Health Maker Lab: dream it, make it*
6. **CATALYZE** transformative research in *Brain, Cancer, Microbes, and First 1000 Days*

HEALTH MAKERLAB

- ❑ Compassion
- ❑ Competence
- ❑ Curiosity
- ❑ Creativity

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Carle ILLINOIS

HEALTH **MAKER**LAB

Building Competencies in Engineering, Innovation, and Research

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CI MED

Phase 1

FINDING YOUR WAY

Pre-clinical courses, meet faculty, tour labs, Discovery – learn a technique, write a case report, outline a plan with a global site, do a literature search

Phase 2

ACQUIRING SKILLS

IDEA Projects course, Core Clerkships, Electives

Phase 3

APPLYING SKILLS

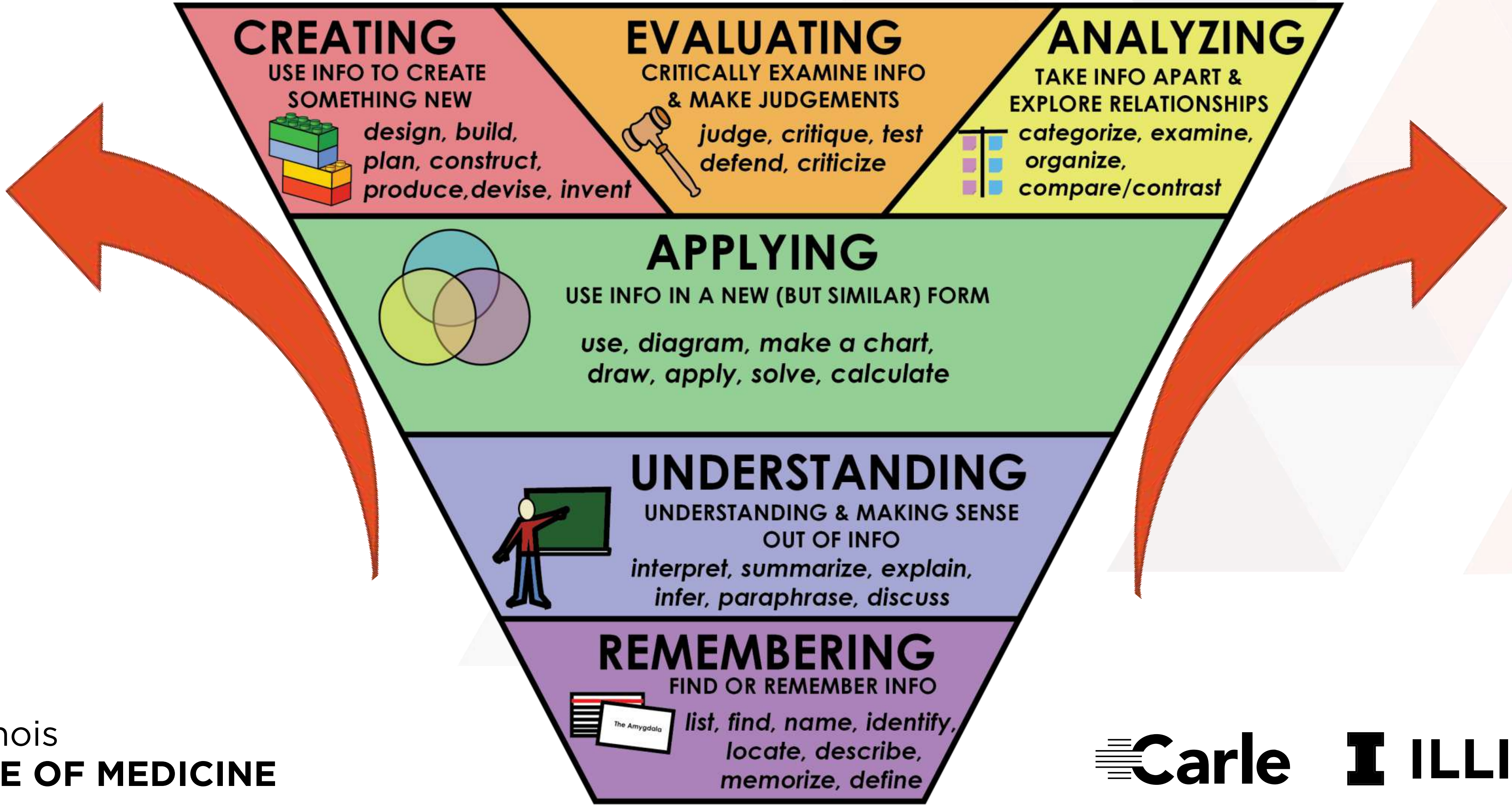
Capstone Project, Data Science Project, Electives

Carle ILLINOIS

HEALTH MAKERLAB

Medical and Engineering Competencies

BLOOM'S TAXONOMY



HEALTH
MAKERLAB

Creating a culture of innovation

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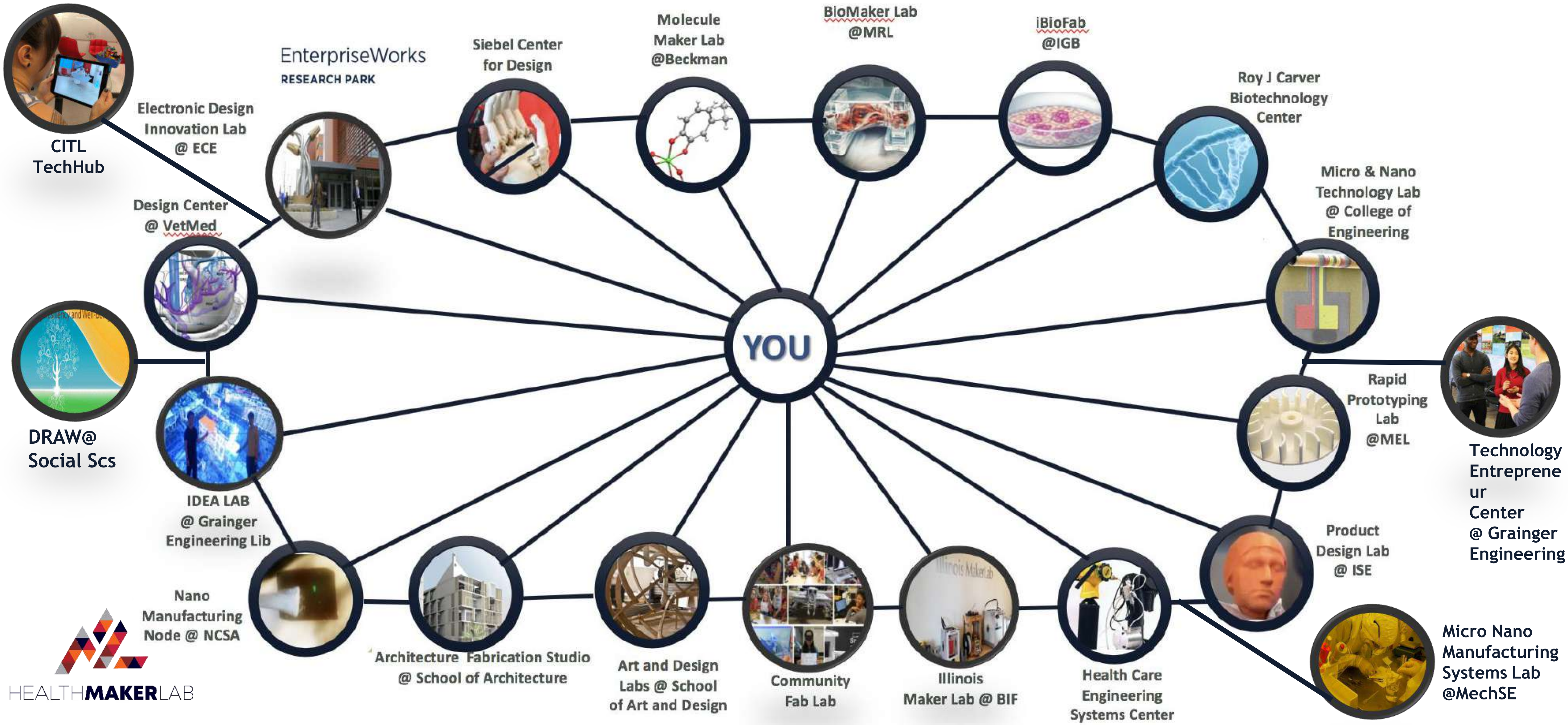
COLLEGE OF MEDICINE

Carle ILLINOIS

Health Maker Lab



HEALTH MAKERLAB

Recent Innovations

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2021 Cohort

HEALTH MAKERLAB

1 A Wire-Free EKG
Kenny Leung i

2 KordoFan
Tayyaba Ali v

3 ECG Shirt
Hanna Erickson i
Manisha Reddy v
Meghna Basavaraju v

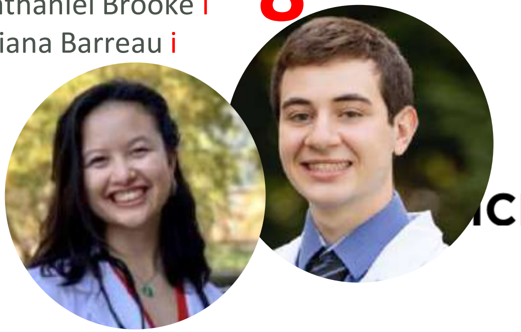
4 VR Cultural Competency Training
Victoria Fields vi
Mardia Bishop vii
Charee Thompson vii
Sarah Bencivenga vi

5 Izzi
Sneha Subramanian vii
Avani Patel iii

6 Music to my Ears
Malik Ali Muhammad iv
Ray Muhammad iii
Asalah Muhammad v

7 Nano-Hyperbaric Oxygen Delivery System
Michael Tsipursky ii
Joseph Irudayaraj vii
Jordan Marsh i
Neelabh Sharma v

8 Preventing Renal Failure
Nathaniel Brooke i
Ariana Barreau i



9 ProteCKD
Ariana Barreau i
Andrew Chang i
Priya Kumar v
Sana Kamdar ii
Thomas Chow v
Phani Gaddipati i

10 STEM Vocabulary App
Mona Jawad v
Ethan Gaughan v
Aditi Adyan v
Ayesha Kazi v
Amy Le v
Elizabeth Troy v
Sri Medisetti v
Sumayyah Hussain v

LEGEND
i CI Med/COM Student
ii Carle Physician
iii Community Member
iv K-12
v Undergraduate Student
vi Graduate Student
vii UIUC Faculty/Staff

2020 Cohort

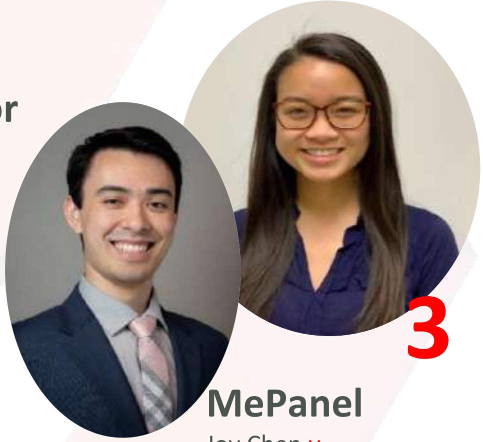
HEALTH MAKERLAB

1

Anemone
Ananya Cleetus v
Devin Dionne v

2

Portable Positive Pressure Ventilator
Mobola Kukoyi ii
Roy Zhou v
Matthew De Venecia iii

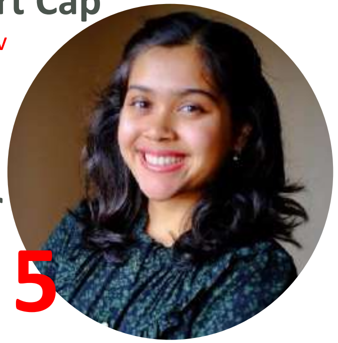


3

MePanel
Joy Chen v
Adam Dama v

4

Paperometer
Shonit Nair Sharma i

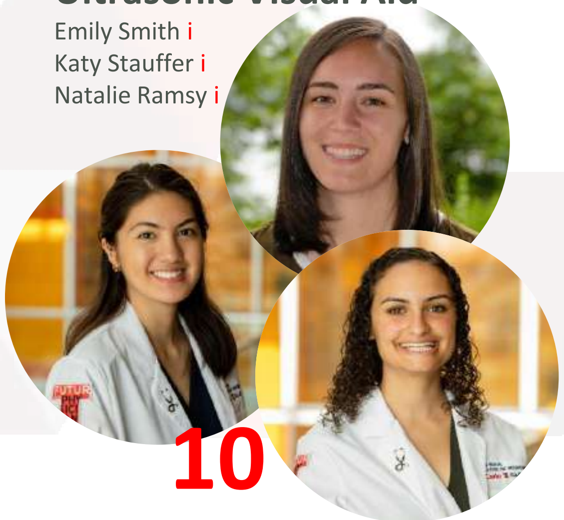


5

PillSafe Smart Cap
Ariana Alam Mizan iv

6

Project Escape
Sebastian Souyris vii
Aaron Brown i
Nekita Thomas vii

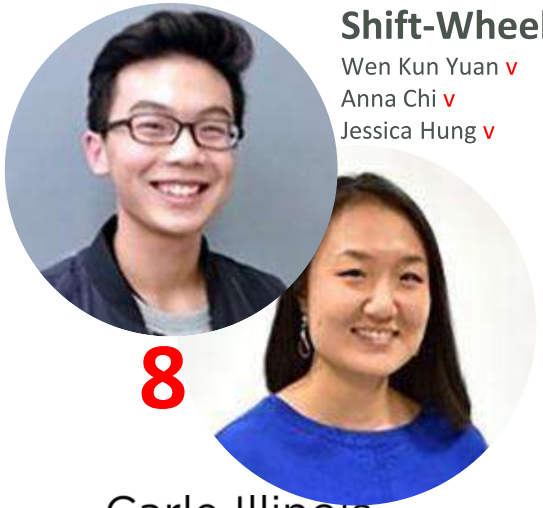


10

Ultrasonic Visual Aid
Emily Smith i
Katy Stauffer i
Natalie Ramsy i

7

Sepsig
Kavya Sudhir v



8

Shift-Wheelchair
Wen Kun Yuan v
Anna Chi v
Jessica Hung v

9

Single Action Needles
Dylan Peters v
David Kostryra v

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I ILLIN

LEGEND
i CI Med/COM Student
ii Carle Physician
iii Community Member
iv K-12
v Undergraduate Student
vi Graduate Student
vii UIUC Faculty/Staff

2019 Cohort

HEALTH MAKERLAB

NOUVO: THE SMART PACIFIER

v Amaury Saulsberry
Akeem Kennedy v
Trevor Sibby v
Siyu Ai v
Not pictured:
Kevin Yu v

1

HEART HEALTH WEARABLE DEVICE

Katherine Chou vi

2

PROGRAMMABLE PILL BOTTLE

Dena Strong vii

3

COMPRESSION STOCKING

Jay Anderson iii
Not pictured:
Judith Yasunaga ii

4

ALICE SENSORS

Mikaela Frechette vi
Thierry Guigma vi
Widya Ramadhani vi

5

PREEMIE POD

Amanda Henderson vii

6

MOBILE PHOTOTHERAPY SUIT

iii Siddiqua Haswarey-Shari'ati
Yusef Shari'ati vi

7

SMART TOILET

Gwendolyn Derk i
Yusi Gong i

8

MINIATURE HORSE POWER

Sarah Nixon iii

9

4-IN-1 VITAL SIGN READER

Maaz Imam v
Haajar Amin Mansour v
Kabir Fakoya v

10

LEGEND
i CI Med/COM Student
ii Carle Physician
Iii Community Member
iv K-12
v Undergraduate Student
vi Graduate Student
vii UIUC Faculty/Staff

inois
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HEALTH MAKERLAB

I-Personal Protective Equipment Menu

COVID-19
CDC Guidelines

FDA Guidance EUA


Face Shield


Masks


Gowns


N95 Respirators


Sterilization

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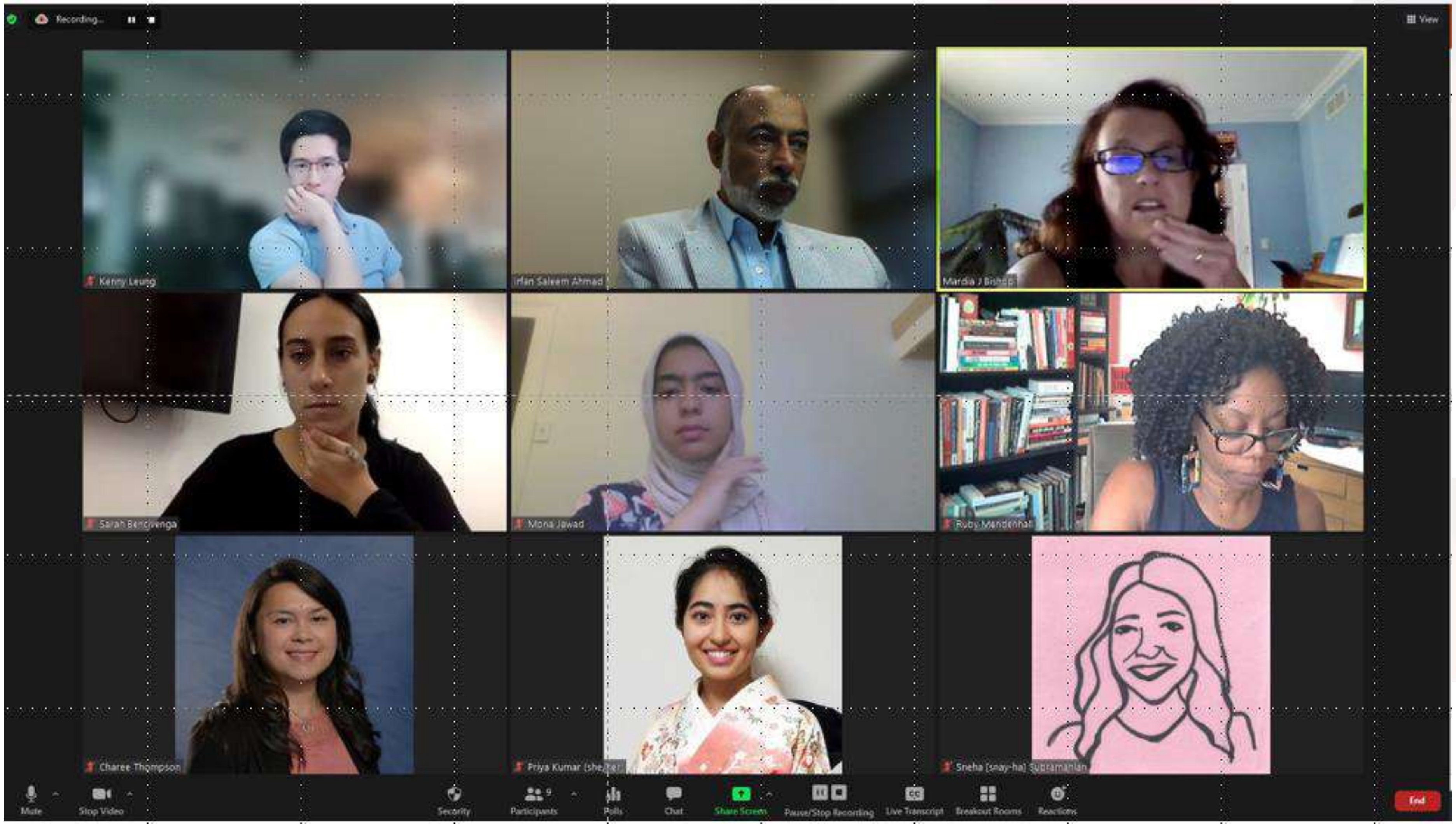
ICCBS Role During the Pandemic-Commendable

- Providing COVID-19 testing facility (3000 tests/day), when the City of Karachi and the country as a whole were under a lot of stress to come up with meaningful but rapid innovative solutions

HEALTH MAKERLAB

Sept 3 Monthly Mentoring Innovators Progress Zoom Meetings



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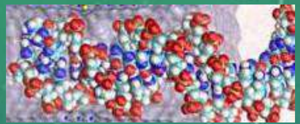
Bionanotechnology

Nanotechnology through *Time*

1959 Richard Feynman gives a speech at annual meeting of American Physical Society which predicted physicists could manipulate matter at the molecular level

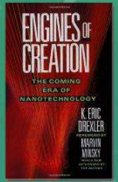
Image courtesy of sptr.net

1980 IBM scientists use a scanning tunneling microscope to directly image individual atoms for first time



1986

Word "nanotechnology" publicly used in Eric Drexler's book



Binnig and Rohrer won Noble Prize in Physics for inventing scanning tunneling microscope

1996 Kroto, Smalley, and Curl's "buckyballs" earn them a Nobel Prize in Physics

Image courtesy of Google Images

1998 US government organized Interagency Working Group on Nanotechnology

2000

$270 million for funding initiation of multi-agency NNI

NSF sponsored "Societal Implications of Nanoscience and Nanotechnology" workshop

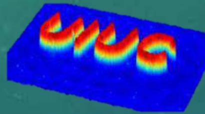
2004

NSF initiates competition for "Center for Nanotechnology in Society" funded at $2.6 million

US Congress passes "21st Century Nanotechnology Research and Development Act"

NCI applies nanotechnology and research for early cancer detection

2014 UI researchers study behavior of nanomembranes associated with transient electronics



2013 Stanford develops first carbon nanotube computer

Image Courtesy of MIT Technology Review

1970 1980 1990 2000 2010 2021

1974 Japanese engineer Norio Taniguchi used the word "nanotechnology"

Image courtesy of shutterstock.com

1985 Physicists Kroto, Smalley, and Curl discover carbon exposed to high temp form spherical molecules called "buckyballs"

Image courtesy of Google Images

1990 Scientists at IBM manipulate individual Xenon atoms to write their company logo

Image courtesy of ibm.com

Image courtesy of foresight.org

Eric Drexler held first doctoral degree in molecular nanotechnology

In US, NSF funded $6 million to begin first program devoted to NSE

1991

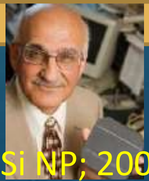
1999 Mihail Roco proposed National Nanotechnology Initiative (NNI) to the White House

Nano.gov National Nanotechnology Initiative

2001 2 academic papers published that analyzed role of nanotechnology in science fiction

2004 *Bulletin of Science, Technology, and Society* devote issue to societal implications

2003 NSF supports 2 major projects at $1.5 million over 5 years along with 600 grants including "nano"



Si NP; 2002

2009 NYU researchers create DNA-like robotic nanoscale assembly devices

2010 Harvard demonstrates nanowire transistor that measures electrical activity in heart cells

NPs for vaccination, theranostics CoV infections

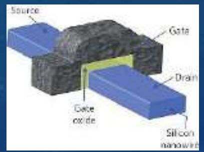


Image courtesy of nature.com

Image courtesy of thatsreallypossible.com

nano@illinois CNST University of Illinois Center for Nanoscale Science and Technology

Designed by Mariam Saadah


Societal Implications of Nanotechnology
INNOVATION
Computation
Agriculture and Food
Atmosphere, Environment and Energy
Communications and Electronics
Medicine and Pharma
Advanced Manufacturing
nano@illinois
Center for Nanoscale Science and Technology
ENTREPRENEURSHIP
Economic • Environmental • Ethical • Global • Healthcare • Legal • Policy • Social

Micro/Nano Solutions

- Engineered Nanomaterials
- Targeted delivery of Fertilizer, Herbicide, Pesticide, and Weedicide
- Water sustainability through nanopolymers hydrogels
- Enhancing seed germination through metal oxide nanoparticles
    - Higher yields and vitamin content
    - Drought resistant

Nanocarriers with smart delivery systems can enhance crop productivity and reduce operations costs

Suggested Ideas

IT Exports

- Freelancing
- Organized IT exports
  - AI ML Block Chain
    - Ag & Food Healthcare
- High School and College-level Mentoring Needed
- Upworks

- India currently has $40-50B of IT exports

Lessons and Needs

- Agricultural Mechanization: **The level of mechanization has a significant positive impact on the cost, output value, income, and return rate of all types of crops**.
- For every 1% increase in the level of mechanization, the yields of all crops, grain crops, and cash crops increase by 1.2151, 1.5941, and 0.4351%, respectively.

Building the Infrastructure of the Future: Requires a National Technology Strategy

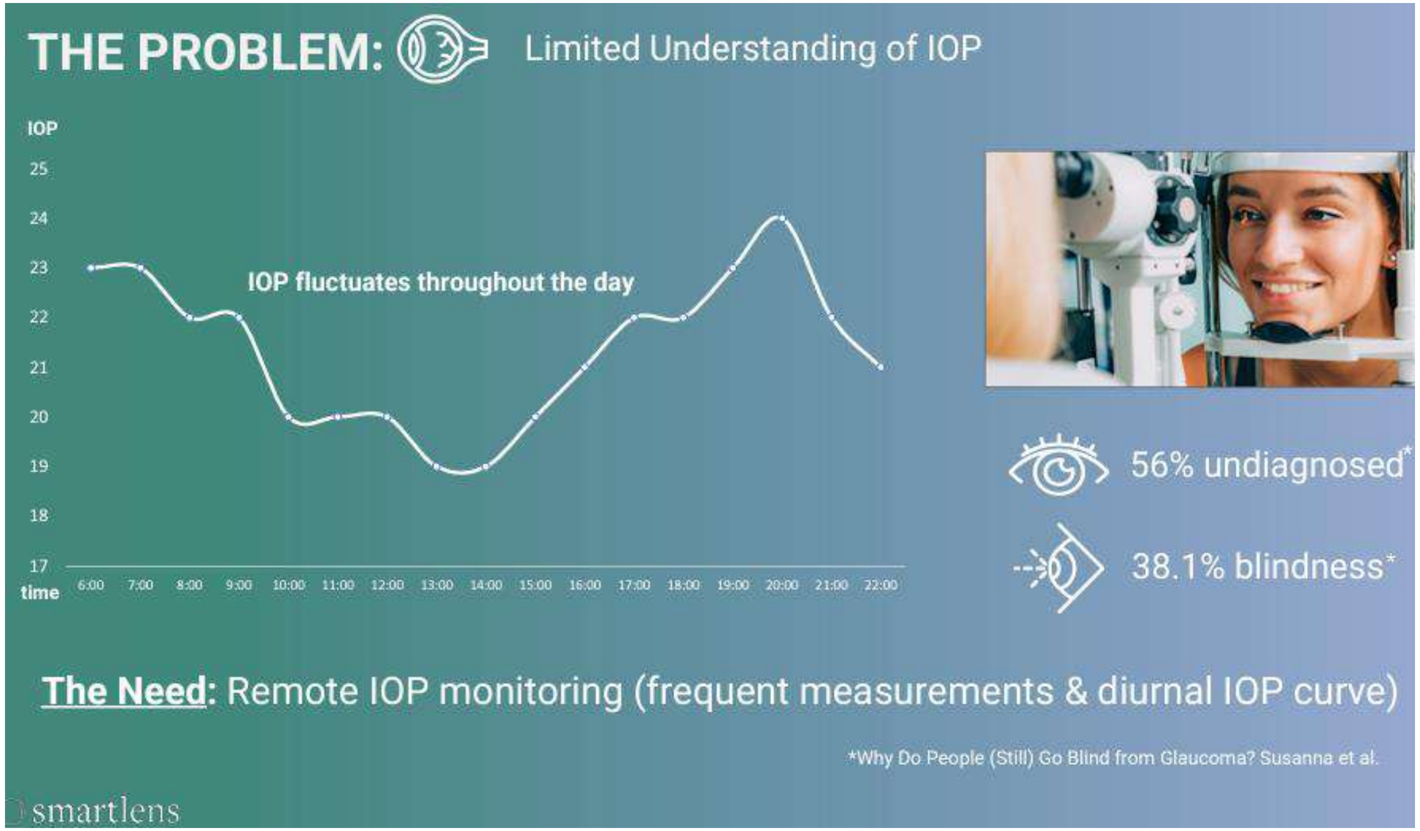
- Smart High Speed Transportation System
- Dynamic Electric Grid with Renewables
- Broadband Internet Connectivity
    - Will improve social welfare across the spectrum
        - Agriculture and Food Health Energy Communications

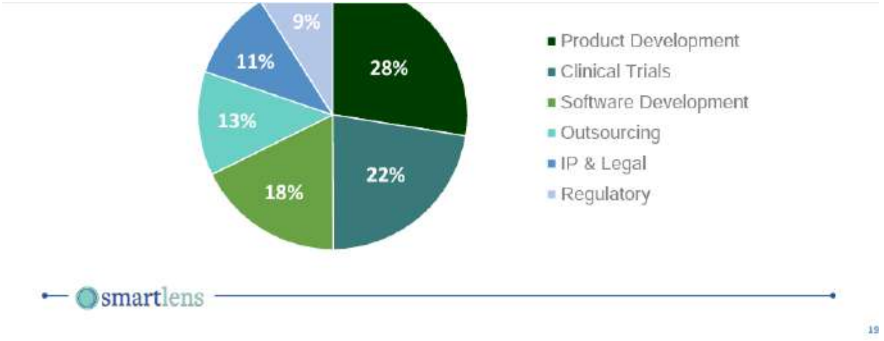
Fuchs, Erica R. 2022. The Next 75 Years of Science Policy

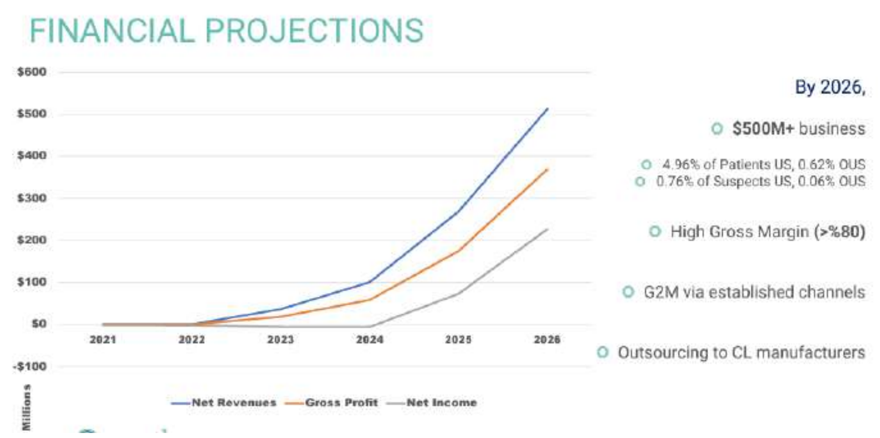
Research and Innovation

Mimicking the Silicon Valley Innovation Ecosystem

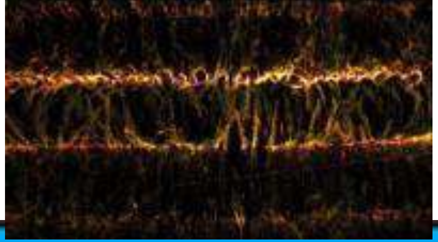
Start a Venture Investment Fund in Silicon Valley


THE PROBLEM: Limited Understanding of IOP
IOP
25
24
23
22
21
20
19
18
17
time
6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00
IOP fluctuates throughout the day
56% undiagnosed*
38.1% blindness*
The Need: Remote IOP monitoring (frequent measurements & diurnal IOP curve)
*Why Do People (Still) Go Blind from Glaucoma? Susanna et al.
smartlens


9%
11%
28%
13%
22%
18%
Product Development
Clinical Trials
Software Development
Outsourcing
IP & Legal
Regulatory
smartlens
19


FINANCIAL PROJECTIONS
$600
$500
$400
$300
$200
$100
$0
-$100
Millions
2021 2022 2023 2024 2025 2026
Net Revenues
Gross Profit
Net Income
By 2026,
$500M+ business
4.96% of Patients US, 0.62% OUS
0.76% of Suspects US, 0.06% OUS
High Gross Margin (>%80)
G2M via established channels
Outsourcing to CL manufacturers

AgBots



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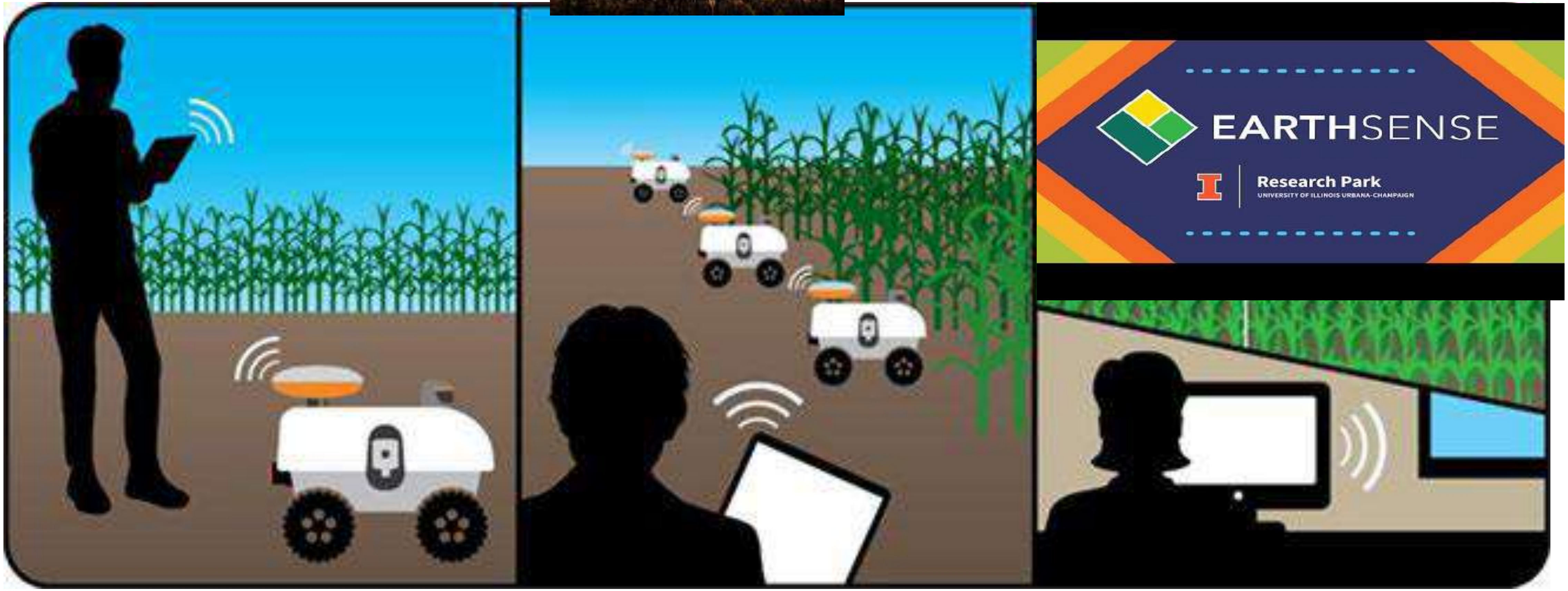


The Grainger Engineering researchers are focused on the mechanisms to increase the levels of autonomy in agbots while enabling interaction with humans / stakeholders, are testing their robots in the Illinois Autonomous Farm testbed. Katherine Rose Driggs-Campbell and Girish Chowdhary. **Center for Digital Agriculture**

UI Bionanotechnology Research Facilities

The Center for Nanoscale Science and Technology (CNST)- a campus-wide collaboratory for facilitating research, education, and entrepreneurship in nanotechnology,
and the College of Applied Health Sciences, University of Illinois

Bionano Lab

- Part of the CNST Collaboratory
- 8000 sq. ft Class 100 clean room
- BioNanotechnology labs
- Research Areas include:

-Nanophotonics and Optoelectronics
- Micro and Nanoelectronics
-Bionanotechnology and Nanomedicine
- MEMS and Integrated Systems

nano@illinois

Hands-on Labs on Nanoparticles

Profs. Irshad Hussain, LUMS, Abid Ali, and Atiya Abbasi , University of Karachi, conducting workshop

nano@illinois

Hands-on Labs on Nanoparticles

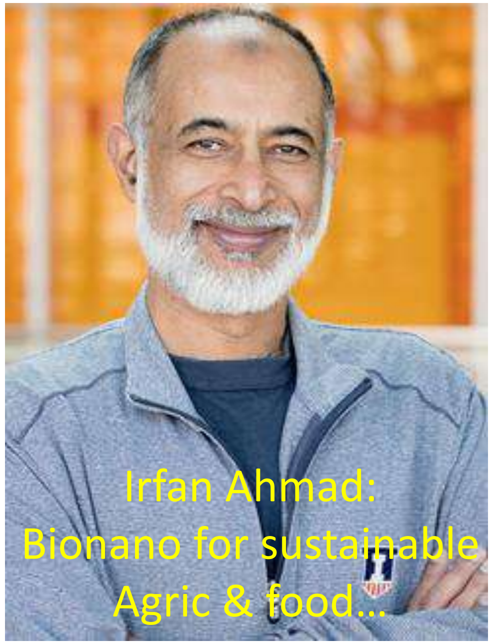
Dr. Irfan Ahmad , University of Illinois explaining a concept to hands-on lab participants

Egypt Saudi Arabia United States Pakistan

Kuwait China Morocco Turkiye

NanoPower Group*

Palestine Japan Jordan UAE



Irfan Ahmad: Bionano for sustainable Agric & food...

Munir Nayfeh- the Palestinian who moved the atoms...

Bulent Aydogan: Nanomedicine- Secrets to a healthy long life...

* Formed in 2004 to promote nanotechnology research, innovation-based entrepreneurship, education/training, and outreach

Recommendations

Recommendations 1/2

- Establish a Research and Innovation Fund to seed projects across OIC
- Establish Digital Health and Digital Agriculture for digital solutions
- Community Engagement for the Advancement of Science and Engineering
- Engagement of Expats

Recommendations 2/2

- Create Awareness
- Innovation-based Entrepreneurship
- Failure is an Option
- Engage OIC and IsDB
- Invite Industry and Policy Makers to the Meetings

Acknowledgements

- SmartSensing Research Group- Research scientists, graduate and undergraduate students
- National Academy of Sciences (NAS)
- Nano Sensors Group, UIUC
- Holonyak Micro and Nanotechnology Lab (HMNTL) , UIUC
- Beckman Institute for Advanced Science and Technology, UIUC
- Center for Nanoscale Science and Technology, UIUC
- Profs. Munir Nayfeh, Bulent Aydogan, Taher Saif, Rashid Bashir,(UIUC); Rashid Ahmed (MUST); Anwarul Hassan (QU); Ilesanmi Adesida, (NU)
- ICCS/HEJ Chemistry Institute, University of Karachi- Prof. Atiya Abbasi
- Prof. Tehmina Anjum, Dr. Hina Ashraf, and collaborators, University of the Punjab

THANK YOU

Contact Info.

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- SAS. 2022. The speed of digital disruption: Sustaining transformation in health care and life sciences. Accessed online on Feb 19, 2023.
- file:///Z:/CIMED/Articles/Digital-transformation-in-hls-112983.pdf

Backup Slides

HEJ Research Institute of Chemistry

International Center for Chemical and Biological Sciences

University of Karachi

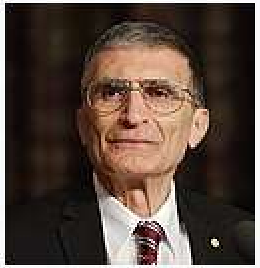
- Houses the single largest doctoral program in Pakistan with over 250 PhD students
- Member of the International Center for Chemical and Biological Sciences system (ICCS)
- Research Areas include:
  - natural product chemistry
  - protein chemistry
  - computational medicinal chemistry
  - plant biotechnology

US-side PI: Kenneth Watkin, Irfan S. Ahmad; PK-side PI: Prof. Attiya Abbasi

Center for Nanoscale Science and Technology and College of Applied Health Sciences, University of Illinois

Nobel Laureates from Muslim Countries

Two Muslims have been awarded the Nobel Prize in Chemistry.

Year	image	Laureate	Country and profession	Rationale	comment
1999		Ahmed Zewail (1946–2016)[2]	Egyptian-American scientist	The 1999 Nobel Prize in Chemistry was awarded to Ahmed Zewail "for his studies of the transition states of chemical reactions using femtosecond spectroscopy".[3]	He is the first Muslim chemist to be awarded the Nobel Prize and the second Muslim scientist.[4][5][6][7][8]
2015		Aziz Sancar (b. 1946)	Turkish-American scientist	The 2015 Nobel Prize in Chemistry was awarded to Aziz Sancar "for mechanistic studies of DNA repair"[9]	He is the first Turkish chemist, and the second Turkish to date to be awarded the Nobel Prize and the third Muslim scientist. [*dubious* – *discuss*][10]

One Muslim has been awarded the Nobel Prize in Physics.

Year	image	Laureate	Country and profession	Rationale
1979		Mohammad Abdus Salam (1926–1996)	Pakistani physicist	The 1979 Nobel Prize in Physics was awarded jointly to Sheldon Glashow, Salam, and Steven Weinberg "for their contributions to the theory of the unified weak and electromagnetic interaction between elementary particles, including, inter alia, the prediction of the weak neutral current".[63]

Leading Research Universities

- Khalifa University, UAE
- King Abdullah University of Science and Technology, Saudi Arabia
- University of Karachi
- Qatar University
- University of Science, Malaysia
- Cairo University, Egypt
- COMSATS, Pakistan
- Sharif University of Technology, Iran
- Quaid-e-Azam University, Pakistan
- Middle East Technical University (METU), Turkiye

Scimago Institutions Rankings, 2022. https://www.scimagoir.com/rankings.php?sector=Higher%20educ

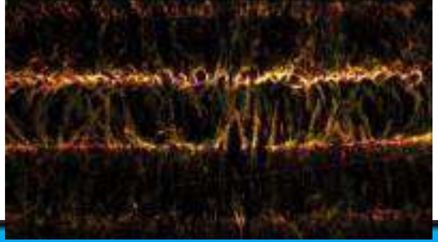
UAE

UAE government's Science, Technology and Innovation Policy and UAE's National Agenda 2021 to reduce dependence on oil revenues and transform into a knowledge-based economy by enhancing its research and development activities have been effective (Vision 2021, 2018).

List of Nominated Engineering-Funded Centers

- Berkeley Sensor and Actuators Center (BSAC)
- Center for Innovative Instrumentation Technology (CiiT)
- Center for Advanced Design and Man of Integrated Microfluidics (CADMIM)
- Center for Advanced Forestry Systems (CAFS)
- Advanced Processing and Packaging Studies (CAPPS)
- Center for Advanced Vehicle and Extreme Environment Electronics (CAVE3)
- Center for Child Injury Prevention Studies (CChIPS)
- Center for the Design of Analog-Digital Integrated Circuits (CDADIC)
- Center for Dielectrics and Piezoelectrics (CDP)
- Center for Electromagnetic Compatibility (CEMC)
- Center for Tire Research (CenTiRe)
- Center for Electrochemical Processes and Technology (CEProTECH)
- Center for Health Organization Transformation (CHOT)
- Laser and Plasma for Advanced Manufacturing (LPAM)
- Center for Particulate and Surfactant Systems (CPaSS)
- Center for Pharmaceutical Development (CPD)
- Ceramics Composites and Optical Materials Center (CCOMC)
- Cooling Technologies Research Center (CTRC)
- Center for Energy-Smart Electronic Systems (ES2)
- GRid-Connected Advanced Power Electronic Systems (GRAPES)
- Science Center for Marine Fisheries Science (SCeMFiS)
- Smart Vehicle Concepts (SVC) Center
- Wind-Energy Science, Technology and Research (WINDStar)

AgBots



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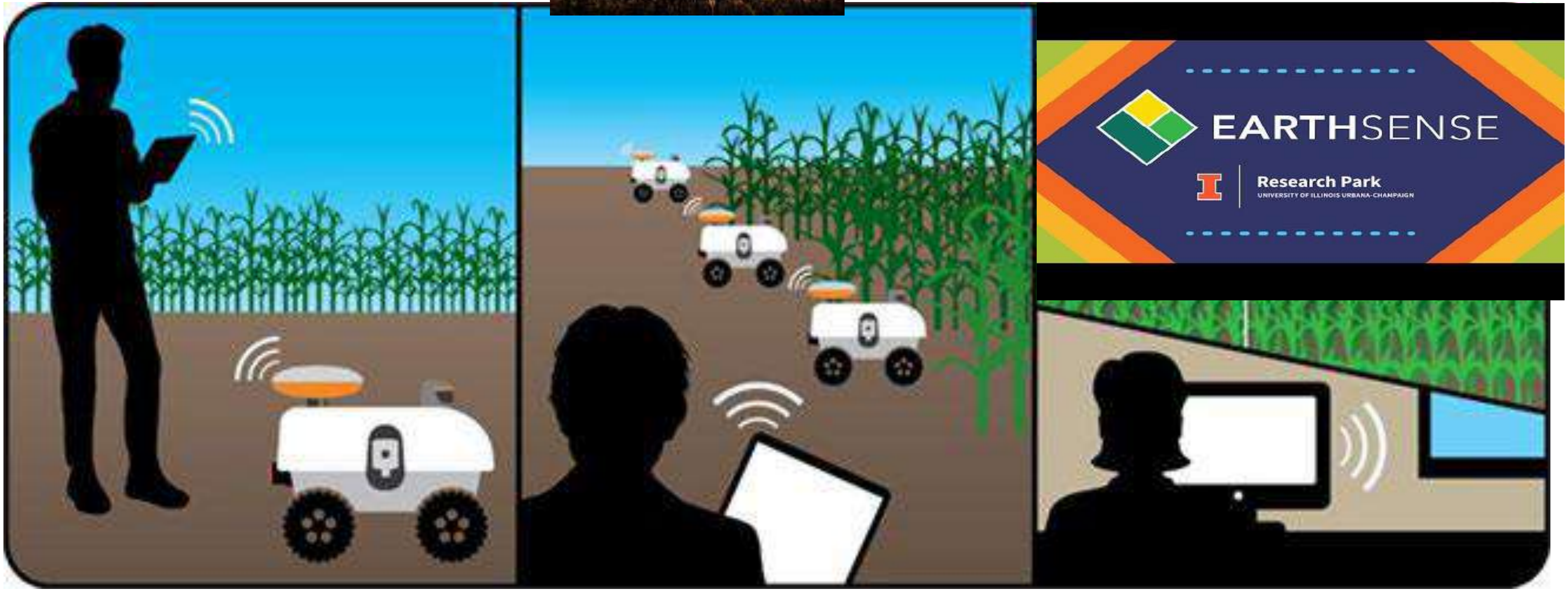

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Coordinated Science Laboratory, UI

AI-FARMS

- The Artificial Intelligence for Future Agricultural Resilience, Management, and Sustainability Institute serves as a nexus for multidisciplinary research teams that advance foundational AI and use these advances to address important challenges facing world agriculture.
- It focuses on technologies that impact production practices, on developing a diverse technically skilled workforce in digital agriculture, and on supporting women and minority farmers.

Smart Sensing Technologies for AgBioFood Research Group

Plant Extracts for Cancer Nanomedicine

Type of data produced -Standardized data format? -Specific to any particle class of nanoparticle? -Data archived anywhere?	**-Plant extracts for medicinal use (cancer and infectious diseases)** **-Current Qty: 100, with 3000 more to study** **-Being explored with NanoHub at Illinois**
Importance and frequency of this type of nanocharacterization -Importance=(1-5 scale, 5 highest) -Frequency of use=(1-5 scale, 5 highest)	Importance: 4 Frequency: 4
Type of equipment/ instrumentation needed	Biophotonic crystal sensor and card reader
Reference materials available (if at all) -Interlaboratory studies performed?	-Beckman Institute for Advanced Science and Technology -Micro and Nanotechnology Laboratory -ICCS/HEJ Chemistry Institute, Karachi; USDA, ARS, National -Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]

Illinois Medicinal Plant Database: Typical Plant Extract Entry

Brassica juncea

Scientific name(s): *Brassica juncea* (L.) Czern. (1), *Brassica integrifloia* (Vahl) O.E. Schulz, non Rupr. (1) *Brassica integrifolia* Rupr. (1). *Brassica japonica* Thunb. (1). *Brassica juncea* (L.) Czern. Var. *crispifolia* L.H. Bailey (1), *Brassica juncea* Czern. Var. *japonica* (Thunb). L.H. Bailey (1), *Brassica willdenowii* Boiss. (1) *Sinapis juncea* L. (1), *Brassica integrifolia* (West). O.E. Schulz (2), *Brassica juncea* (L.) Hook. F. & Thomson (3), *Brassica juncea* (L.) Coss. (3), *Brassica juncea* (Linn.) Czern. Et. Coss (4)

Family name(s): *Brassicaceae* (1)
Cruciferae (2)
English name(s): India mustard (1), curled mustard (4), brown mustard, leaf mustard, mustard greens,
chinese mustard (8)
Urdu name: Sarson (5) سرسوں
Arabic name: Khardal خردل

Imaged at Beckman Visualization Lab.

Scientific classification

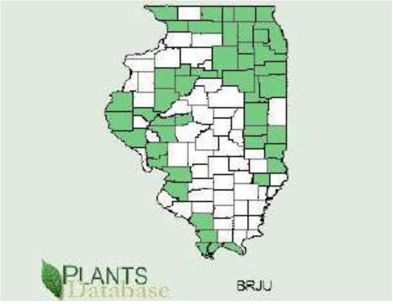
Kingdom: Plantae
Division: Angiosperms
Order: Brassicales
Family: Brassicaceae
Genus: *Brassica*
Species: *B. juncea*

Introduction

Brassicaceae is a large family which include 350 genera and about 3000 species (5). It is a distributed nearly worldwide, especially in the temperate areas, with the highest diversity in the Irano-Turanian region, Mediterranean area, and Western North America (6). The genus *Brassica* includes plants that are annual, biennial, or perennial herbs. There are about 40 species in this genus distributed mainly in the Mediterranean region; only seven of them are found in Pakistan, among them is *Brassica juncea* (L.) Czern (5).

Brassica juncea (L.) Czern is native to Asia temperate, widely naturalized and widely cultivated (7).

Distribution



Description

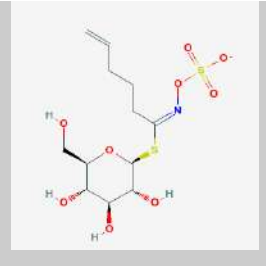
Brassica juncea (L.) Czern is an erect, reddish-brown (5). There is tremendous variation in the basal leaf morphology of *Brassica juncea* (L.) Czern., and minor variants have been recognized at specific, subspecifical, and varietal ranks (10).

Constituents and Uses

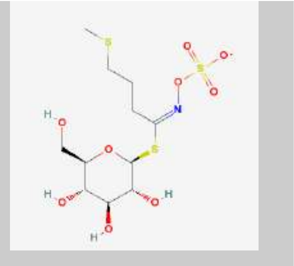
Brassica juncea (L.) Czern. is high in vitamin A, vitamin C, and iron. Seeds contain sterols, sinigrin, myrosin, sinapic acid, sinapine, and fixed oils. Hydrolysis of sinigrin by the enzyme myrosin yields allyl isothiocynate, glucose, and potassium bisulfate. Allyl isothiocynate is volatile. Allyl isothiocyanate is an irritant. It is also lachrymatory and has counterirritant properties when greatly diluted. It should not be tasted or inhaled when undiluted. It is one of the most toxic essential oils. Volatile mustard oil has strong antimicrobial (bacteria and fungi) properties (11).

Brassica juncea (L.) Czern is reported to be anodyne, aperitif, diuretic, emetic, rubefacient, and a stimulant. It is a folk remedy for arthritis, footache, lumbago, and rheumatism. Seeds used for tumor in China. Roots used as a galactagouge in Africa. Believed to be aperient and tonic, the volatile oil is used as a counterirritant and stimulant. In Java the plant is used as an antisyphilitic emmenagogue. Leaves applied to the forehead are said to relieve headache. In Korea, the seeds are used for abscesses, colds, lumbago, rheumatism, and stomach disorders. Chinese eat the leaves in soups for bladder inflammation and hemorrahe. Mustard oil is used for skin eruptions and ulcers (11).

Phytochemicals



Glucobrassicanapin



Glucoiberverin

Gluconapin

Notes

Disclaimer: Everything mentioned in this database is for educational purposes. The University of Illinois cannot take responsibility for any adverse affect from the use of plants mentioned in this database. Always seek advice from a professional before using a plant medically.

Mohammed, et al.

Overall Conclusions

- Bionanotechnology research provides avenues for transitioning to **environment-friendly agriculture** and for enhanced **food security**
  - more research is needed

- **Digital Agriculture** in sync with Machine Learning/Artificial Intelligence and Bionanotechnology could revolutionize communities and improve livelihoods by alleviating poverty

- The **next generation agricultural engineering workforce** has to be prepared to work at the intersection of bionano in agricultural sciences, big data, and sensing technologies.

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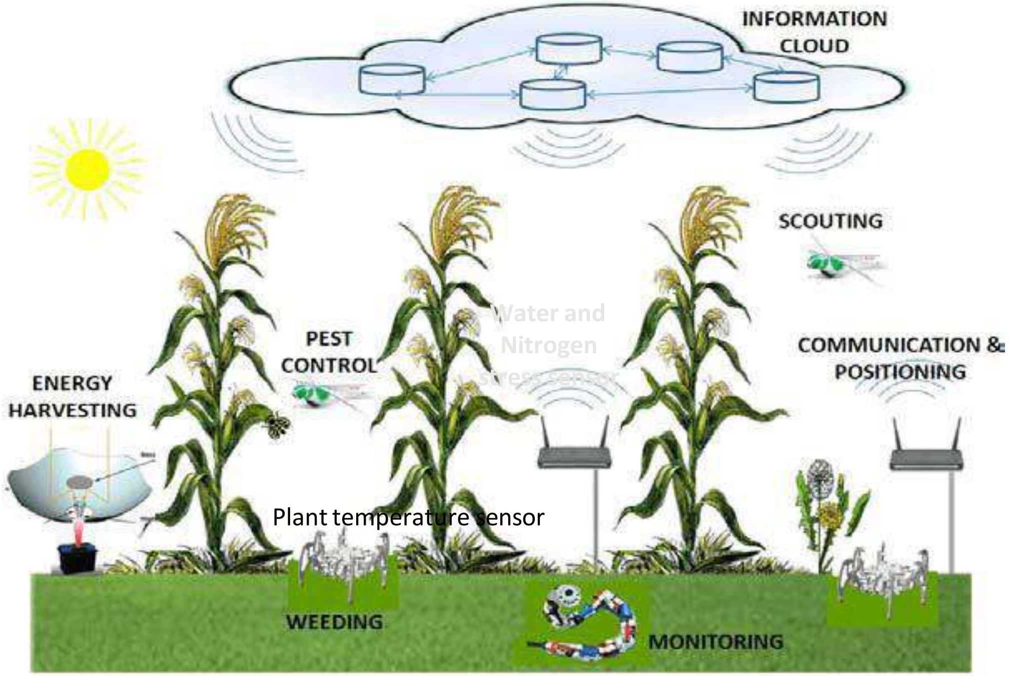
Research Faculty, Agricultural & Biological Engineering;

Holonyak Micro and Nanotechnology Lab.; and Biomedical and Translational Sciences

August 8, 2018, rev. 10/18/22

Research Interests

- Biological Engineering
- Off-Road Equipment Engineering
- Nanomedicine



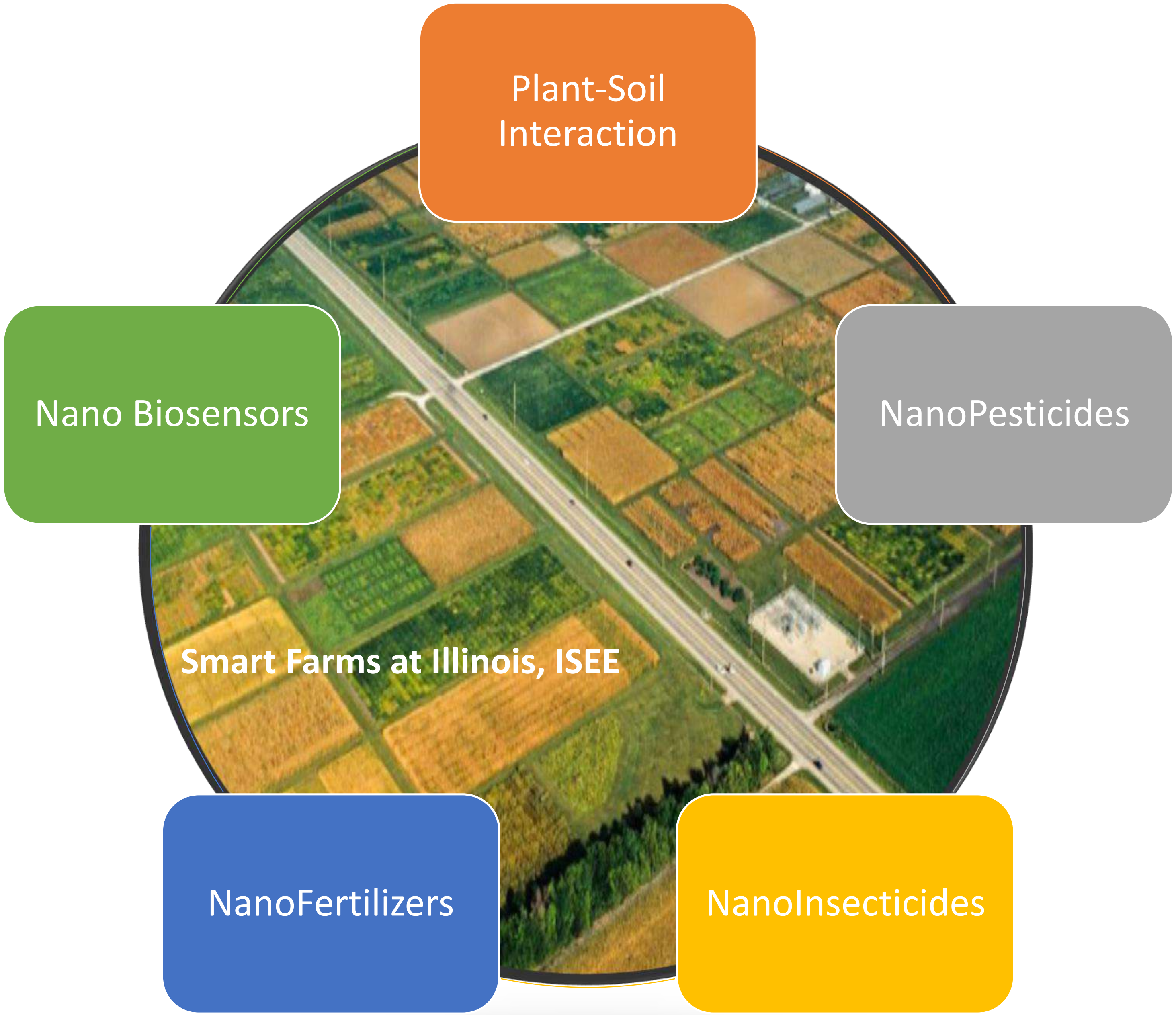
Current Projects

- QNRF: A Novel Microchip based Spatial Gene Expression Analysis Assay for Breast & Prostate Cancer
- USDA: Innovative Food Dehydration Technologies for Improving Product Quality, Energy Efficiency, Sustainability
- NSF NCN: Hierarchical nanoManufacturing Node (https://nanohub.org/groups/nanoMFG)
- NSF I/UCRC: Center for Advanced Research in Drying (CARD) (Dryingresearch.org)
- DOD: Mechanism of Fungal Degradation in Military Aircraft Coatings - completed
- Dudley Smith Initiative: Reducing Insecticide Resistance: Development of Unique Liposomes Pest Control System (LPCS)-completed

Interest areas for collaboration/future work

Advanced manufacturing, Digital agriculture, Food safety, Smart sensing technologies

Keywords: Bionanotechnology, Crop, Imaging, Sensors, Nanomedicine, Pathogenesis, Soil


Plant-Soil Interaction
Nano Biosensors
NanoPesticides
Smart Farms at Illinois, ISEE
NanoFertilizers
NanoInsecticides

Key Motivations: Bionanotechnology toward Environment-friendly Agriculture

- The global challenge is to feed 9 billion people by 2050 with a 60% increase in food availability.
- The agricultural and food sectors are confronted with such large issues as climate change, urbanization, sustainable use of resources, and environmental issues like run-off and accumulation of pesticides and fertilizers.
- Bionanotechnology can address such impacts as damage to the ecosystem with toxin release due to the overapplication of fungicides, insecticides, pesticides, and fertilizers.
- Bionanotechnology can contribute to the potential increase in crop production, food security, and sustainability. Fundamental and innovative research is needed to address these challenges for improved biodiversity, productivity, nutrition, and quality.
- Understanding the mechanisms of host-parasite interactions at the molecular level, developing a new generation of pesticides and their transport mechanisms, preservation, and packaging of food.
- Focus on research efforts toward environment-friendly agriculture through the development of liposomes as a novel carrier for designing slow-release formulations of commercially available nematicides, the use of CuO nanoparticles for disease management and plant health improvement, and the sensing of soil nitrates.

Barriers to Overcome: Bionano in Agriculture

- Determination and minimization of toxicity levels- risk assessment

- Bionano Regulatory Framework

- Global adoption of new Agricultural Protocols
- (through the UN FAO, the USDA, FDA, WFP)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on
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Hands-on Labs on Nanoparticles

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Hands-on Labs on Nanoparticles

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- National Academy of Sciences
- Nano Sensors Group, UIUC
- Holonyak Micro and Nanotechnology Lab, UIUC
- Beckman Institute, UIUC
- Center for Nanoscale Science and Technology, UIUC
- Profs. Munir Nayfeh, Taher Saif, Rashid Bashir
- ICCS/HEJ Chemistry Institute, University of Karachi- Prof. Atiya Abbasi
- Prof. Tehmina Anjum and collaborators, University of the Punjab

FUNCTIONAL NANOMATERIALS FOR BIOMEDICAL AND PHARMACEUTICAL APPLICATIONS

IRSHAD HUSSAIN
Professor, Department of Chemistry & Chemical Engineering,
SBA School of Science & Engineering (SSE),
Lahore University of Management Sciences (LUMS), Pakistan

ABSTRACT

Metal/metal oxide nanoparticles have been recognized as an important class of materials whose properties can be tuned by controlling their nanoscale features. A control over their size, shape and surface chemistry is extremely important for any potential applications in biomedical and environmental sciences. In this regard, we have demonstrated several reproducible protocols to prepare metal nanoparticles from subnanometer to over 100 nm in aqueous/organic media with a fair control over their size, shape, and surface chemistry. These metal nanoparticles have been used as building blocks to design/ synthesize new nanostructured materials using template-based and template-less approaches. The functionalized metal/ metal oxide nanoparticles/ nanoclusters possess interesting optical, recognition and catalytic properties and we are now focusing more on their applications in biological sciences especially those in bio-sensing (bacterial detection), bio-imaging, drug delivery, improved bioavailability, targeted delivery of drugs, multidrug resistance and environmental remediation. This talk will, therefore, be an overview of our interdisciplinary research activities to synthesize functionalized metal nanoparticles possessing unique chemical and physical properties, and their diverse applications in biomedical and pharmaceutical sciences.

Functional Nanomaterials for Biomedical Application

Irshad Hussain

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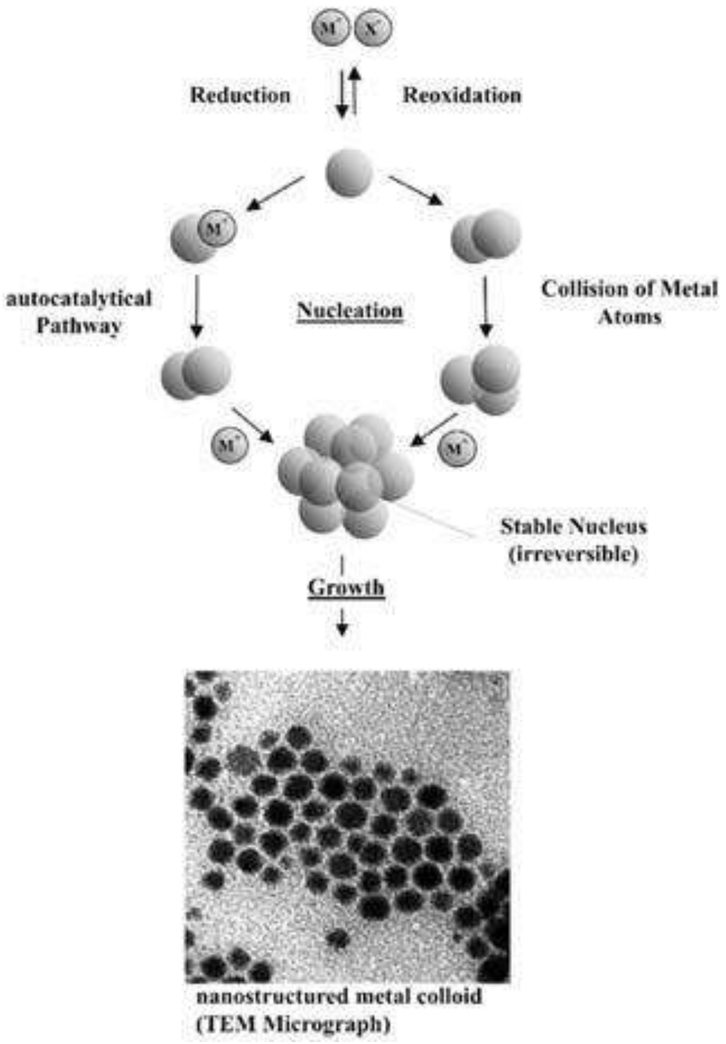
LUMS
A Not-for-Profit University

24th IAS Conference on Challenges to Promote S & T for Socio-Economic Development in OIC Countries, at ICCBS, University of Karachi, on March 7-8, 2023

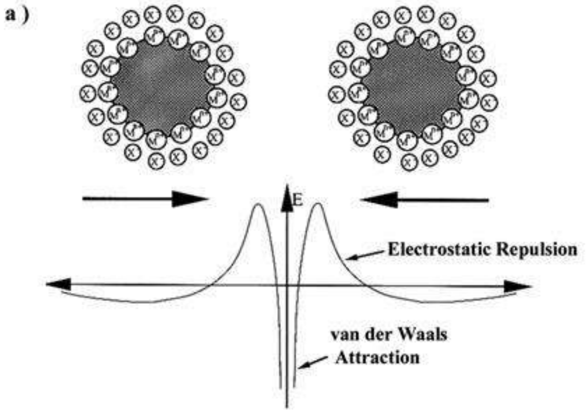
OUTLINE

- Synthesis of metal nanoparticles/nanoclusters
- Metal NPs/NCs applications in biosensing
- Metal NPs/NCs applications in drug/gene delivery
- Nanomaterials to improve bioavailability and pharmacokinetics of drugs
- Metal NPs/NCs applications to address multidrug resistance (MDR)

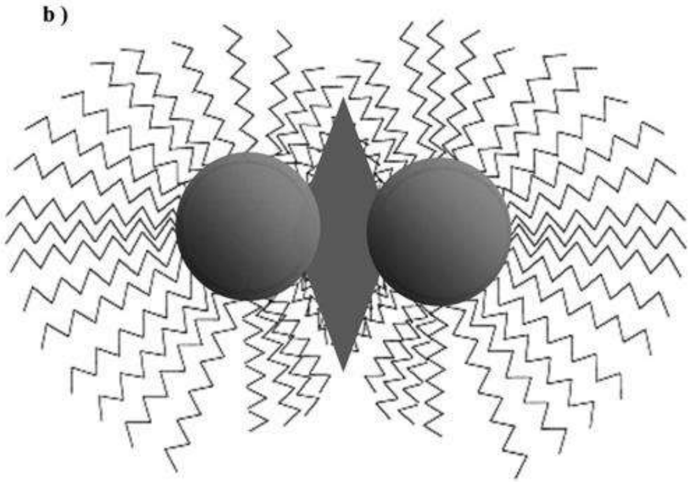
Metal Nanoparticles Synthesis – A Chemical Reduction Approach



Chemical reduction of metal precursors



Electrostatic/charge stabilization



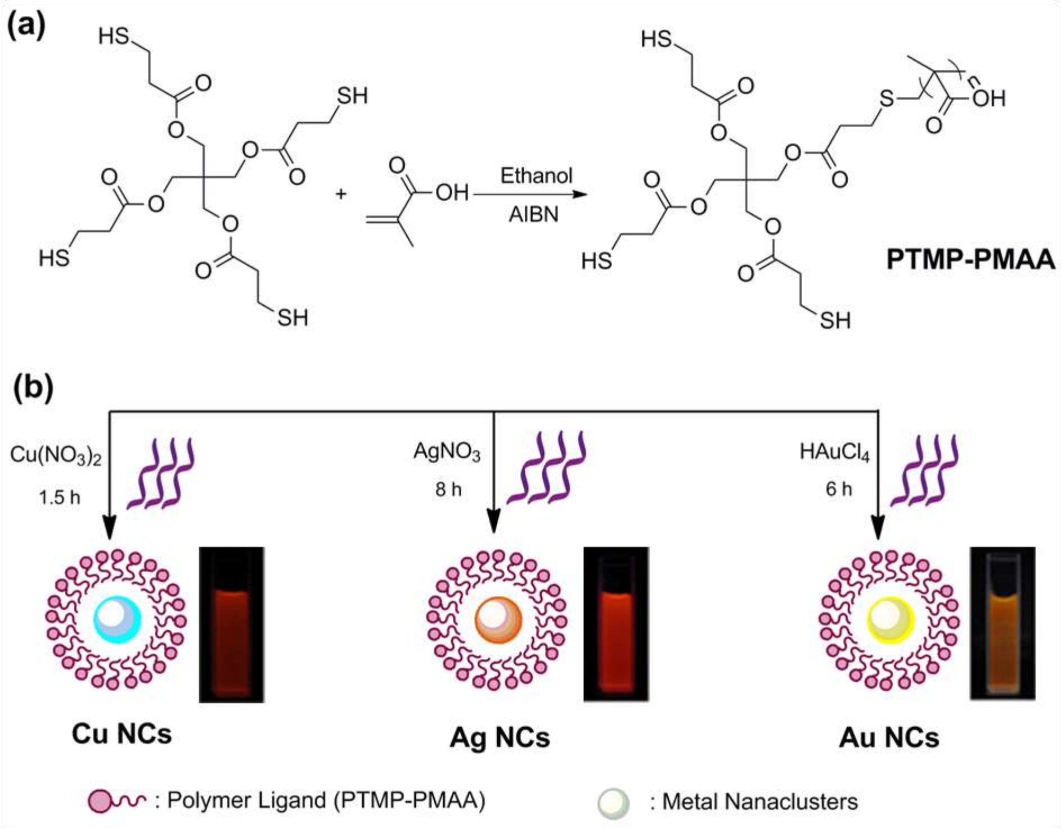
Steric stabilization

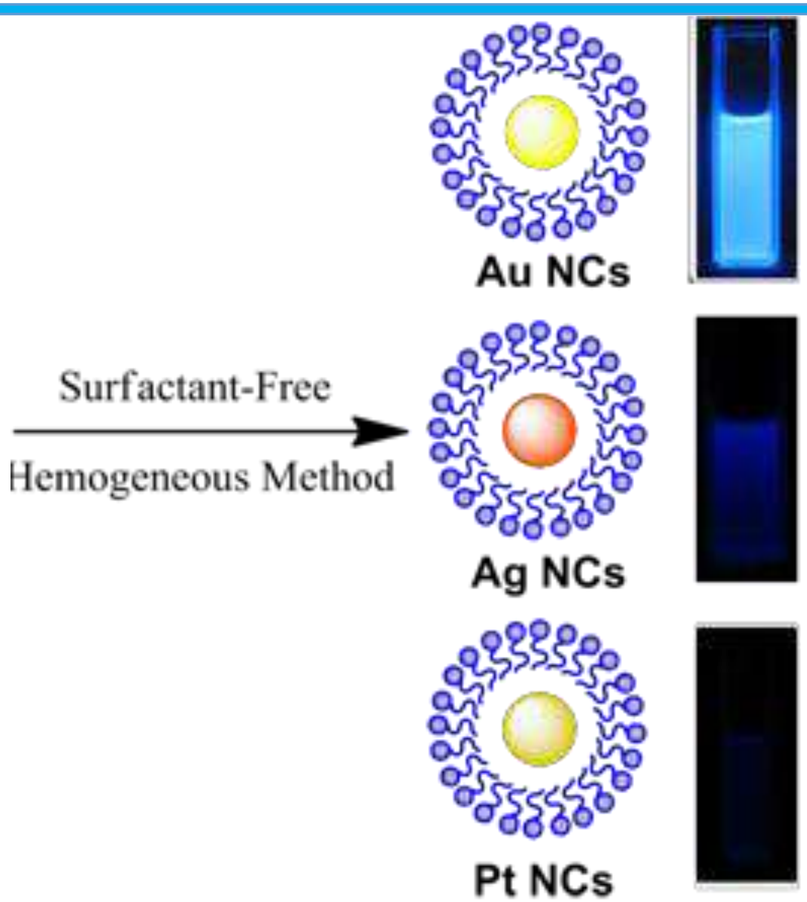
What factors control the rate of formation of metal nuclei, growth of metal nuclei, and ultimately size, shape and surface chemistry of metal NPs?

Nature of reducing agents, stabilizers, solvent, pH and temperature etc.

Thiol (-SH) and amine ($-NH_2$) containing organic molecules are generally better stabilizers for MNPs.

Subnanometer Fluorescent Metal Nanoclusters

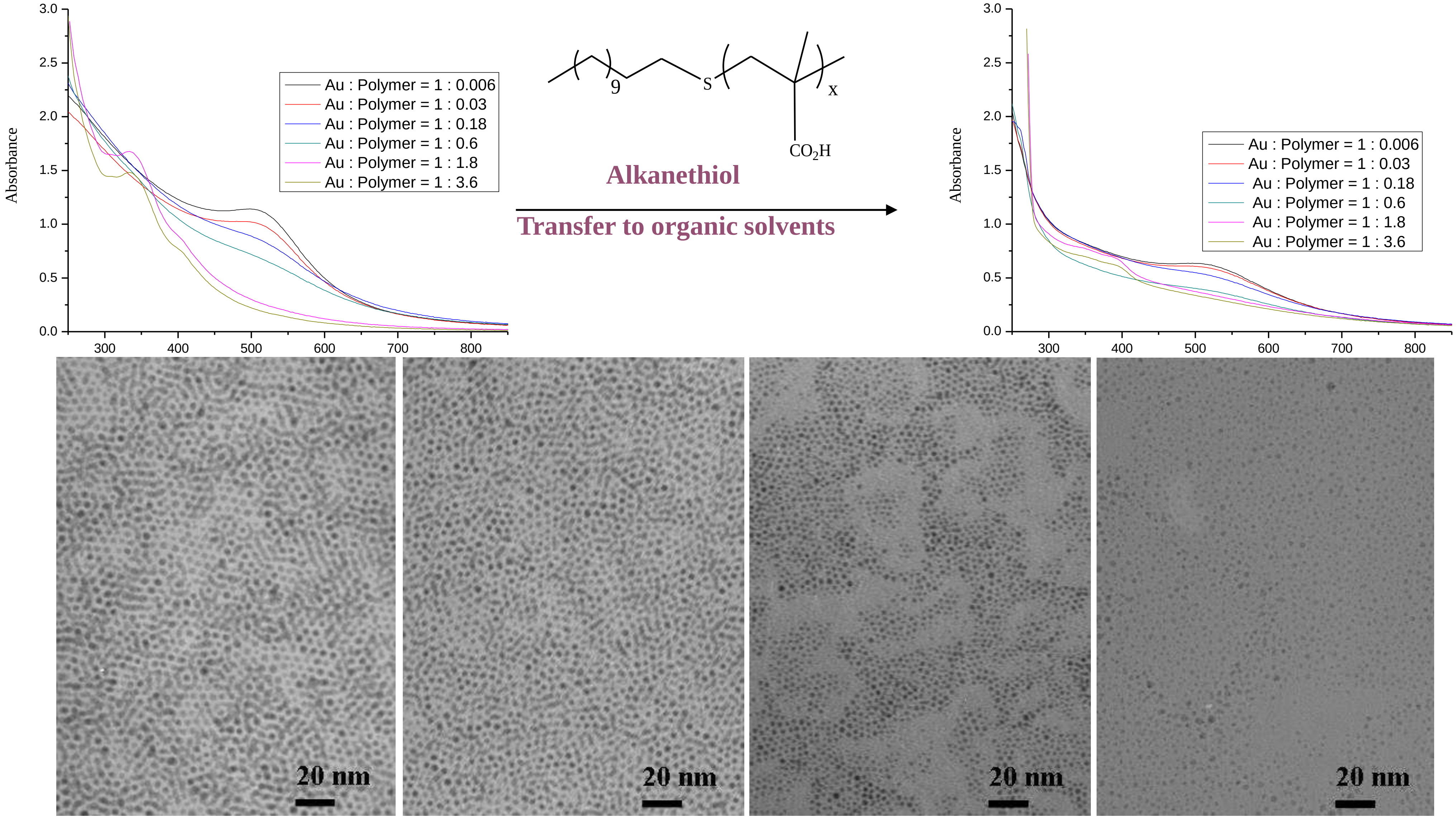




Water-soluble fluorescent metal nanoclusters were prepared by photo-reduction/chemical reduction of their inorganic precursors in the presence of polymer i.e., PMMA functionalized with pentaerythritol tetrakis 3-mercaptopropionate (PTMP).

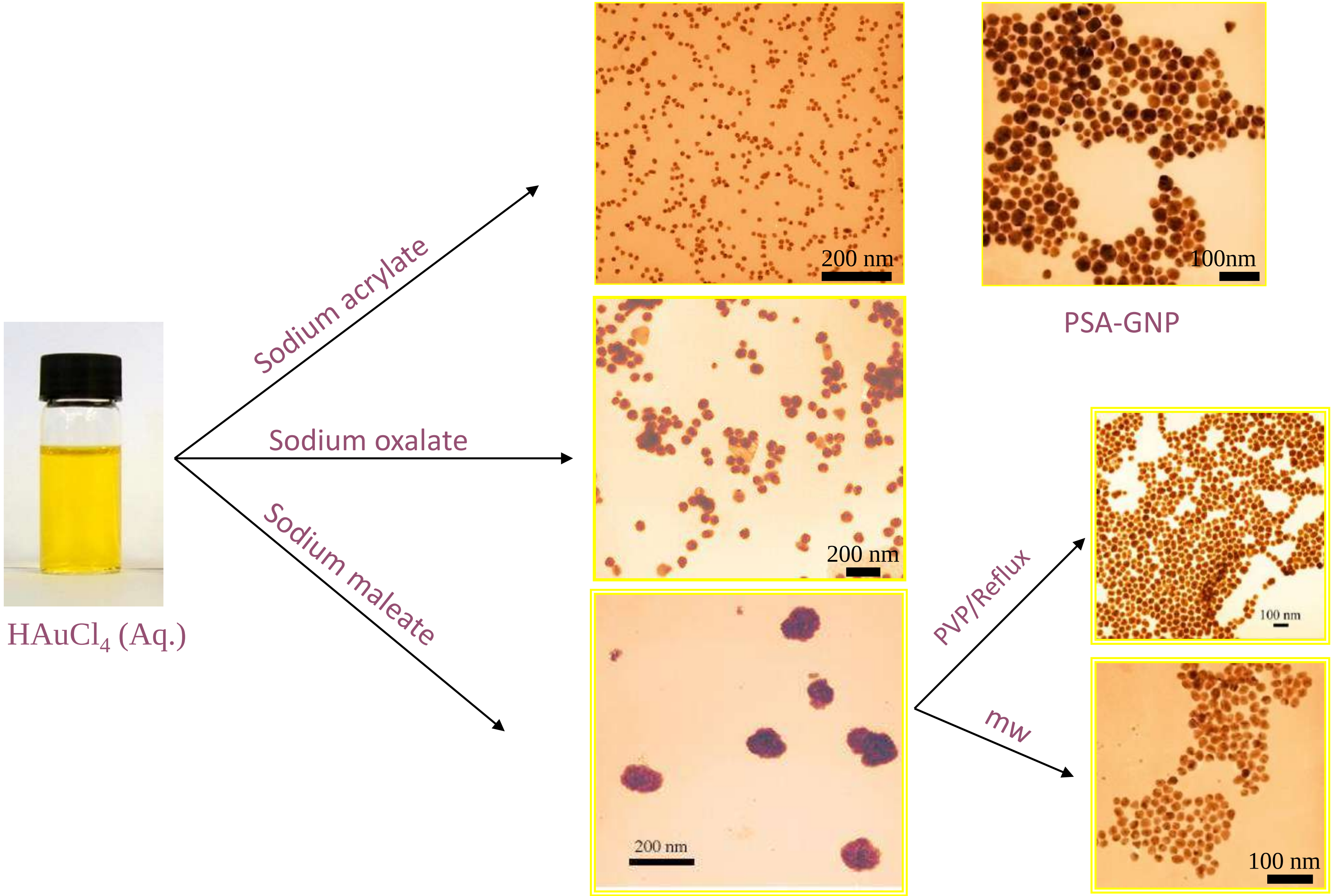
Zhang *et al.* Hussain and Tan. ***Chemical Communications***, **2012**, 48, 567; Huang *et al.* Hussain and Tan. ***J. Phys Chem C***, **2012**, 116, 448; Rotello and Hussain *et al.* ***Langmuir***, ***2012***, *28, 2023; Zhang & Shumaila et al.*, ***JMCB*****,** 2017, 5, 5608; *Yulian et al.*, ***Nanoscale*****,** 2019, 1, 1287

Controlling the Size of Metal Nanoclusters & Nanoparticles



Hussain *et. al.*, ***J. AM. CHEM. SOC.*** 2005, 127, 16398; Wang *et al.*, ***Langmuir*** 2006, 23, 885; Tan *et al.*, ***Nanoscale***, 2011, 3, 1600.

Controlling the Size of Metal NPs



Hussain *et al.*, ***Langmuir***, 2003, *19*, 4831

Optical Properties of Metal Nanoparticles

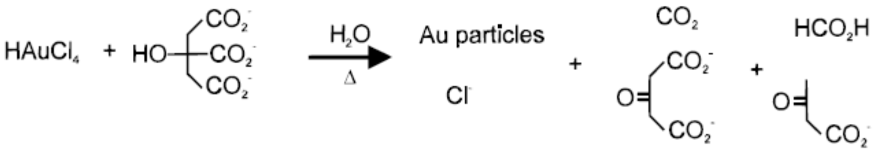
$HAuCl_4$ (Aq.)

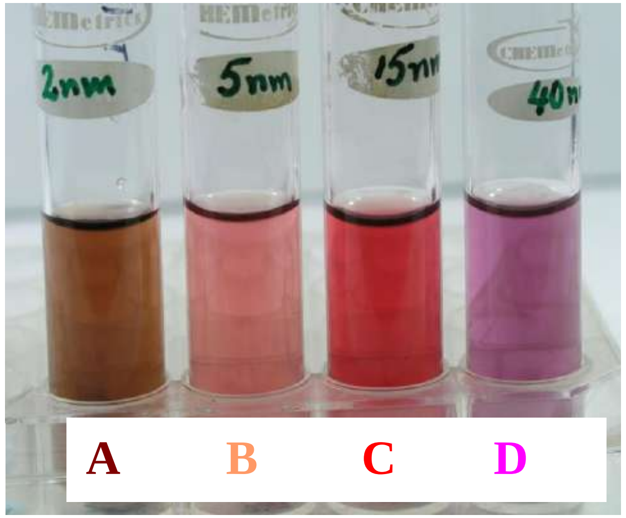
A = $MSA + NaBH_4$

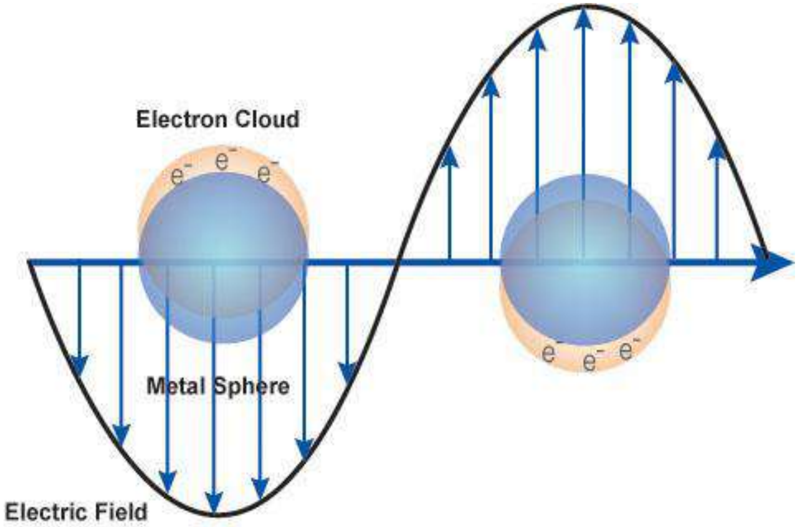
B = $Na_2CO_3 + NaBH_4$

C = Citric acid

D = Citric acid (less conc.)

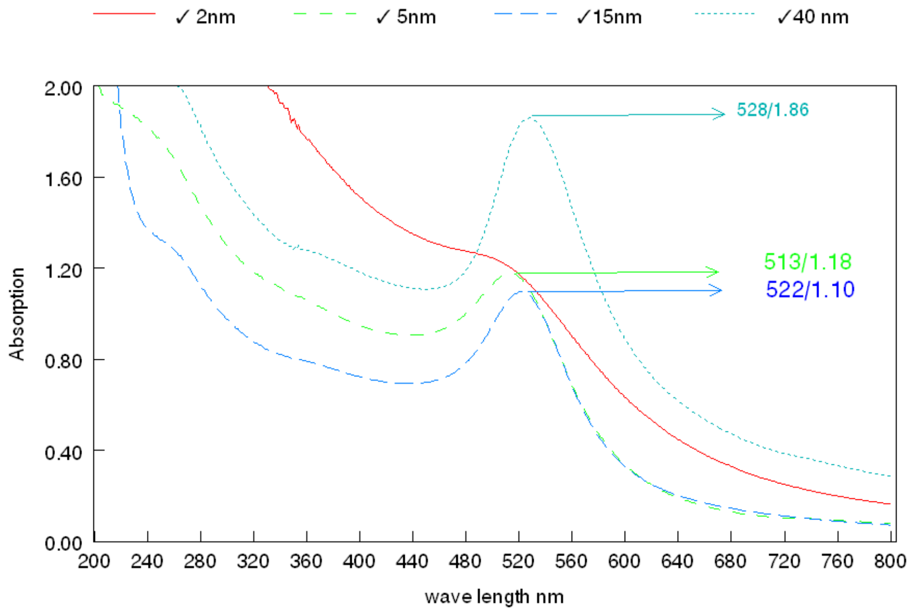






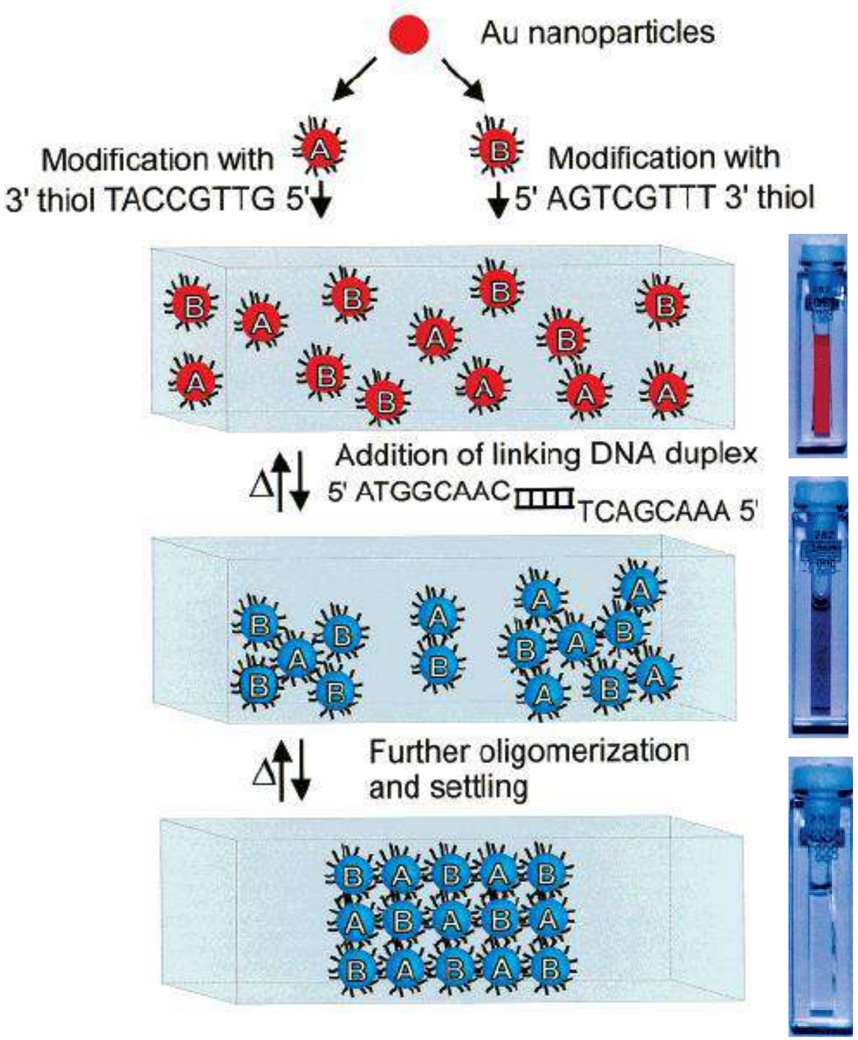
The origin of surface Plasmon resonance and color of metal NPs

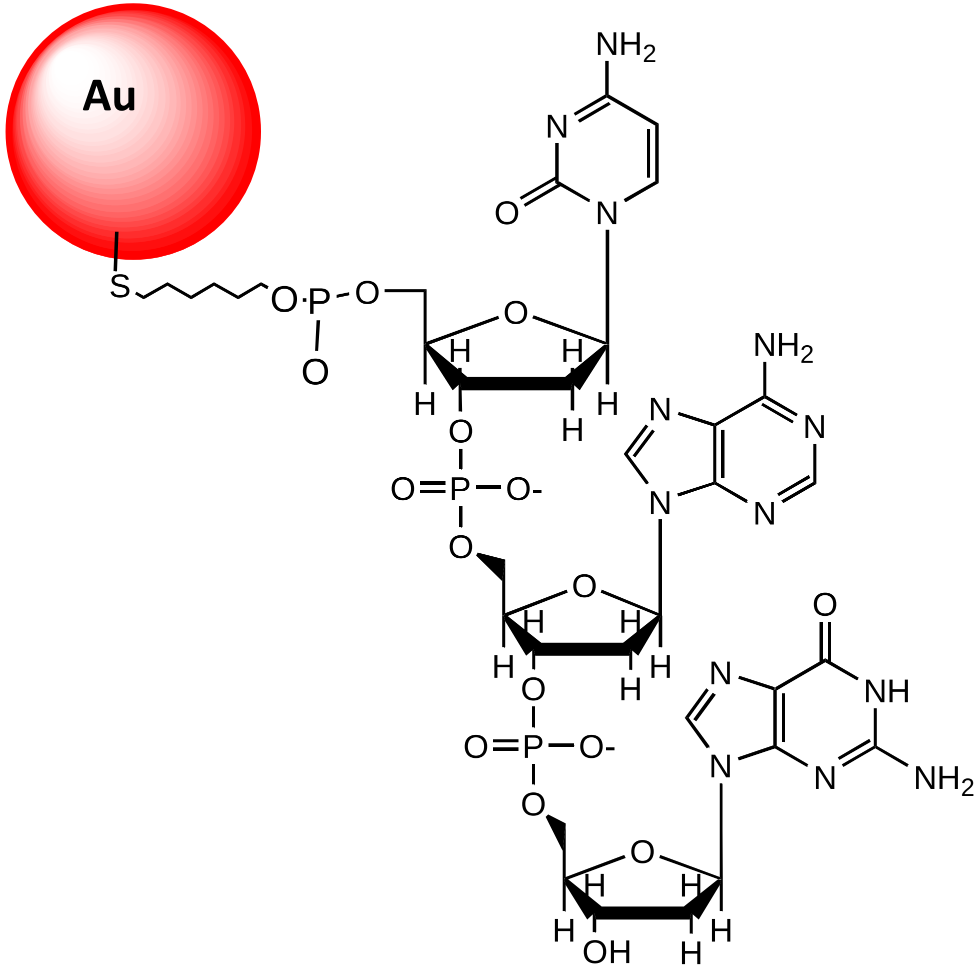
Surface Plasmon resonance of Au, Ag and Cu nanoparticles is in the visible region and, therefore, they are of different colors



UV-visible spectra of GNPs of different sizes

DNA-Gold Nanoparticles Conjugates for DNA Detection



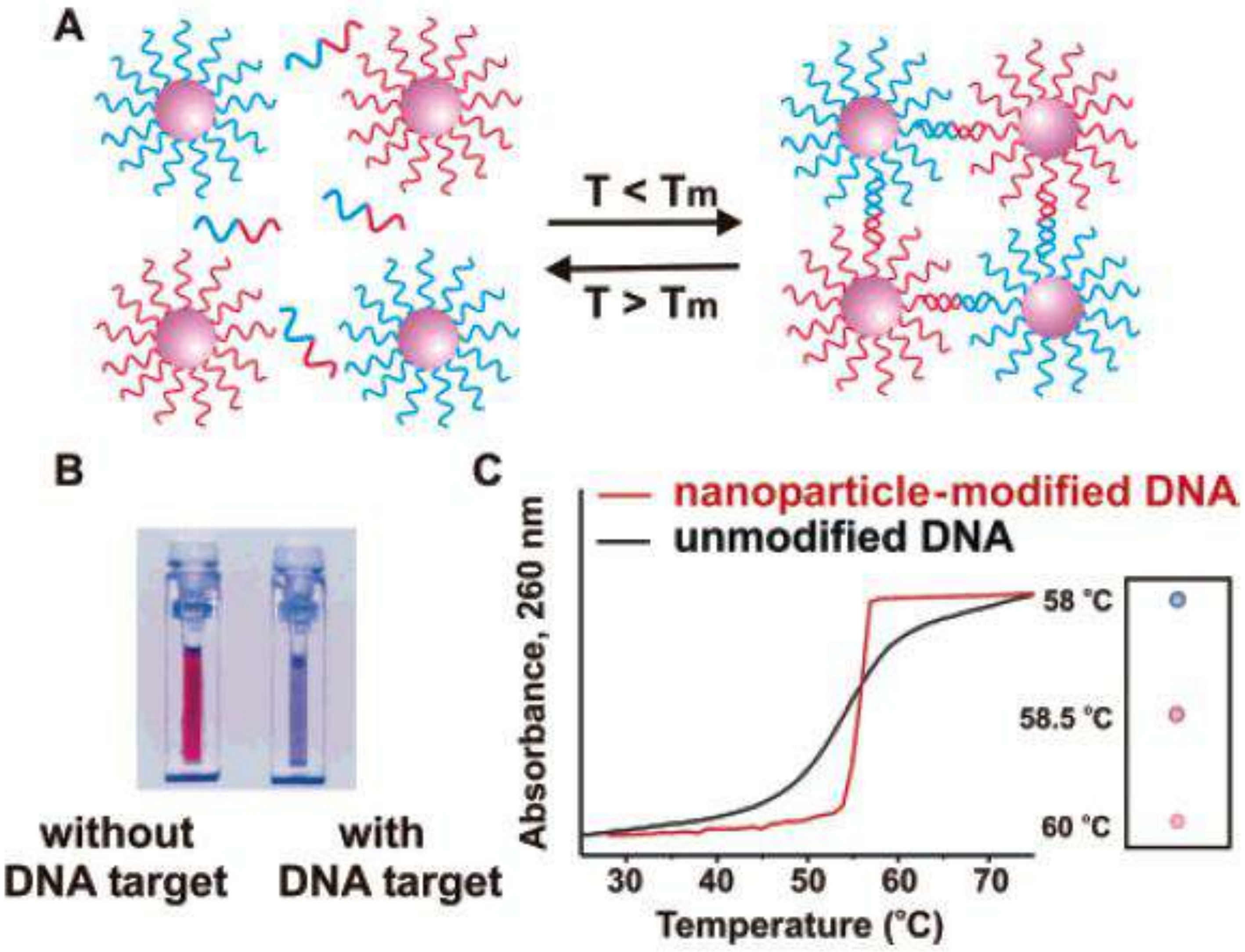


A simple colorimetric assay can be developed to detect complementary strands of DNA bound on gold nanoparticles surface based on the change in color.

Mirkin *et al.* ***Science*** 1997, 277, 1078

GNPs -Based Colorimetric Assay for the Detection of DNA

GNPs are conjugated with double stranded DNA with sticky ends. In this case, two types of GNPs are conjugated with dsDNAs whose sticky ends are non-complementary to each other. In the presence of a target DNA, one half of which is complementary to DNA on one type of GNPs and other half complementary to DNA on other type of GNPs, the particles will join resulting in their aggregation that can be monitored visually as well as by UV-visible absorption spectroscopy. These GNPs have specific melting temperature (Tm), which depends on the extent of binding of target DNA with probe DNA.



Mirkin *et al.* ***Science*** 1997, 277, 1078

Naked Eye Detection of COVID-19 Using DNA Functionalized Au NPs

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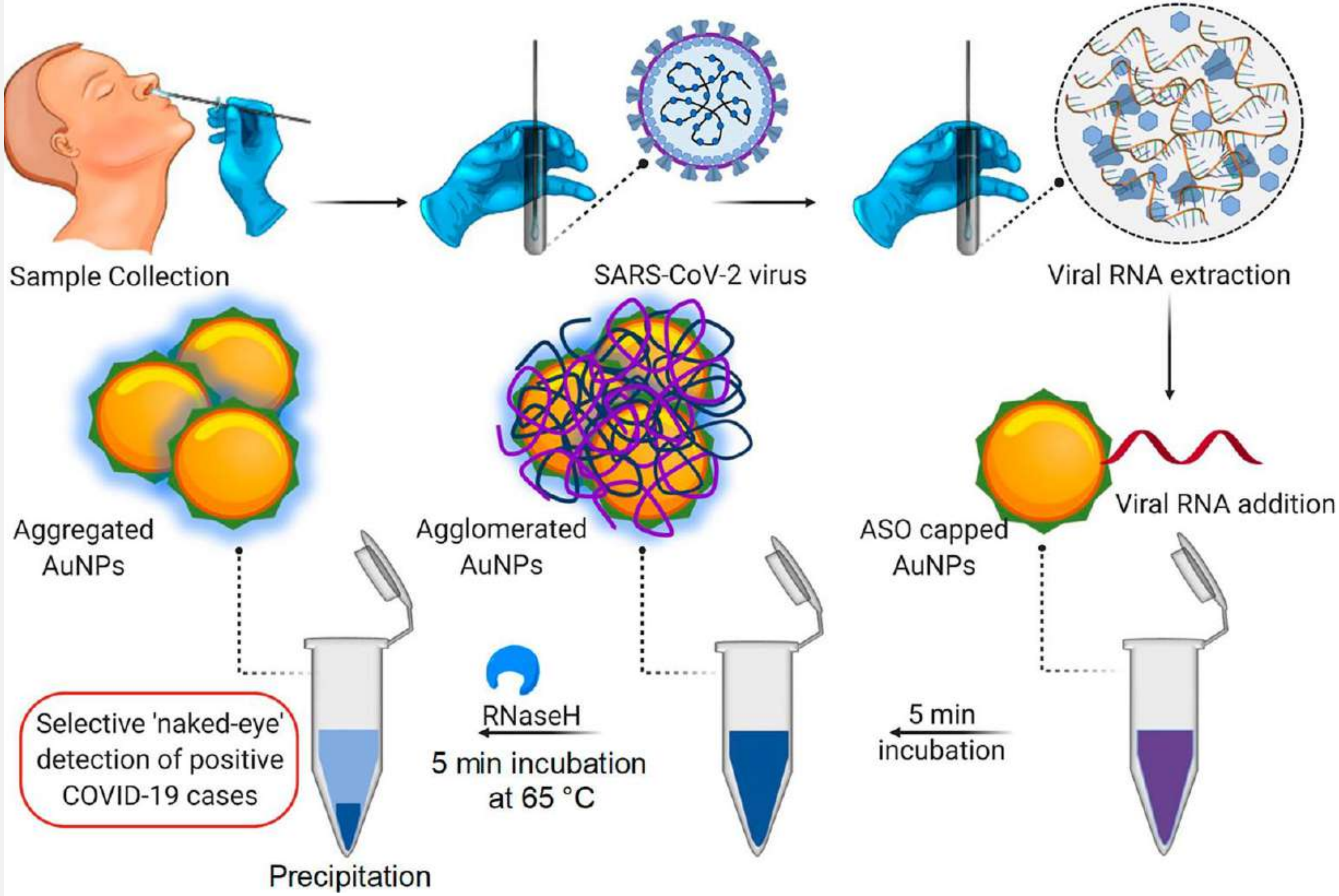
Gold nanoparticles capped with suitably designed thiol-modified antisense oligonucleotides (ASOs) specific for N-gene (nucleocapsid phosphoprotein) of SARS-CoV-2, agglomerate selectively in the presence of its target RNA sequence of SARS-CoV-2 and demonstrate a change in its surface plasmon resonance and thus the colour. The addition of RNaseH cleaves the RNA strand from the RNA−DNA hybrid leading to a visually detectable precipitate from the solution mediated. The selectivity of the assay has been monitored in the presence of MERS-CoV viral RNA with a limit of detection of 0.18 ng/μL of RNA having SARS-CoV-2 viral load.



ACS Nano 2020, 14, 7617−7627

Colorimetric Detection of COVID-19 Using Au NPs

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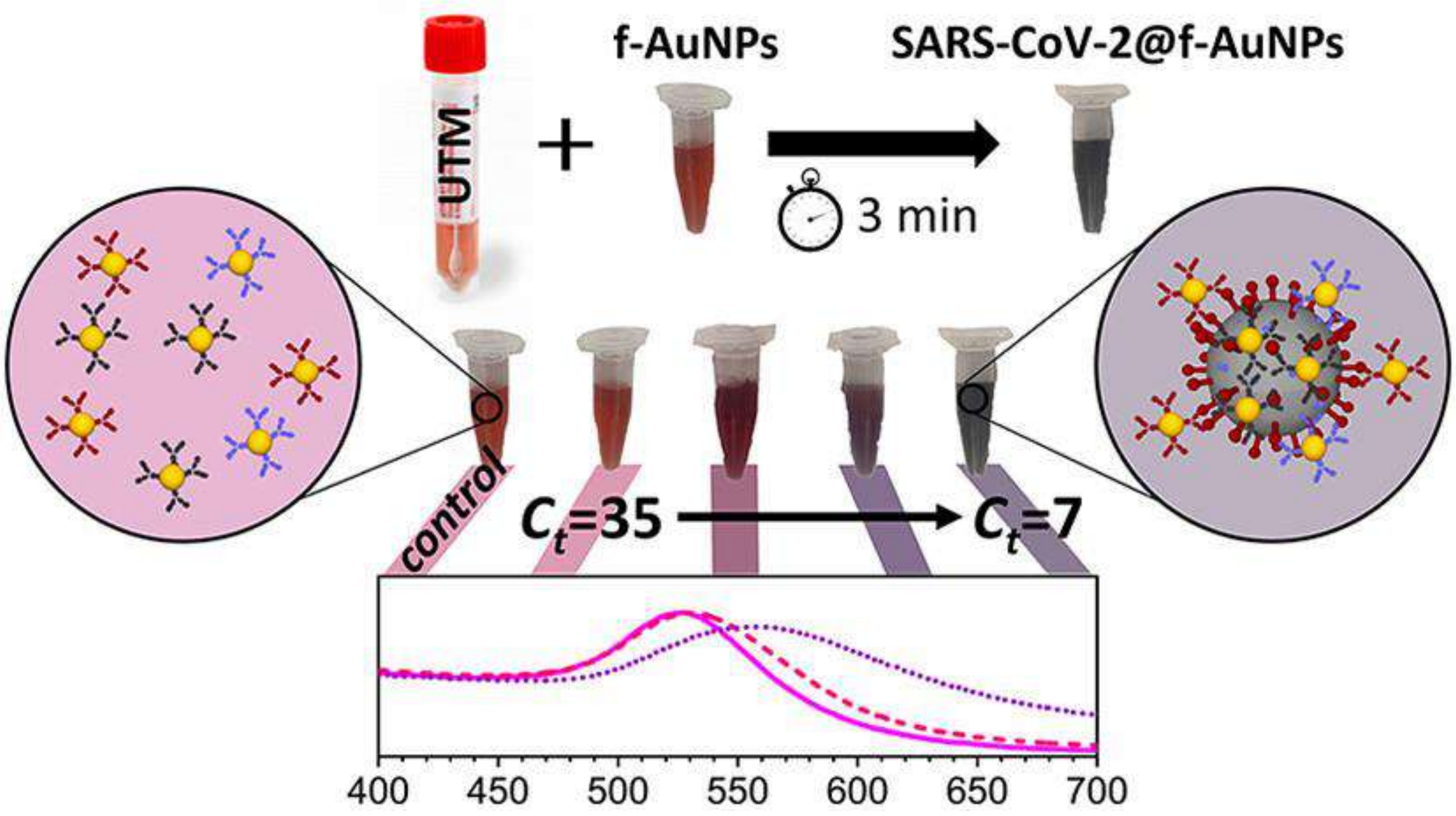
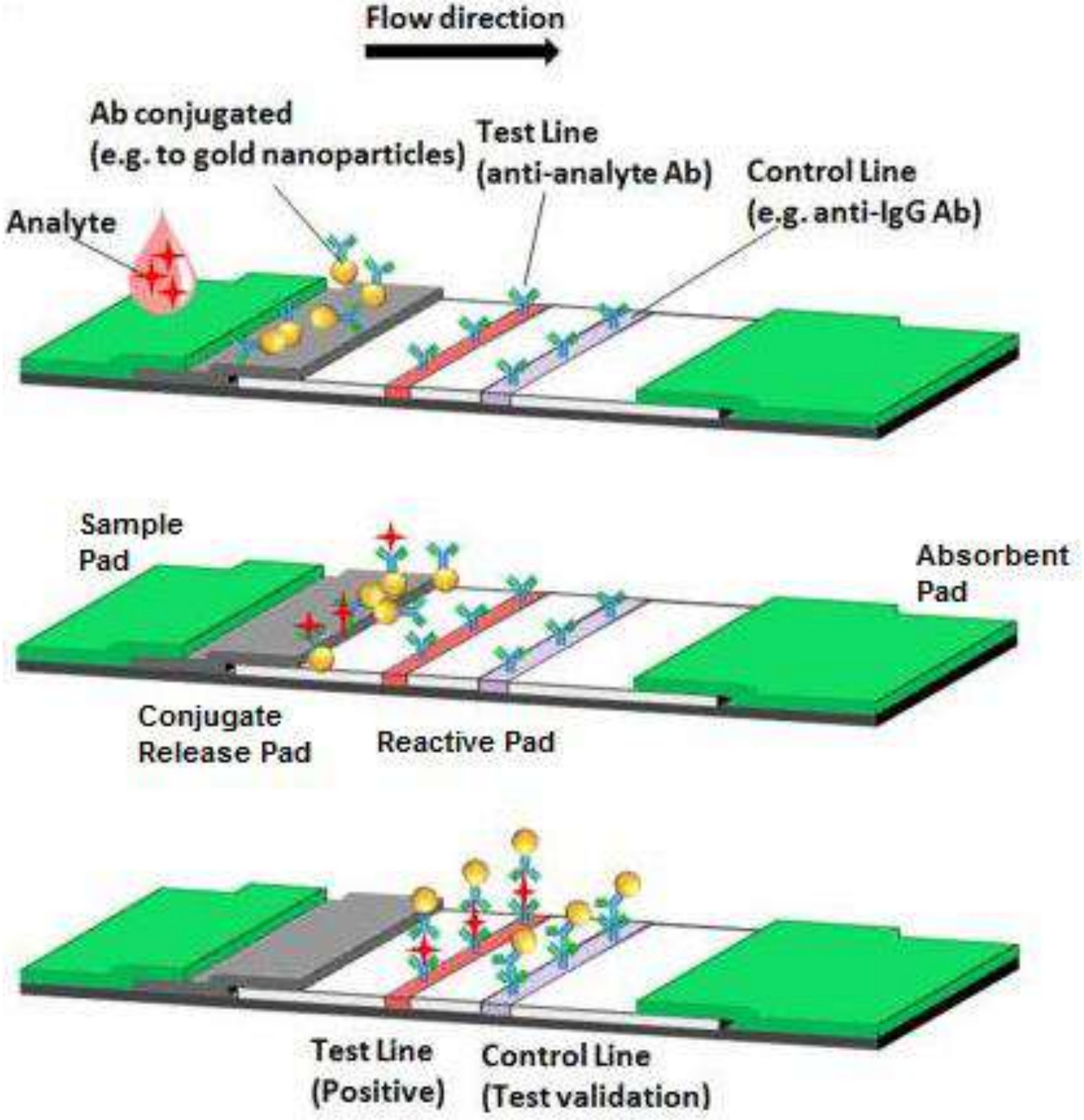
AuNPs functionalized with antibodies targeting three surface proteins of SARS-CoV-2 (spike, envelope, and membrane) is red-shifted in few minutes when mixed with a solution containing the viral particles. The detection limit of this colorimetric method is approaching that of the real-time PCR and has great potential for mass testing.



ACS Sensors 2020, 5, 3043−3048

AuNPs Based Lateral Flow Immunoassay for PoC devices

Antibody conjugated gold nanoparticles are used in conjugate release pad that bind with the analyte (human chorionic gonadotropin (hCG) in case of pregnancy test) that binds further with the analyte specific antibody immobilised on the test line to produce a colour. Analyte-free Ab-conjugated AuNPs bind with IgG antibodies on the control line to ensure the proper diffusion of AuNPs. Such assays have potenial for other diagnostic purposes e.g., to ascertain failure of internal organs (e.g., heart attack, renal failure or diabetes), COVID or other infections, contamination with specific pathogens including biowarfare agents, presence of toxic compounds in food, environment and even the abuse of (illicit) drugs.



Major challenge of LFIA is sensitivity

Trends in Analytical Chemistry 2021, 137, 116205; *ACS Nano* 2020, 14, 7783; *ACS Appl. Nano Mater.* 2019, 2, 8, 5020

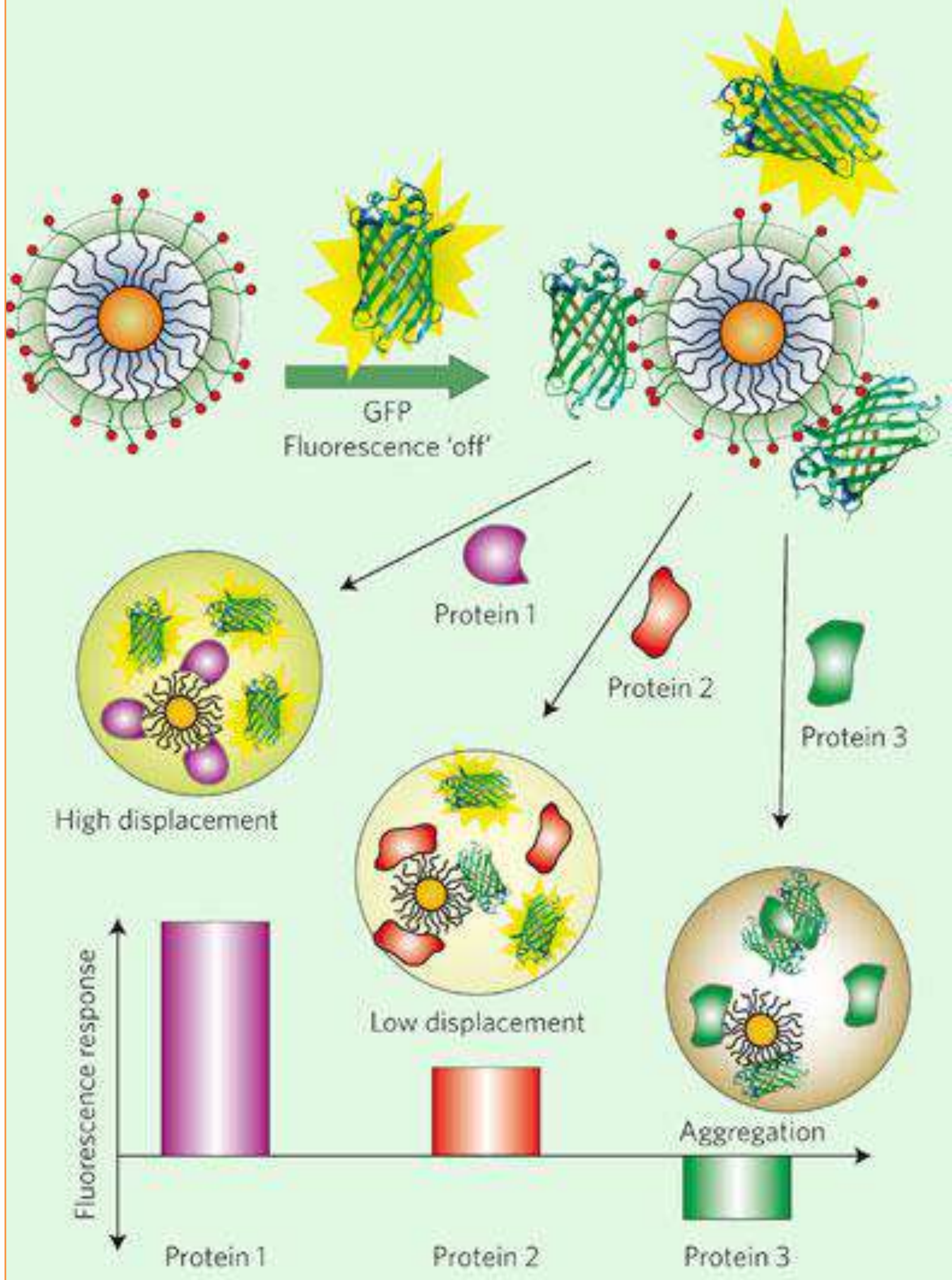
Functionalized Gold NPs Based Chemical Nose to Sniff Various Diseases

GNPs are functionalized with cationic/anionic ligands.

Fluorescent proteins/polymers are electrostatically conjugated to these nanoprobes.

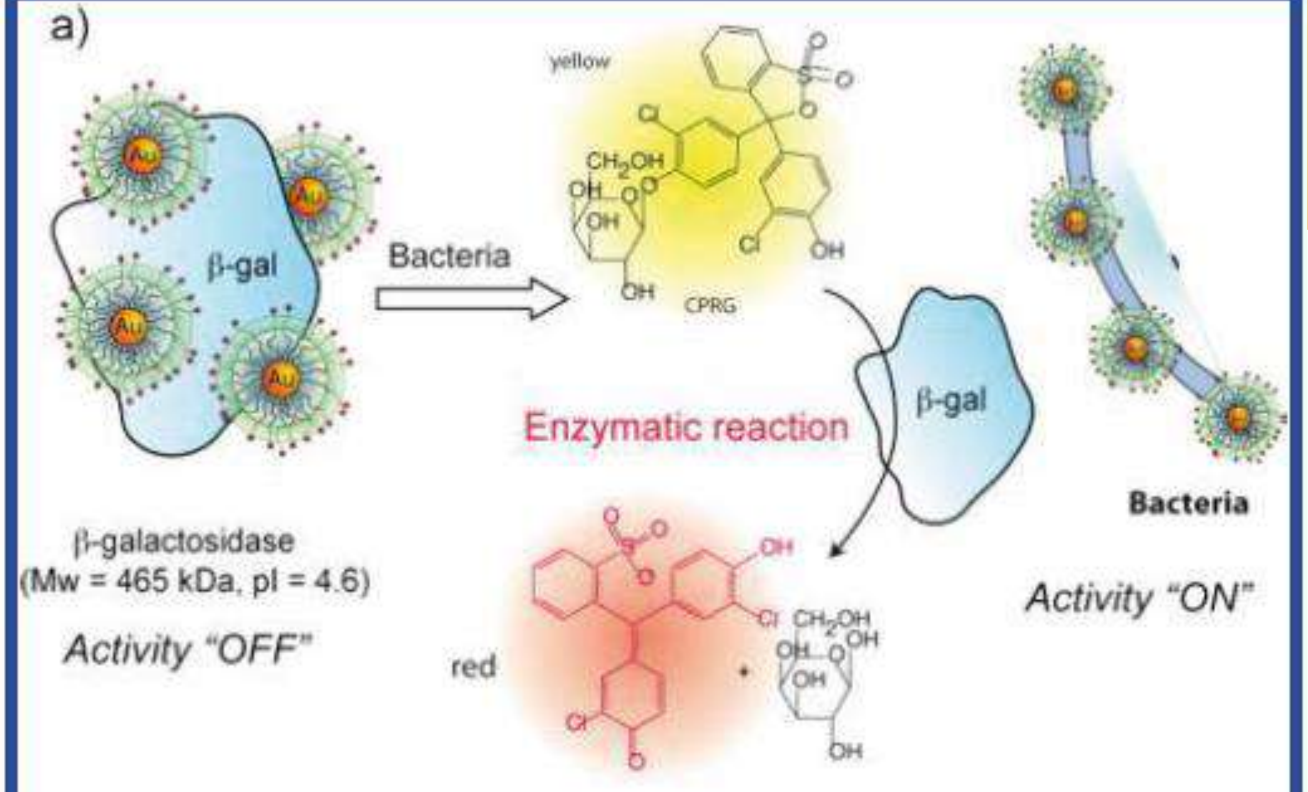
Fluorescence of released proteins is measured after diseased proteins compete with the conjugated proteins.

Great potential to detect various diseases at early stages.

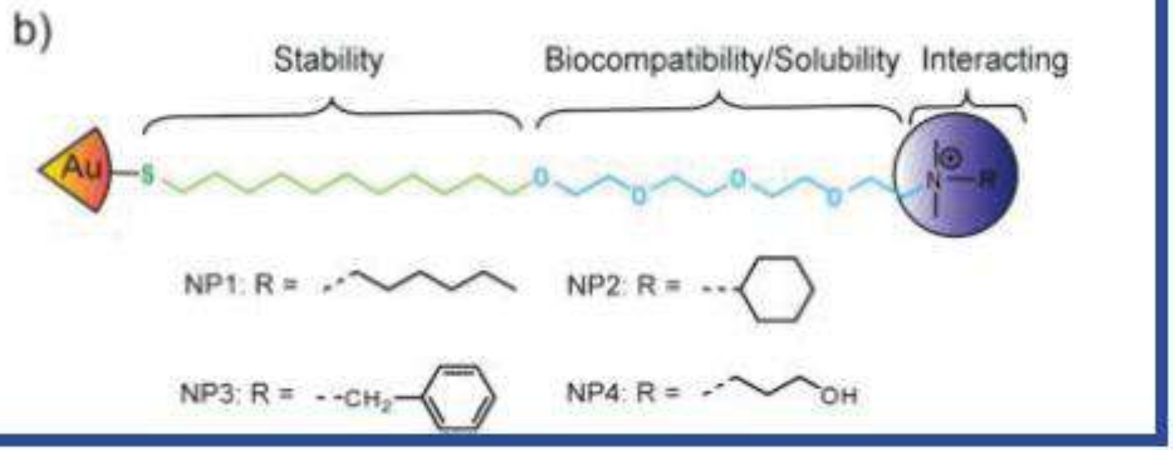


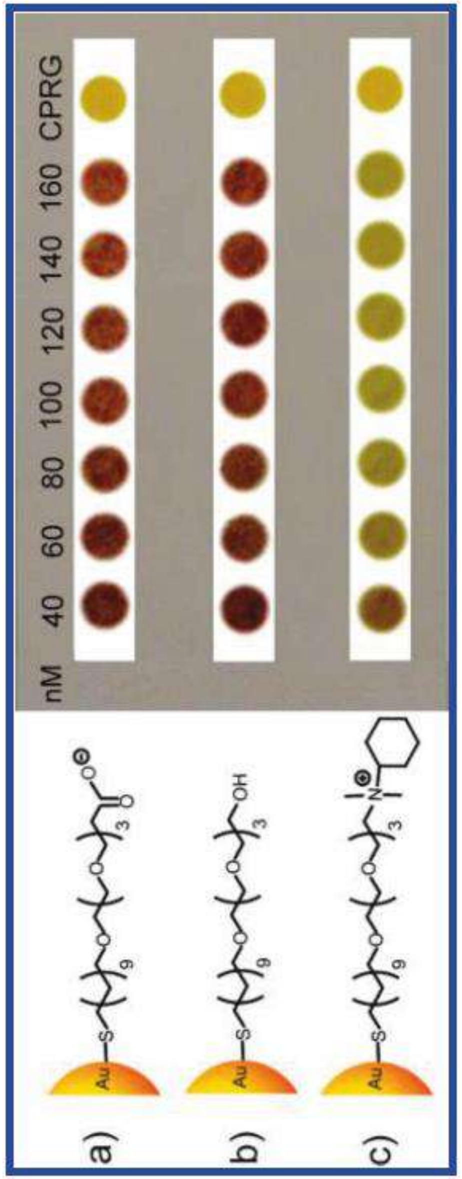
Rotello *et al.*, *Nat. Nanotech.* 2011, 6, 573-579

Bacterial Detection Using Cationic Gold Nanoprobes



CPRG = chlorophenol red β-D-galactopyranoside

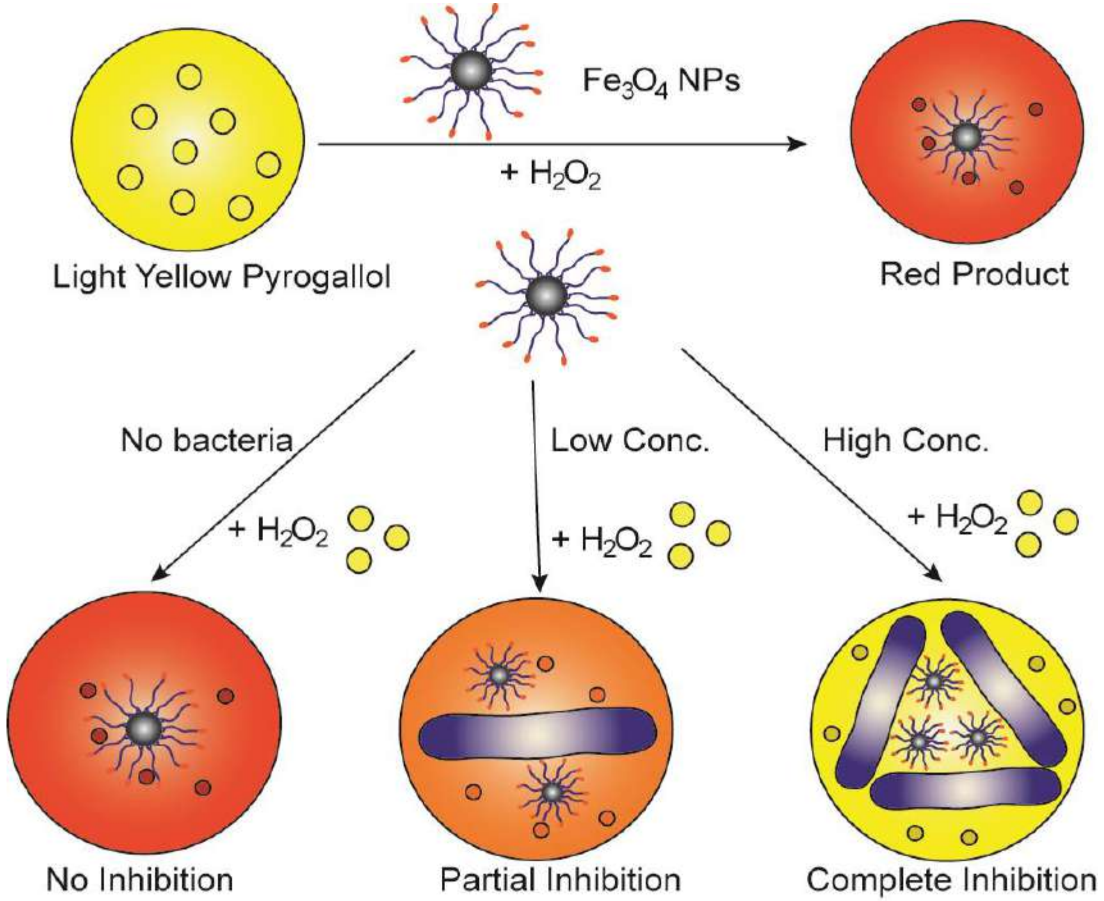


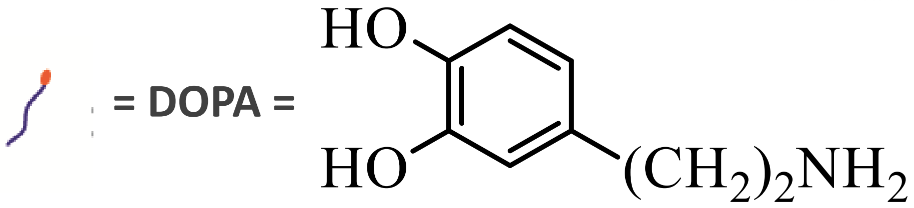


Rotello *et al.*, ***J. Am. Chem. Soc***. 2010, 132, 5285

MIONs for Bacterial Detection – Turn-off Sensing

- Positively charged NPs
- Interaction with bacteria
- Catalytic activity inhibited
- No color production
- In absence of bacteria, color is produced





Shazia Mumtaz *et al*., ***Chem. Commun.*** 2017, 53, 12306 & ***J. Phys D***, **2017**, 11LT02

Design & Synthesis of Highly Stable MIONs for Drug Delivery and MRI

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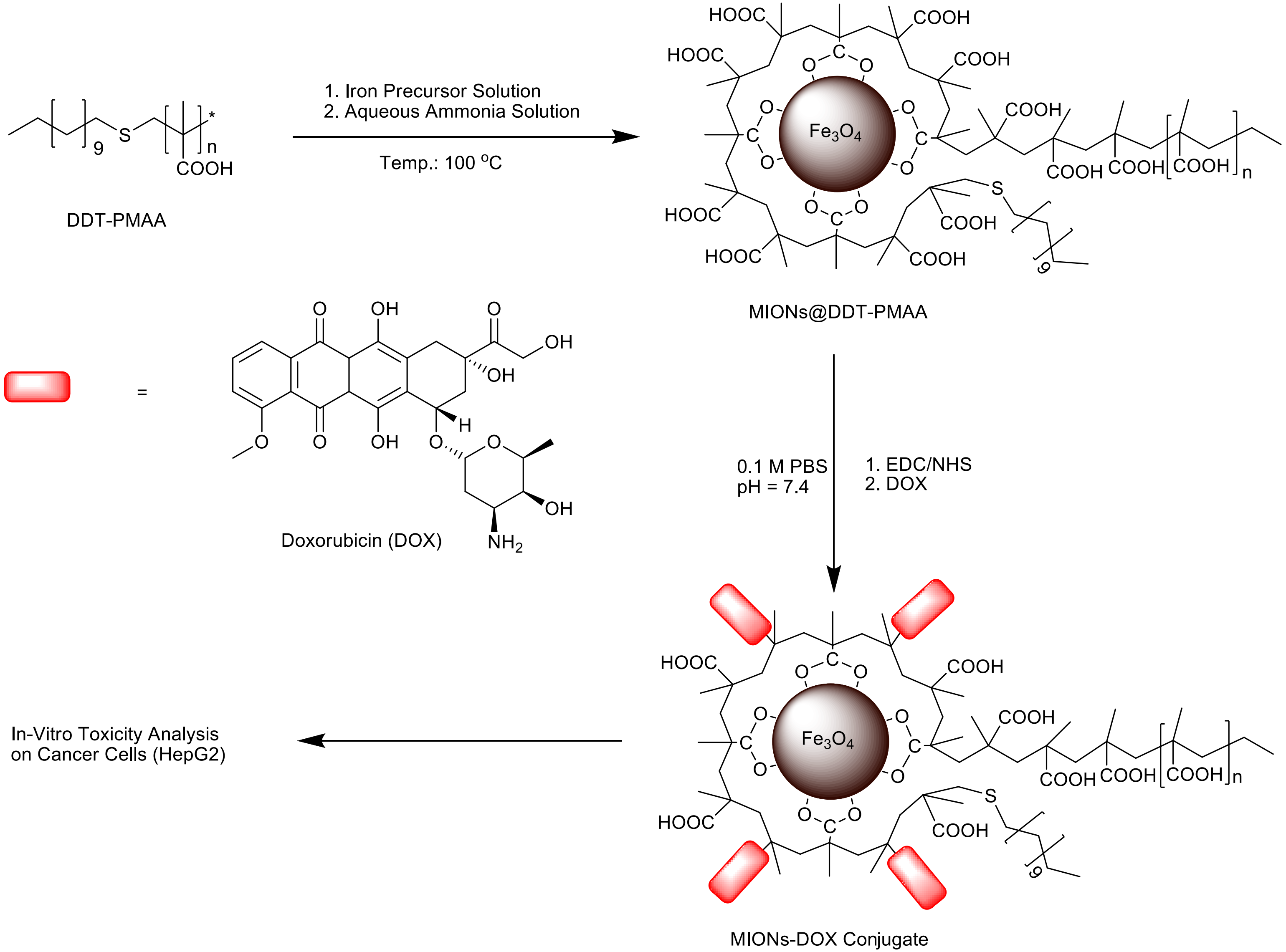
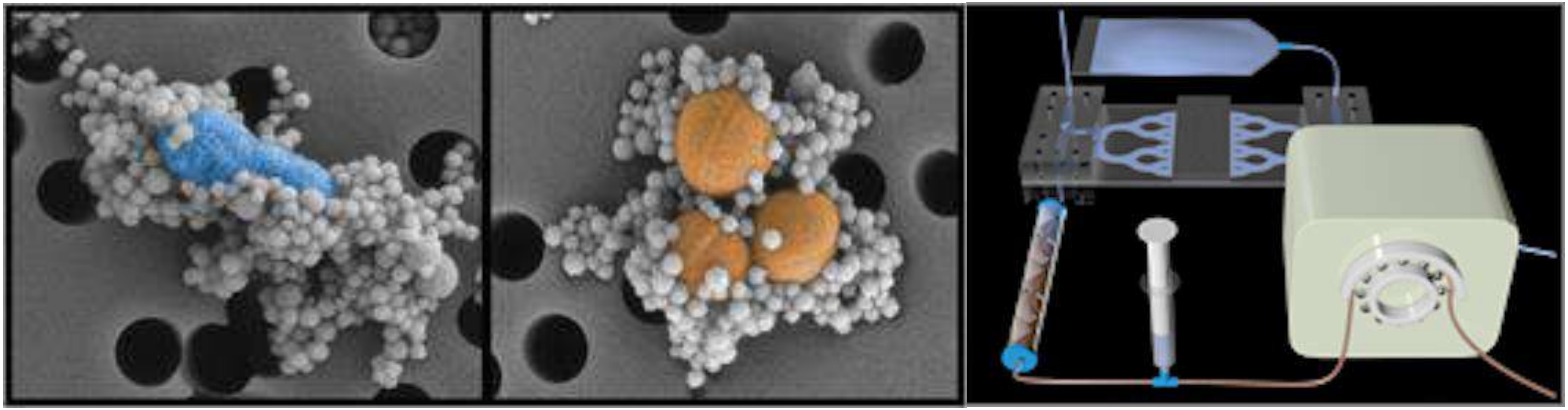
Biocompatible and non-toxic uniform magnetic iron oxide nanoparticles (MIONs) coated with multifunctional polymer were further functionalized with an anti-cancer drug i.e. doxorubicin (DOX) and its efficacy, as a model drug delivery system, was determined using HepG2 cells. The efficiency of the drug–NP conjugates was found to be significantly higher than that of the free drug.



Irfan, Bien and Hussain *et al.* ***J. Mater. Chem. B***, 2013, 1, 2874

Magnetic Nanoparticles Based Biospleen to Treat Sepsis by Removing Blood Pathogens

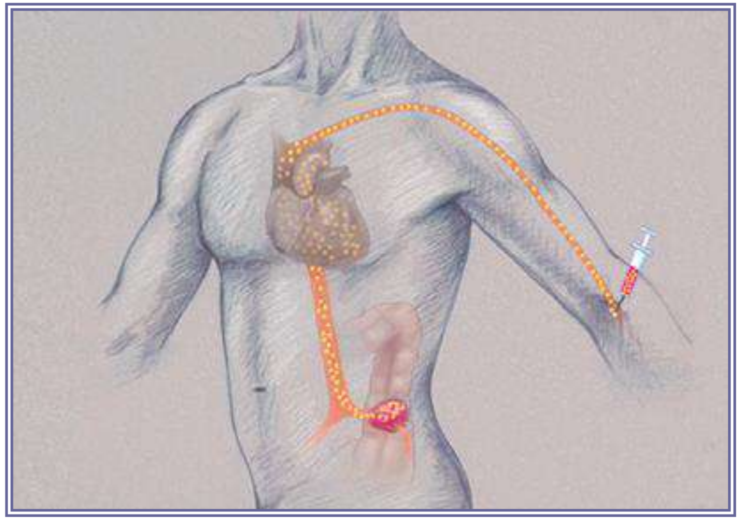
Novel dialysis-like therapeutic device inspired by the spleen comprises of tiny nanometer-sized magnetic beads that are coated with a genetically engineered version of a natural immune system protein called mannose binding lectin (MBL). quickly filters bacteria, fungi and toxins

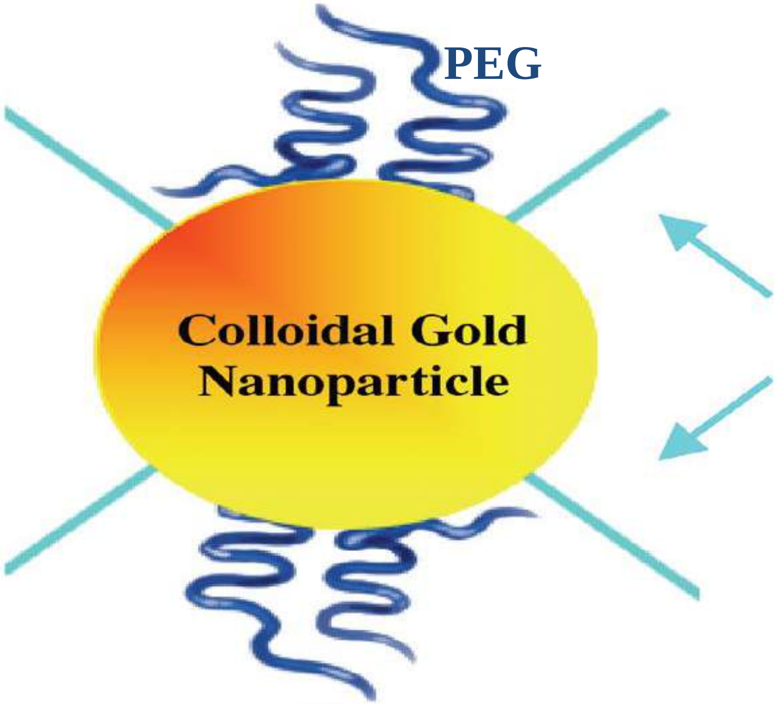


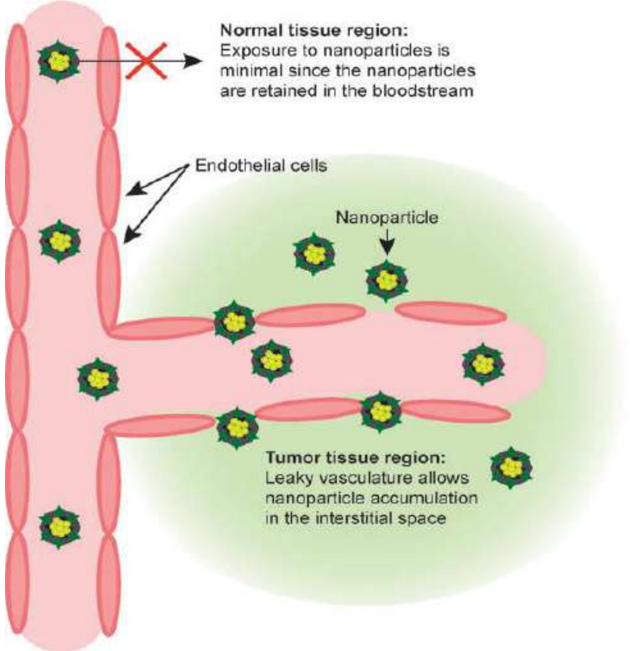
Kang *et al.* ***Nature Medicine***, 2014, 1211

Gold NPs for Cancer Detection & Treatment

Au NPs have the potential to deliver cancer drugs only to the target tumors by conjugating with tumor specific proteins thus minimizing side effects and increasing efficiency. Au NPs are now being evaluated not only as drug delivery systems but also as cancer monitoring and treatment system.







Porous Gold NPs for Targeted Drug Delivery

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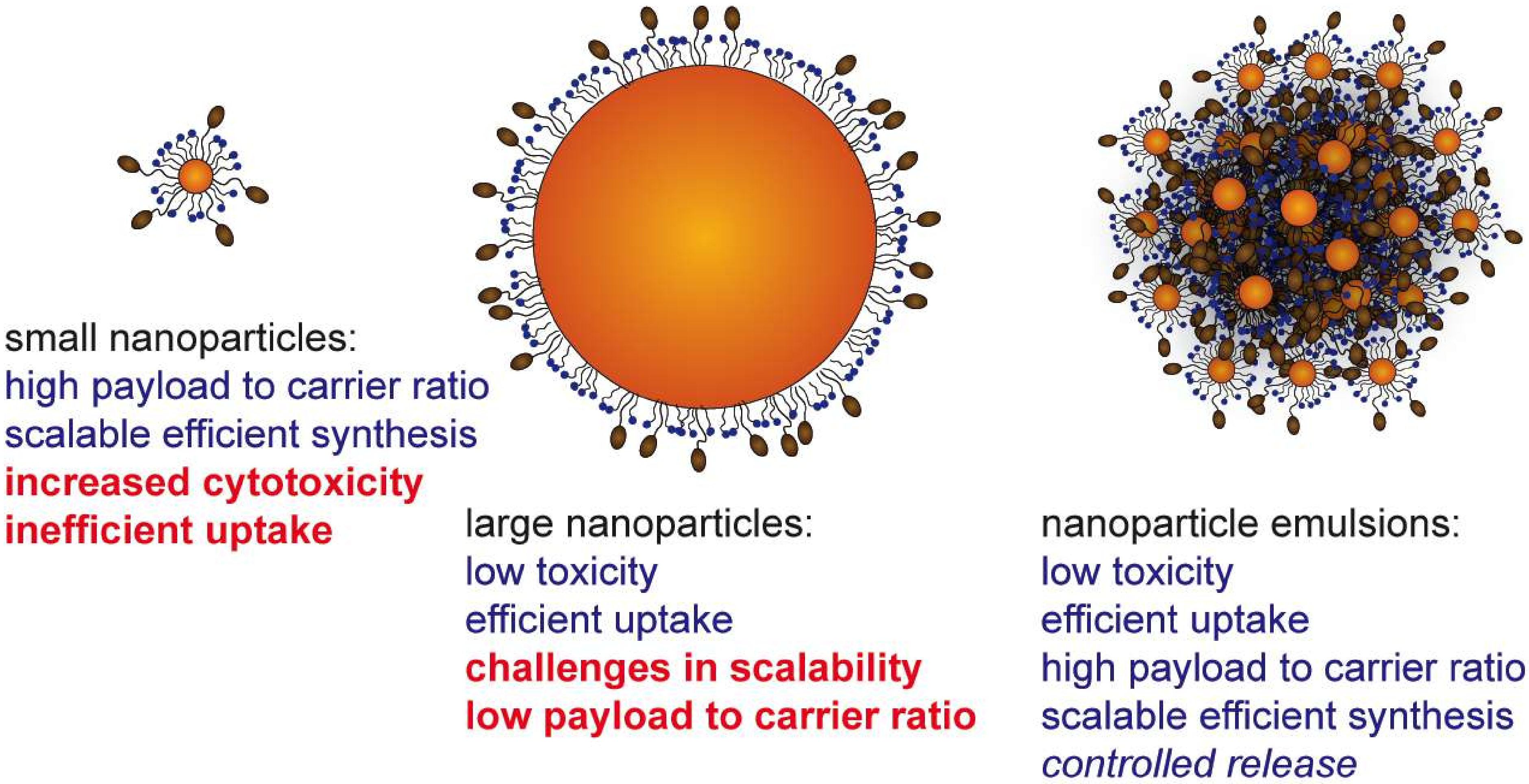

Hussain and Wang *et. al.*, ***Langmuir***, **2006**, 2941; Hussain *et. al.*, ***J. Colloid & Interface Science***, **2010**, 350, 368; Ayesha and Hussain et al., ***Material Letters***, 2013, 95, 78; Ayesha and Hussain *et al.* ***Journal of Colloid & Interface Science****, 2015, 446, 59.*. Irfan, Bien and Hussain *et al.* ***J. Mater. Chem. B***, 2013, 1, 2874; Ayesha et al., ***Material Letters*****,** 2013, 95, 78; and ***Journal of Colloid & Interface Science****, 2015, 446, 59;* Ibrahim Javed et. al., ***Journal of Materials Chemistry B,*** 2015, 3, 8359; Ibrahim Javed et. al., ***Colloids & Surfaces – B*****,** 2016, 141, 1-9; Farhan Sohail *et. al*., ***Journal of Materials Chemistry B,*** 2016, 4, 6240; Faisal Usman *et. al*., ***RSC Advances*****,** 2016, 4, 94896; Shumaila Razzaque *et. al*., ***Polymers,*** *2016, 8, 156;*

Porous Gold Nanoparticles for Drug Delivery

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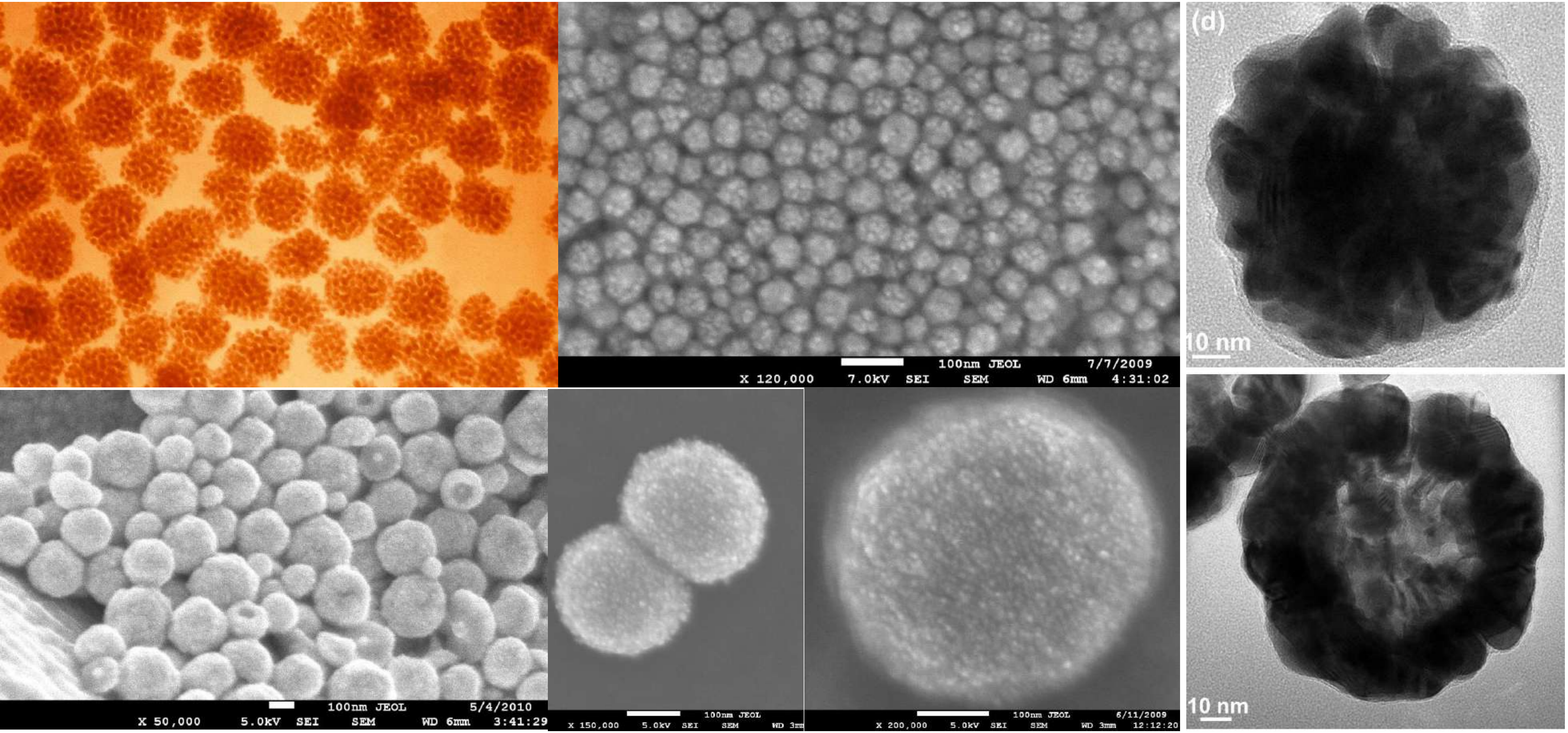
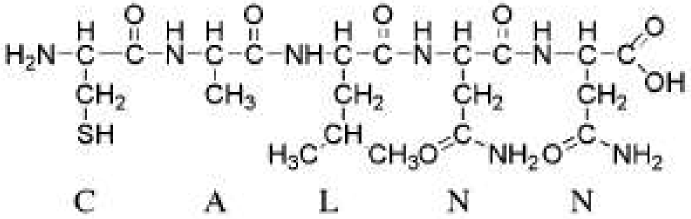


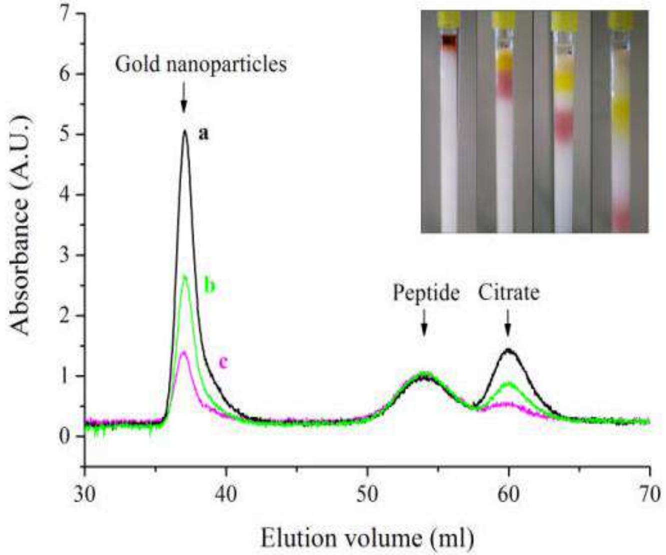
Hussain and Wang *et. al.*, ***Langmuir***, **2006**, 2941; Hussain *et. al.*, ***J. Colloid & Interface Science***, **2010**, 350, 368; Ayesha and Hussain et al., ***Material Letters***, 2013, 95, 78; Ayesha and Hussain *et al.* ***Journal of Colloid & Interface Science***, *2015, 446, 59.*

Peptide Coated Highly Stable Gold Nanoparticles

These peptide coated gold nanoparticles

- **Can be freeze-dried to store as re-dispersible powders**
- **Purification and size separation by size-exclusion chromatography**
- **Highly stable under extreme biological conditions**
- **Protein chemistry unchanged, so very useful for bio-conjugation and recognition purposes**

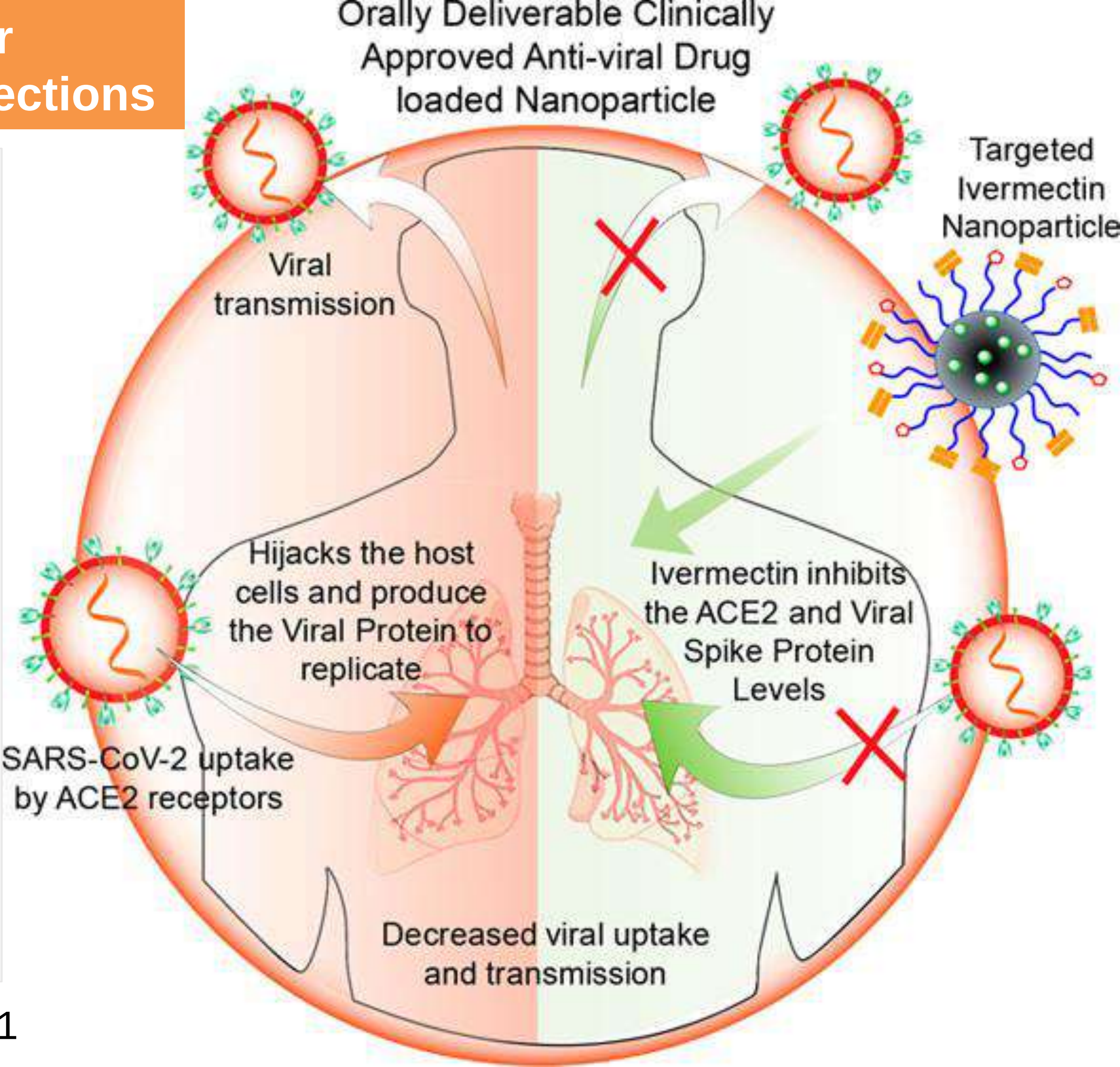




Levy and Hussain *et. al*., ***J. AM. CHEM. SOC***., 2004, 126, 10076

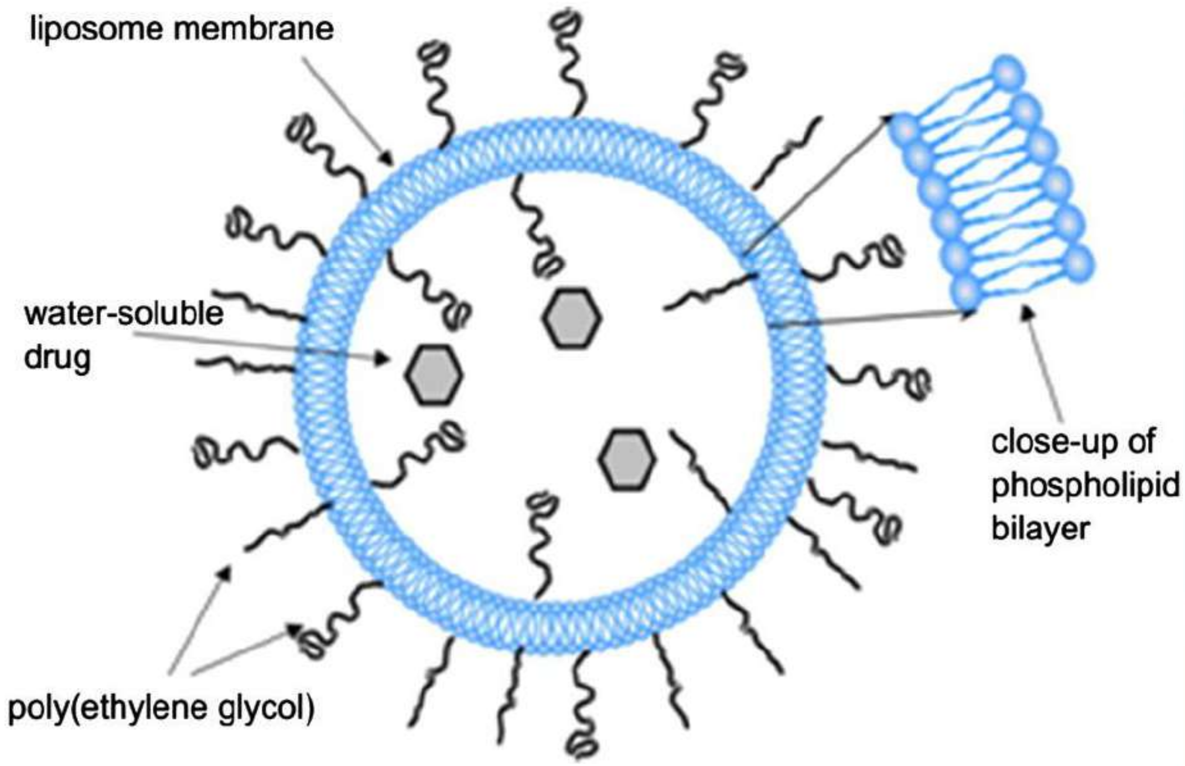
Ivermectin Loaded Polymer Nanoparticles to Treat COVID Infections

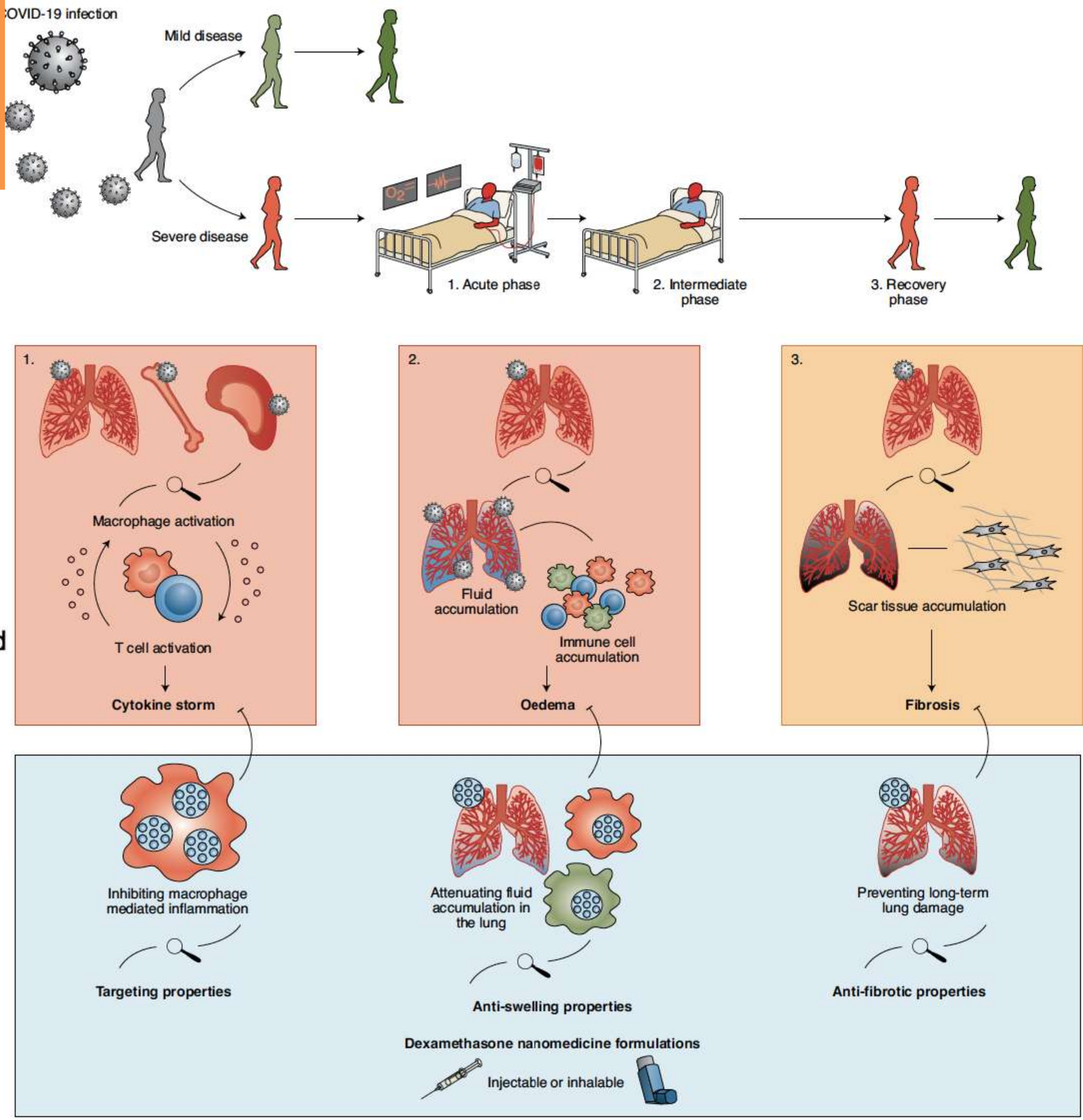
Ivermectin (FDA approved antiviral drug) packaged in orally administrable nanoparticles can serve as a vehicle to deliver a more potent therapeutic antiviral dose & demonstrate its efficacy to decrease expression of viral spike protein & its receptor angiotensin-converting enzyme-2 (ACE2) that are keys to lowering disease transmission rates. Polymer nanoparticles tagged with an Fc immunoglobulin fragment, to facilitate their transport from gut epithelial barrier to reach the bloodstream, have great potential in this regard.



ACS Pharmacol. Transl. Sci. 2020, 3, 1371

Liposomal Dexamethazone as Anti-COVID-19 Drug





Journal of Controlled Release 2014, 190, 624;
Nature Nanotechnology 2020, 15, 618

NPs-Assisted Delivery of Antiviral-siRNA as Inhalable Treatment for Human Respiratory Viruses: A Candidate Approach against SARS-COV-2

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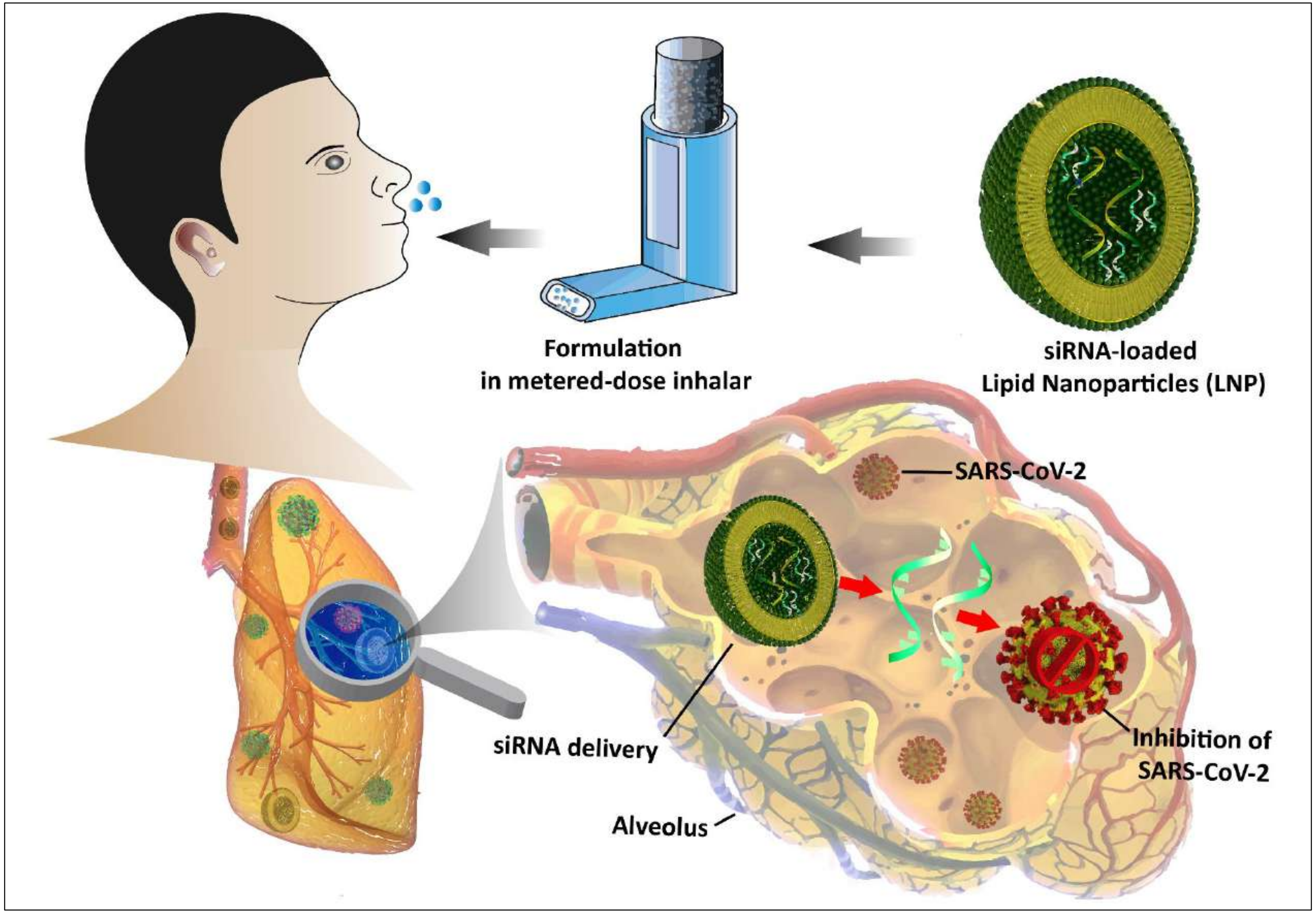
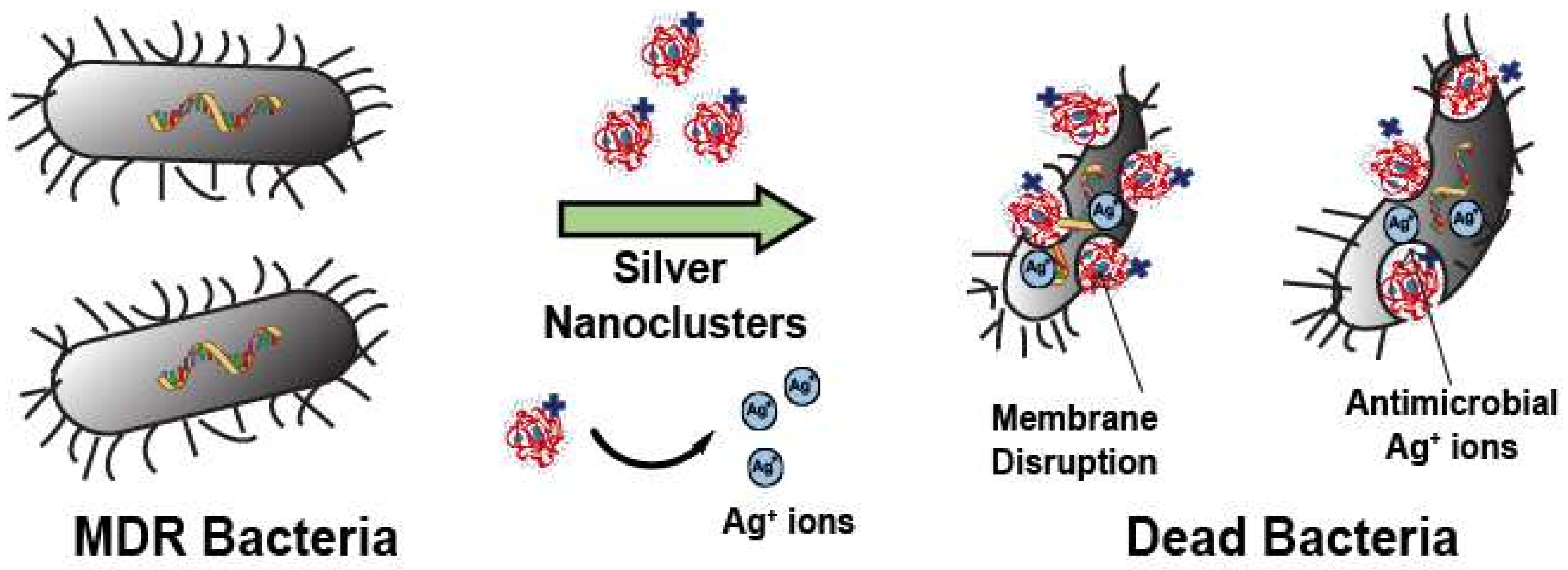
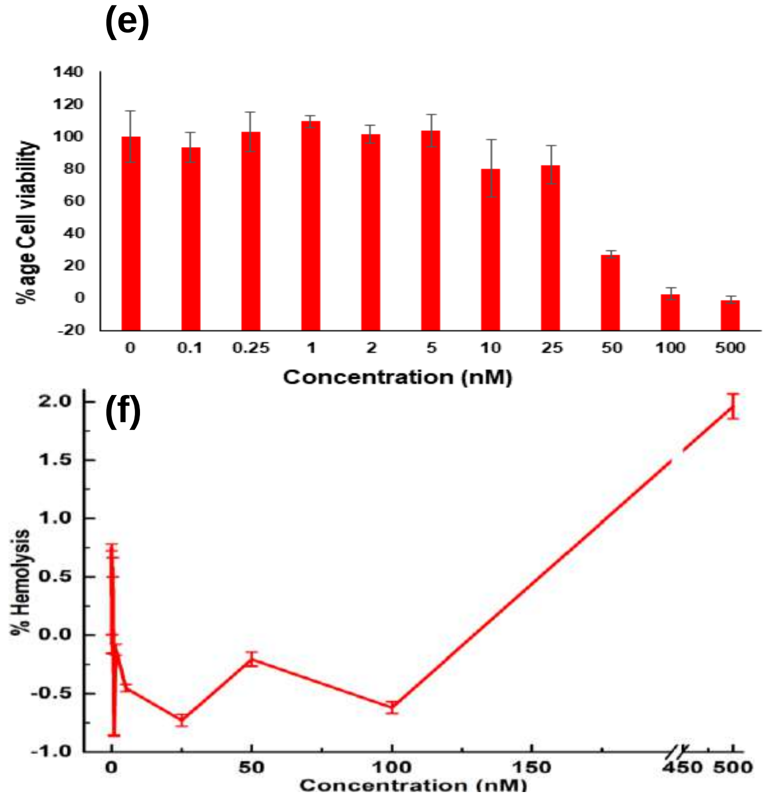
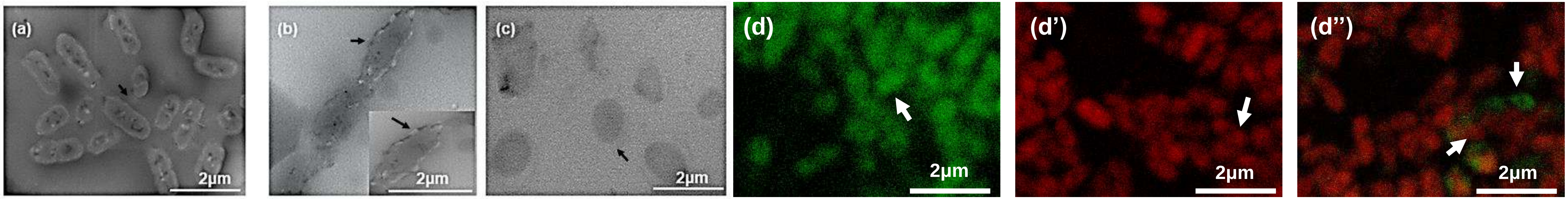


Ata Ullah and Asma Rehman *et. al*., ***Nano Select***, **2020**, 1, 612

Cationic Ag NCs to Combat MDR in Bacteria

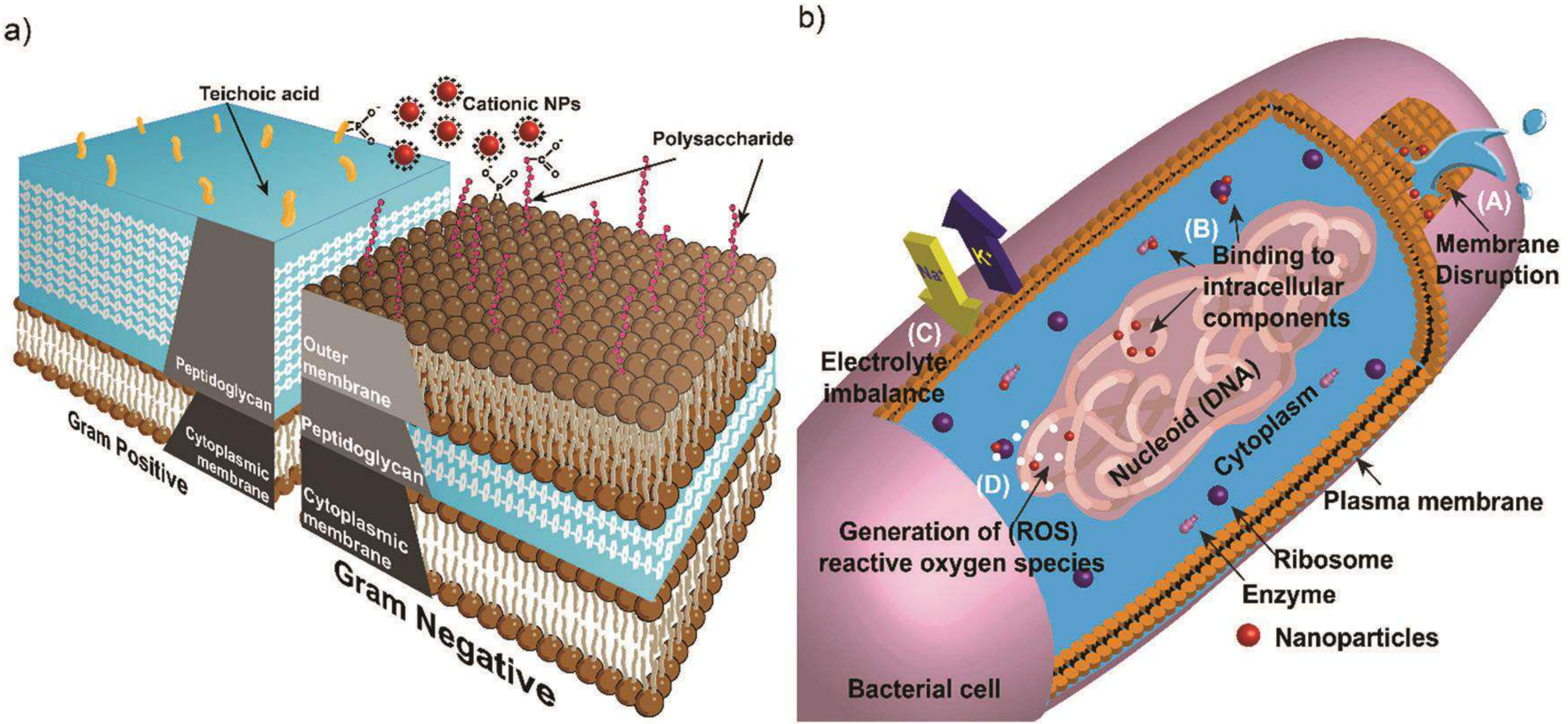






Huma et al., ACS Omega 2018, 3, 16721

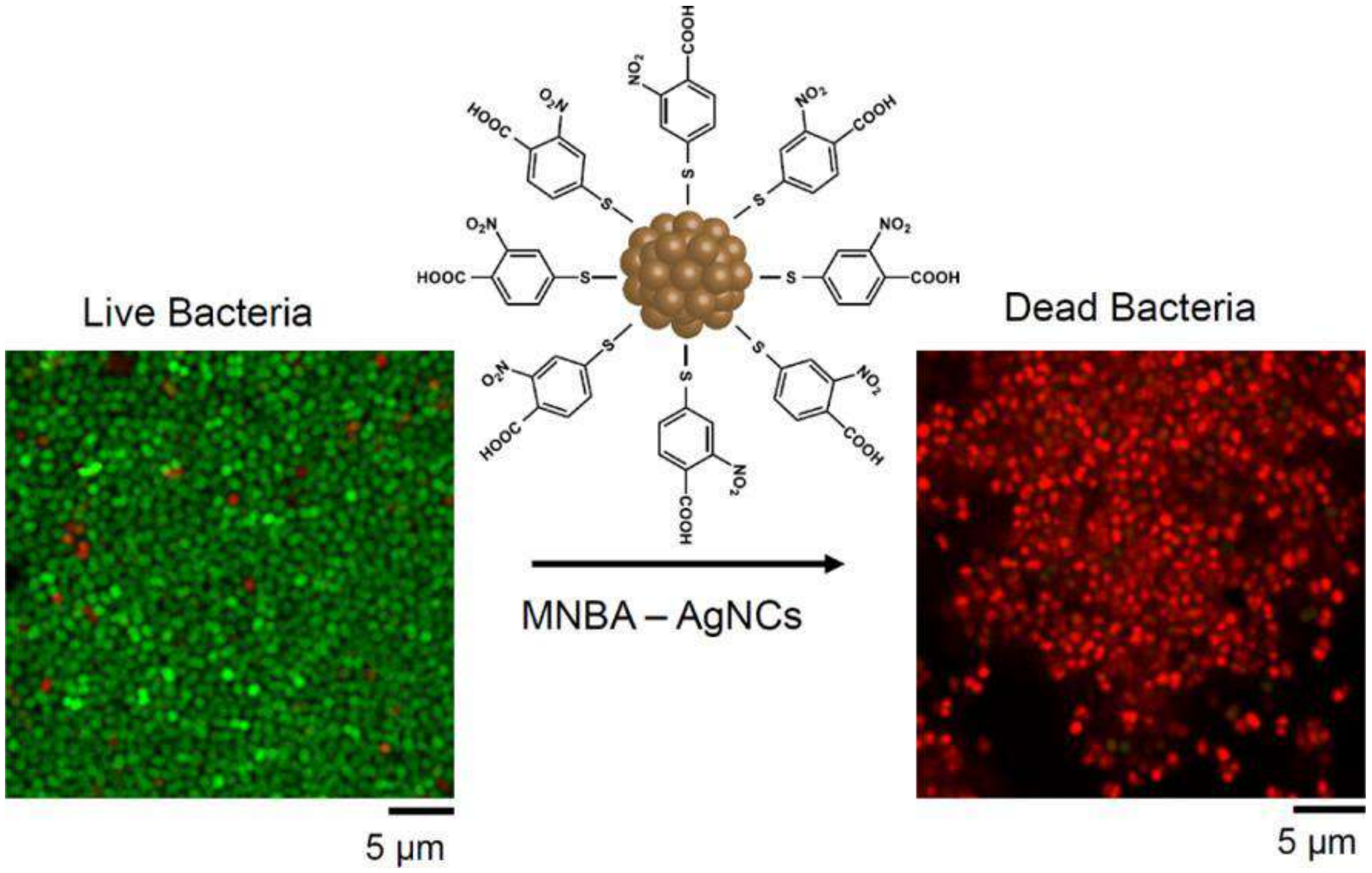
Nanomaterials to Address MDR - related Issues



Akash & Shazia, *et. al.*, ***Chem Soc Rev.***, 2019, 48, 415

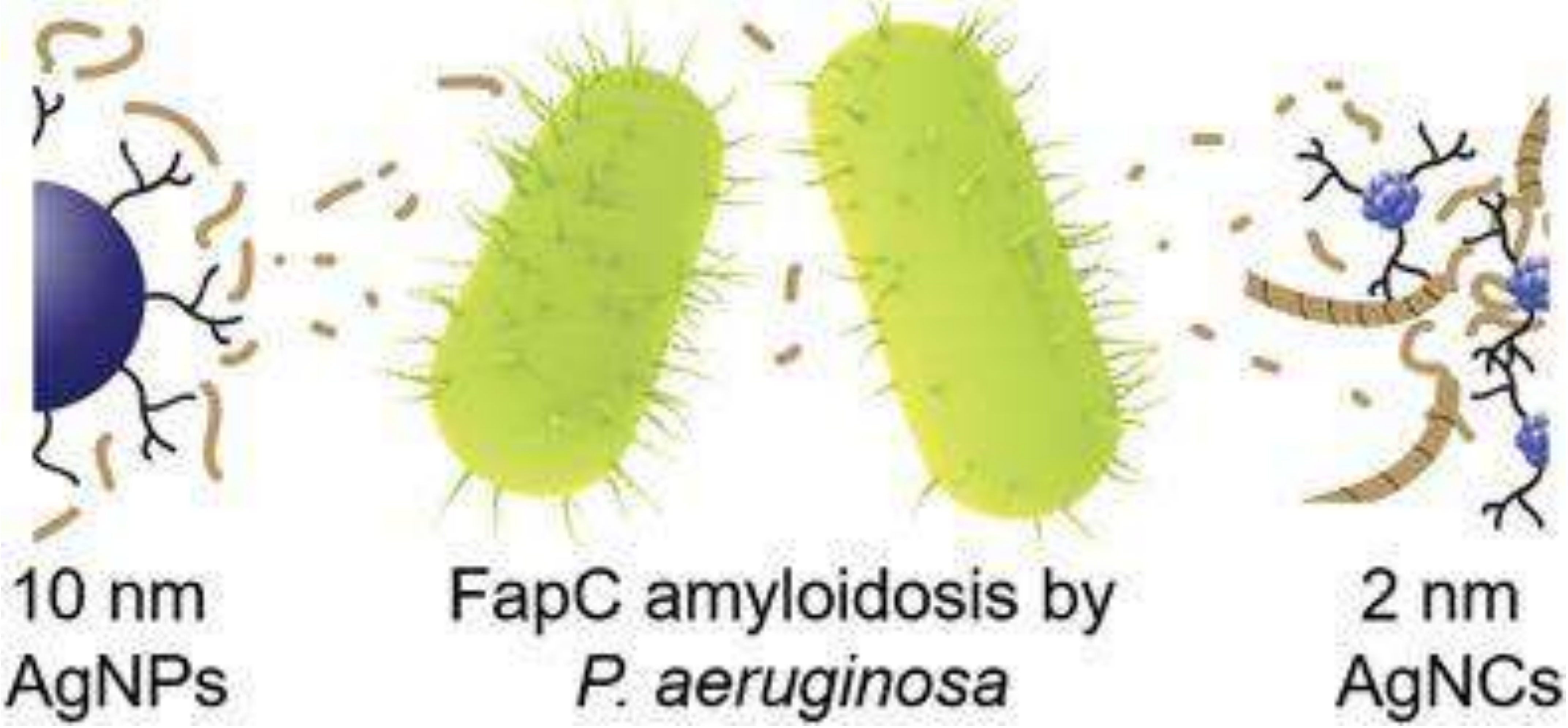
Ag_{44} NCs - Antimicrobial to Address MDR

MNB coated Ag_{44} NCs are found very effective to treat sexually transmitted infections causes by Multidrug resistant bacteria i.e., *Neisseria gonorrhoeae* at doses non-toxic to mammalian cells (in vitro studies.



Maria et al., ***ACS Applied Materials & Interfaces***. 2020, 12, 27994

Nanosilver Mitigates Biofilm Formation via FapC Amyloidosis Inhibition



Antibiofilm potency of Ag NPs correlates with their capacity of FapC fibrillization inhibition

Huma et. al., *Small* 2020, 16, 1906674

Emulsion-Templated Porous Materials for Environmental Remediation

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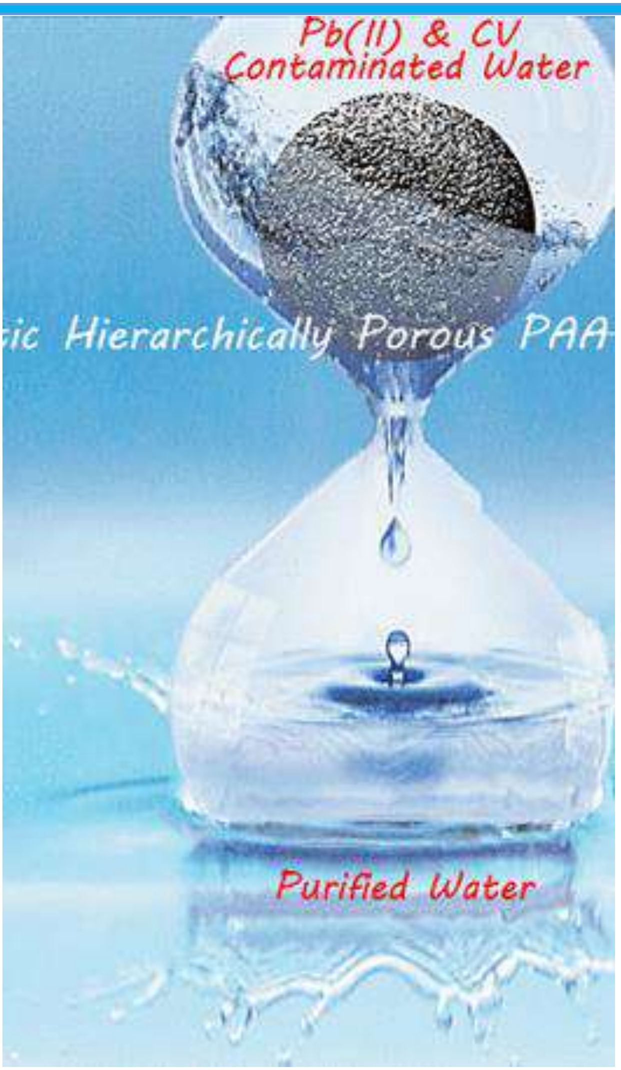

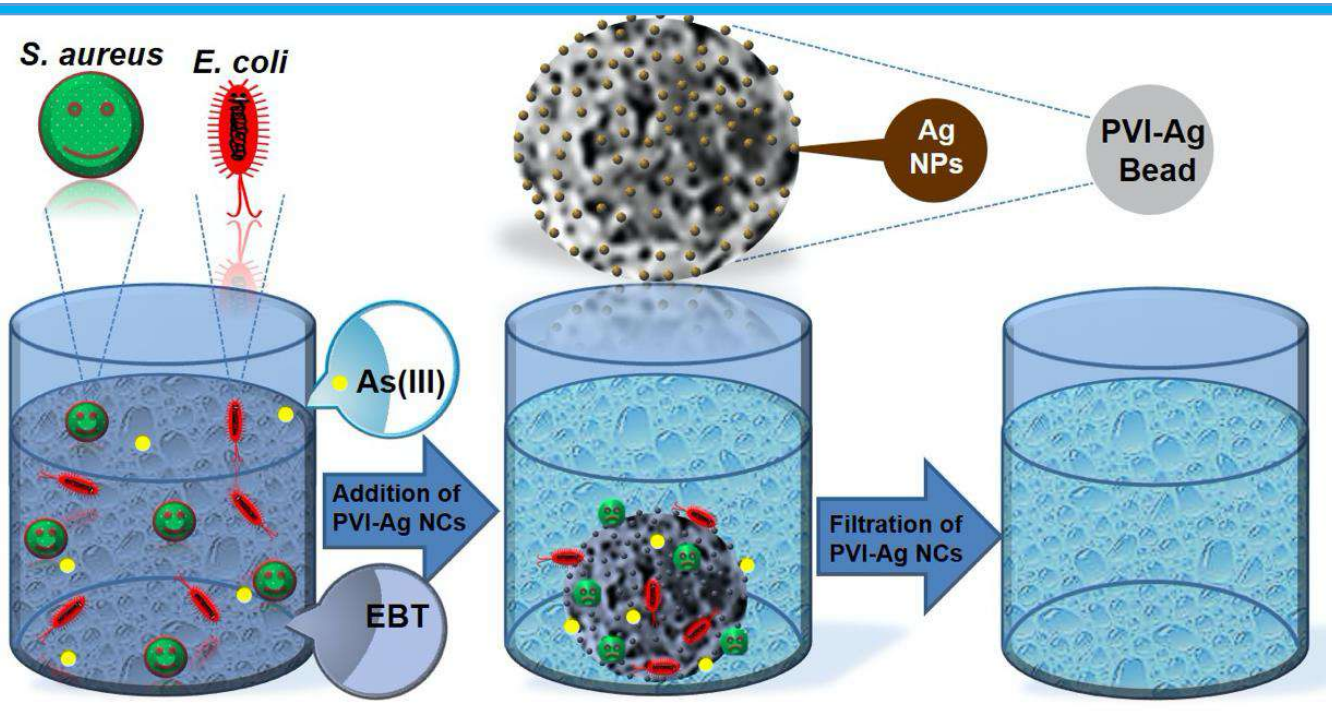

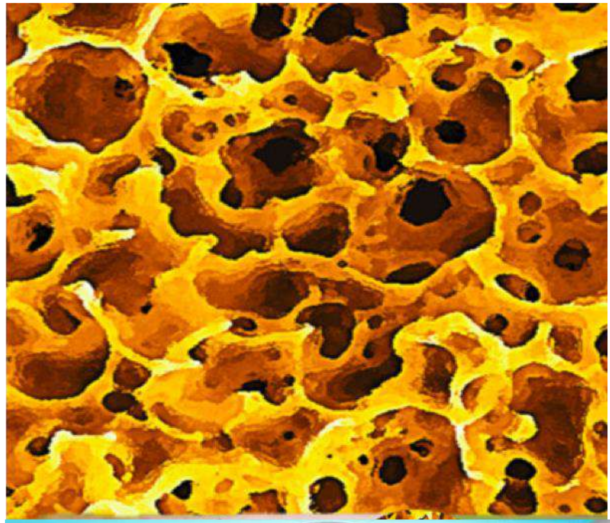

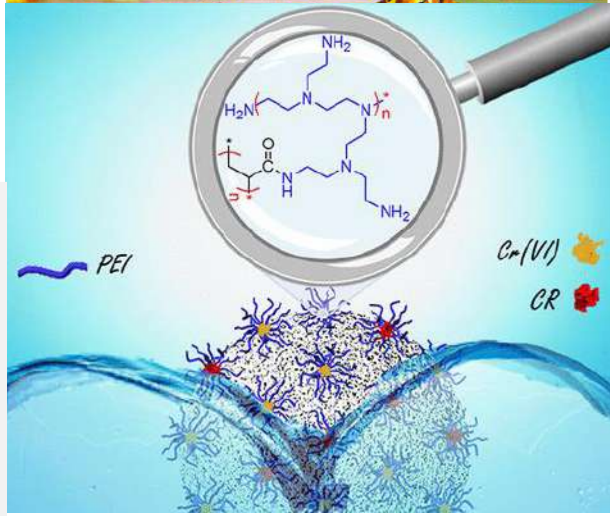

The control over the surface chemistry and porosity of hirerarchically porous polymer/composite helps to develop customised adsorbents for the effficiccient removal of organic and inorganic pollutants

Mudassir et al. ***ADVANCED SCIENCE*** 2021 (in press); Mudassir et al. ***ACS Applied Materials & Interfaces 2021, 13, 27400***; Mudassir et al. ***ACS Applied Materials & Interfaces*** 2017, 9, 24190; Mudassir et al. ***Langmuir*** 2019, 35, 13165; Mudassir et al. ***Langmuir*** 2019, 35, 8996; ***RSC Advances*** 2018, 8, 29636.

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NIBGE, Faisalabad: Nanobiotech group and other collaborators …

SBASSE, LUMS: Functional nanomaterials group and other colleagues …..

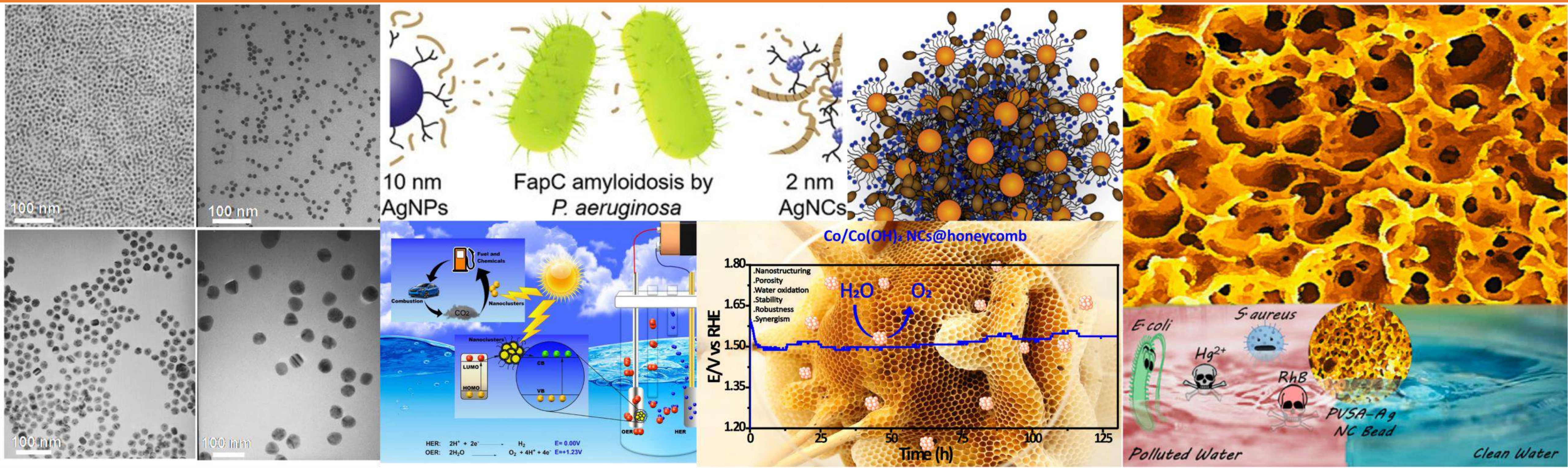
UMass, Amherst: Prof. Vincent Rotello's group

EPFL, Lausanne: Prof. Francesco Stellacci's group

Philipps Uni. Marburg: Prof. Wolfgang Parak's group

KAUST, KSA: Prof. Osman Bakr's group

FUNCTIONAL NANOMATERIALS GROUP – IRSHAD HUSSAIN



Hussain et al., *Langmuir* 2003, 19, 4831; Levy & Hussain et. al., *J. AM. CHEM. SOC.* 2004, 126, 10076; Zhang & Hussain *et al.*, *Nature Materials* 2005, 4, 787; Hussain & Tan et. al., *J. AM. CHEM. SOC.* 2005, 127, 16398; Wang & Hussain et al., *Langmuir* 2006, 23, 885; Zhang & Hussain et al., *Angew. Chem. Int. Ed*. 2008, 47, 4573; Zhang & Hussain *et al.*, *Adv. Mater*. 2004, *1*, *27;* Zhang & Hussain *et. al.*, *Chem. Commun*. 2006 , 2539; Roth & Hussain *et. al.*, *Chem. Commun*. 2004, 1532; Roth & Hussain *et. al.*, *J. Electroanal. Chem*. 2005, 581, 79; Hussain & Wang *et. al.*, *Langmuir* 2006, 2941; Kanaras & Hussain *et. al.*, *Small* 2007, 1, 67; Hussain *et al* *Langmuir* 2009, 25, 1934; Hussain *et. al.*, *Nanoscale* 2010, 2, 2575; Asma & Hussain *et. al.*, *JCIS*, 2010, 350, 368; Rotello & Hussain *et al.*, *Langmuir* 2012, 28, 2023; Tan & Hussain *et al*. *Chem Commun.* 2012, 48, 567; Tan & Hussain *et al*. *J. Phys Chem C*, 2012, 116, 448–455. Khan & Hussain *et al.*, *IJHE* 2013, 38, 2332; Lina & Hussain *et al.*, *J. Mater. Chem. A* 2013,1, 10148. Bien & Hussain *et al*. *J. Mater. Chem. B* 2013, 1, 2874; Sumaira & Hussain *et al.*, *Cellulose* 2014, 21, 395; Yang & Hussain *et al.*, *J. Mater. Chem. A* 2014, 2 11930; Maria & Hussain *et al.*, *Biosens. & Bioelect*. 2014, 52, 242; Yan & Hussain *et al.*, *Mol. Chem. Phys*. 2014. 215, 1257; Carolina *et al.*, 2014, *CoChE* 2014, 4, 88; *J. Mater. Chem. A* 2015, 3, 6542; Javed *et al.*, *J. Mater. Chem. B* 2015, 3, 8356; Rehman *et al.*, *Analyst* 2015, 140, 7366; Wei *et al.*, *RSC Advances* 2015, 5, 92017; Song *et al.*, *Dalton Transactions* 2015, 44, 13906; Javed *et al.*, Ayesha *et al.*, *J Colloid Interfac Sci* 2015, 446, 59; Wang *et al.*, Aamer *et. al.*, Espinosa *et al.*, *RSC Advances* 2016, 6, 23310; *Colloids & Surfaces B* 2016, 141, 1-9; *Nanoscale* 2016, 8, 9695; *RSC Advances* 2016, 6, 81569; *CHEMCATCHEM* 2016, 8, 1671; *JMCB* 2016, 4, 6240; *Colloids and Surfaces A* 2016, 508, 301; *RSC Advances* 2016, 6, 94896; *JMCB* 2017, 5, 742, *Int. J. Biol. Macromol* 2017, 95, 138; *Materials Letters* 2017, 192, 56; *Chem Select* 2017, 2, 7497; *RSC Advances* 2017, 7, 42900; *JMCB* 2017, 5, 5608, *ACS AMI* 2017, 9, 24190; *Journal of Physics D* 2017 (*In press*); *Int. J. Biol. Macromolec.* 2017, 95, 138; *Int. J. Biol. Macromolec.* 2017, 102, 170; *Science Advances* 2017, 3, e1602610; *Chem. Commun*. 2017, 53, 12306; *Nanomedicine*, 2018, 13, 25; *Colloid and Surfaces A* 2018, 539, 391; *Scientific Reports* 2018, 8, 13304; *Int. J. Nanomedicine* 2018, 13, 3145; *Journal of Hazardous Materials* 2019, 364, 441; *ACS Omega* 2018, 3, 16721; *ACS Applied Energy Materials* 2018, 2, 363; *Microchimica Acta* 2019, 2019, 186, 127; *ChemSusChem* 2019, 12, 1517; *Nanoscale* 2019, 11, 1286; *Chemistry - A European Journal* 2019, 25, 548; *ACS Applied Nanomaterials* 2018, 2, 546; *Microchimica Acta* 2019, 186, 127; *Chem. Soc. Rev*. 2019, 48, 415; *Nature Communications* 2019, 10, 676; *Langmuir* 2019, 35, 13165; *Nanoscale Adv*. 2019, 1, 2924; *Cell Cycle* 2019, 18, 2281; *ChemSusChem* 2019, 12, 5117; *Langmuir* 2019, 35, 13165, *Chemistry - A European Journal* 2020, 26, 11209; *Small* 2020, 16, 1906674; *Electrochimica Acta* 2020, 341, 136032; *JMCB* 2020, 8, 8444; *ACS-AMI* 2020, 12, 27994; *ACS-AMI* 2021, 13, 468; *Nanophotonics* 2021, 10, 1595; *Nanomedicine* 2021, 16, 819; *J. Mol. Liquids* 2021, 333, 115972; *RSC Advances* 2021, 11, 19755; *Mater. Sci & Eng. B* 2021, 271, 115257; *Macromolecules* 2021, 54, 5848; *ACS AMI* 2021, 13, 27400; *Nanoscale* 2021, 12, 14207; *ACS Applied Energy Materials* 2021, 8685; *Advanced Science* 2021, 2102540; *Nature Communications* 2021, 1; *Energy Conversion and Management* 2022, 254, 115262; *Journal of Electroanalytical Chemistry* 2022, 905, 115977; *IJHE* 2022, 47, 36118; *NanoImpact* 2022, 28, 100419; *ChemistrySelect* 2022, 7, e202202774; *JALCOM* 2022, 932, 167647; *IJHE* 202248, 4719; *J. Env. Chem. Eng*. 2022, 11, 109185; *ACS Applied Nanomaterials* 2023. 6 (3), 1631; *J. Mol. Liq.* 2023, 376, 121438; *RSC Advances* 2023, 13, 4932; *Advanced Therapeutics* 2023 (in press); *Nature Communications* 2023 (under revision).

DESIGN AND SYNTHESIS OF NANOMATERIALS FOR BIOMEDICAL AND ENERGY APPLICATIONS

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NanoBio Lab, Institute of Materials Research and Engineering, USA

ABSTRACT

Nanostructured materials can be designed with sophisticated features to fulfill the complex requirements of advanced material applications. Our laboratory has developed organic and inorganic nanoparticles and nanocomposites for advanced drug delivery, antimicrobial, stem cell culture, and tissue engineering applications. In addition, we have nanofabricated microfluidic systems for drug screening, *in vitro* toxicology, and diagnostic applications. The nanosystems allow for the rapid and automated processing of drug candidates and clinical samples in tiny volumes, greatly facilitating drug testing, genotyping assays, infectious disease detection, point-of-care monitoring, as well as cancer diagnosis and prognosis.

We have also synthesized metallic, metal oxide and semiconducting nanoclusters, nanocrystals and nanosheets of controlled dimensions and morphology. The nano-sized building blocks are used to create multifunctional systems with excellent dispersion and unique properties. Nanoporous materials of a variety of metal oxide and organic backbone have also been created with high surface areas and well-defined porosities. These nanostructured materials are successfully tailored towards energy and sustainability applications.

** *Institute of Materials Research and Engineering*
31 Biopolis Way, The Nanos, Singapore 138669
https://jyyinglab.net
E-mail: jyying@imre.a-star.edu.sg

THE MULTIDISCIPLINARY BS DEGREE IN NANOSCIENCE AND NANOTECHNOLOGY: ITS GROWING ACADEMIC AND SOCIO-ECONOMIC IMPORTANCE

N. M. BUTT FIAS
Professor & Chairman, Preston Institute of Nano Science & Technology (PINSAT), Preston University Kohat, Islamabad Campus, Pakistan

ABSTRACT

Nanotechnology is the new and fast growing technology of great socio-economic and strategic importance. It is applied to almost all kinds of industries; may be Energy, Defense, Space, Oil and Gas Exploration, Mineral Development, Clean drinking water, Pharmaceuticals, Healthcare and Medicine, Electronics, IT, Environment, Climate Change Mitigation, Consumer goods industry or whatever.

It is the technology where materials of very small sizes, the sizes of atoms and molecules or the sizes at nanoscale(10^{-9}m) are used in the industrial products and that greatly adds value to the relevant industrial products both in terms of quality and the efficacy of the production. The nanoscale of materials used for nanotechnology is normally considered involving material sizes of up to 100 nanometers. One nanometer(nm) being one billionth of a meter(10^{-9}m).

Nanotechnology is seen with such a high industrial potential that it is regarded as an INDUSTRIAL REVOLUTION of 21st Century. This aspect is reflected in the fact that advanced countries like USA, Japan, EU, China etc. are investing billions of dollars annually in a global race of socio-economic power dominance.

USA for example from 2001 to 2021, has invested over 38 billion dollars on nanotechnology, including **1.98** billion dollars for the year 2022. The political leaders of advanced countries have supported Nanotechnology programs on **NATIONAL LEVEL** to give it serious considerations.

Regarded as an ***Industrial Revolution*** *the applications of nanotechnology to various industries is expected to last for several decades in future, some business experts estimating the global marketing potential of 2-3 trillion dollars of nano-based products.*

Keeping this importance in view it is pertinent that a **Nano-specific qualified and trained HUMAN RESOURCE must be produced to best utilize their training and experience**. Such specific human resource is needed in all spheres of employment, not only in Industries and in Academia but also in allied areas of employment like Legal and IPR fraternity who need to be familiar with nano based products during the litigation or patenting process.
To produce such human resource, the educational institutions need to adopt the curriculum in education and training of nanotechnology at all levels of education, not only at the University teaching or R&D levels but also at the college level down to the school level.

One of the important level of teaching is the undergraduate level after which the entry doors are available to higher studies in various subject specialties and the needs of Industries or R&D institutions.

In the present presentation we therefore emphasize the importance of BS level teaching at the international level as well as the national level by describing the successes achieved over the past few years of execution of such undergraduate and post graduate degree programs in Nanotechnology.

Currently several countries have designed appropriate curricula for formal degrees in Nanotechnology in natural sciences as well as engineering sciences. Such curricula, of necessity, have a multidisciplinary mixer, particularly of natural and social sciences at BS level and possibly in some countries the mixer of engineering and natural sciences is also in the offing.

It is re-emphasized that the BS level (16 years education) is a very important level as it is a feed to higher degrees and research and also directly required to the industry.

A survey showed that BS in Nanoscience and Nanotechnology degree awarding institutions in 2010 were about 30 which increased by 2017 to over 100, a threefold increase showing fast growth for proper degree qualifications in Nanotechnology area.

We have found excellent results during the last 10 years as the FIRST HAND experience of launching in Fall-2010 the 4 year BS (Nanoscience and Nanotechnology) degree at the Preston Institute of Nanoscience and Technology (PINSAT) at the Preston University Kohat, Islamabad Campus, Islamabad.

Our 65 BS (Nanoscience and Nanotechnology) graduates produced with this Multidisciplinary degree with teaching of theory and practical of 4 nano-based subjects of **Physics**, **Chemistry**, **Biology** and **Materials Science** won 59 MS/PhD fully-funded scholarships (0ver 90 %) in 12 countries, which is rare percentage globally of winning fully -funded MS/PhD scholarships by the BS graduates of a University.

In this paper, some of the successful examples of the multidisciplinary BS/MS degrees in Nanoscience and Nanotechnology in Pakistan and abroad will be discussed with available facts.

"The Multidisciplinary BS degree in Nanoscience and Nanotechnology : Its growing Academic and Socio-Economic Importance"

Prof. Dr. N. M. Butt, S.I.

M.Sc(Punjab), Ph.D(Birmingham), D.Sc(Birmingham)

Preston Institute of Nano Science and Technology (PINSAT).

Preston University Kohat,

Islamabad Campus. Islamabad.

(e-mail: nmbutt36@gmail.com)

Presentation at:

The joint IAS and COMSTECH ***,"24th International Scientific Conference on Challenges to Promote Science & Technology for Socio-Economic Development in OIC Countries",*** ICCBS,KARACHI, PAKISTAN.

March 7 – 8, 2023

Presentation Scheme on Nanotechnology in Pakistan.

1 .First Ever Initiation: 1995 (Lecture on New Materials at PINSTECH- N.M.Butt)

Important Support by Professor Atta Ur Raman as Federal Minister & Chairman HEC.

2. Second Initiative : Formal NanoEducation - 2010 :

Multidisciplinary BS (Nanoscience &Nanotechnology) Degree.

Excellent Successful Outcome-10 Years Experience.

(All Times Support: Dr.Abdul Basit –Chancellor Preston University}

3.Important Financial Support :

- International Development Research Centre-IDRC (Canada)[2011-2013]

- Pakistan Academy of Sciences (PAS): 3 Research Grants-:(2011-13) , (2014-16),(2018-20)

****

Nanotechnology in Pakistan.

(i). 1995:First time in Pakistan referred the word "Nanotechnology" used by Tani Guchi's paper of 1974 on "Transistor fabrication".
(Ref: Invited Lecture on Biomaterials, PINSTECH,Islamabad 1995) N.M.Butt .

(ii). 2001: Conference on Nanotechnology, COMSATS Institute of Information Technology (CIIT), Islamabad, 2001. Invited Lecture-N.M.Butt

(iii) 2002: Nanotechnology: An Overview ,The 12th IAS Conference , Islamabad , October 14-17, 2002. Invited Lecture IAS Conference Islamabad.

(iv) 2003:Nanotechnology:The Key Technology :, Islamabad, July 31, 2003:
Pakistan Academy of Sciences PAS –Invited Lecture=N.M.Butt

****

Important National level Support

by

Professor Atta-ur-Rahman , Minister of S&T, Govt of Pakistan

Approval of (i)Rs 36 Million for administration and (ii) Rs 945 million for Research Projects of 5 Universities/Institutes

to

"National Commission on Nano-Science and Nano-Technology"

(Chairman :Dr.N.M.Butt 2003-2008)

****

Now (2023)nanotechnology Research is in almost all Science Universities of Pakistan.

First PC-1 Draft of Nanotechnology corrected by Professor Atta-ur-Rahman in his own hand writing during our Air-travel from Islamabad to Karachi - Sept 2003

PC-I

PLANNING COMMISSION
GOVERNMENT OF PAKISTAN

Development of Nano-Science and Nano-technology

Formulation of National Nano-science and Nano-technology Policies/Action Plan and its Implementation in Pakistan

Pakistan Council of Scientific and Industrial Research (PCSIR)
(Ministry of Science & Technology)

PINSTECH NED PCSIR RAU NED

(September 2003)

Prepared by:	Javaid Dr. Javaid Bashir Principal Scientific Officer PINSTECH, P.O. Nilore Islamabad Ph:- 9290231/3142 Fax:- 9290275 E-mail:- jbashir@pinstech.org.pk
Checked by	N. M. Butt Dr. N. M. Butt, Chairperson, National Commission on Nano-technology (NCN), Islamabad. Ph:- 2207265 Fax:- 9290275 E-mail:- nmbutt@pinstech.org.pk
Approved by	Dr. Anwar-ul-Haq Chairman PCSIR, Islamabad, Ph:- 9258336 Fax:- 9258167 E-mail:- anwar@comsats.net.pk

Annex-I

Annual phasing and financial requirements of the Project					
Sr. No.	Item	Financial Distributions			
		First Year	Second Year	Third Year	Total
1.	Post-doctoral Fellowships, Lab. Equipment, Research Grants etc.	5.000	5.500	5.500	16.000
2.	Conferences, Workshops, Scientific Visits etc.	2.000	2.000	1.500	5.500
3.	Books and Journals	0.000	0.500	0.500	1.000
4.	Establishment charges (Annex. IV)	1.864	1.864	1.864	5.592
5.	Office Equipment and accessories (Annex-V)	2.000	0.500	0.500	3.000
6.	Vehicles, POL, maintenance etc (Annex-VI)	1.000	0.500	0.500	5.000
7.	Contingencies (unforeseen/ miscellaneous etc.)	0.600	0.600	0.600	1.800
	Total	11.964	10.964	11.964	34.892

Corrections of budget figures of PC-1 by Professor Atta-ur-Rahman as Federal Minister of Science & Technology , Govt of Pakistan

HIGHER EDUCATION COMMISSION
H-9, ISLAMABAD, PAKISTAN Website: http://www.hec.gov.pk

Prof. Dr. Atta-ur-Rahman
Nishan-i-Imtiaz, Hilal-i-Imtiaz, Sitara-i-Imtiaz, Tamgha-i-Imtiaz
UNESCO Science Laureate
Chairman
(Federal Minister)

No. 1—1 /CHR/HEC/03/ 2760
September 30, 2003

My dear doctor sahib, السلام علیکم

I shall be grateful if the PC-I is revised and sent back to me urgently. It should cost Rs. 36 million after the following changes have been incorporated:

1.	12 Post-doctoral Fellowships @ US$ 25,000/year = US$ 300,000/-	Rs. 18 million approx.
2.	Lab. Equipment = US$ 200,000/- =	Rs. 12 million
3.	Others (as in your PC-I) =	Rs. 6 million
	TOTAL:	Rs. 36 million

With kind regards,

Yours sincerely,

Prof. Dr. Atta-ur-Rahman

Dr. N. M. Butt
House No.155
Street-15, Sector E-7
Islamabad

Email: chairman@hec.gov.pk Ph: +92 51 9290129-30, Fax +92 51 9290128

Research Projects-Pakistan-2004

First Time Funds for Research Projects in Nanoscience and Nanotechnology approved by Prof. Atta-ur-Rahman as Federal Minister of S&T /Chairman HEC .

No.	Project	Institution	Rs million	Funded by
i.	Synthesis and Characterization	PIEAS	60	HEC
ii.	Nano-magnetism	QAU	137	HEC
iii.	Micro/Nano electronic devices	CIIT	189	HEC
iv.	Nano-Composites	GIK Private Inst.	195(not released)	HEC
v.	Nano-biotechnology	NIBGE	155	MoST
Vi	Nano-devices, L.E.D. etc	PINSTECH	196	MoST
vii.	Nano Coating	PCSIR Lhr	13	MoST
	Total : US$ 15million		945	

Scientific & Socioeconomic Importance

Scientific & Socioeconomic Importance

- **Scientific:**
  - **Surface** to **Volume** Ratio of Particles
  - **Quantum** Science at nano scale.
  - **Properties** at Bulk scale very Different from Nanoscale.
  - **Multidisciplinary**
- **Socio Economic:**
  - **Society**— **Public Acceptance**
  - **Economy-** Investment and Industry
  - **Safety**,Standards and **Regulations.**
  - Intellectual Property Rights **(IPRs).**

GLOBAL IMPACT

- **Applications of nanotechnology have developed.**
- **Potential of 3.1 trillion dollar market by 2020. It was $147 billion products in 2007 and 1 Trillion $ in 2013.(www.luxresearchinc.com).**

- **2586 nanoproducts already in the market by Nov 2009 (Ref: Helmut Kaiser Consultancy, Germany).**

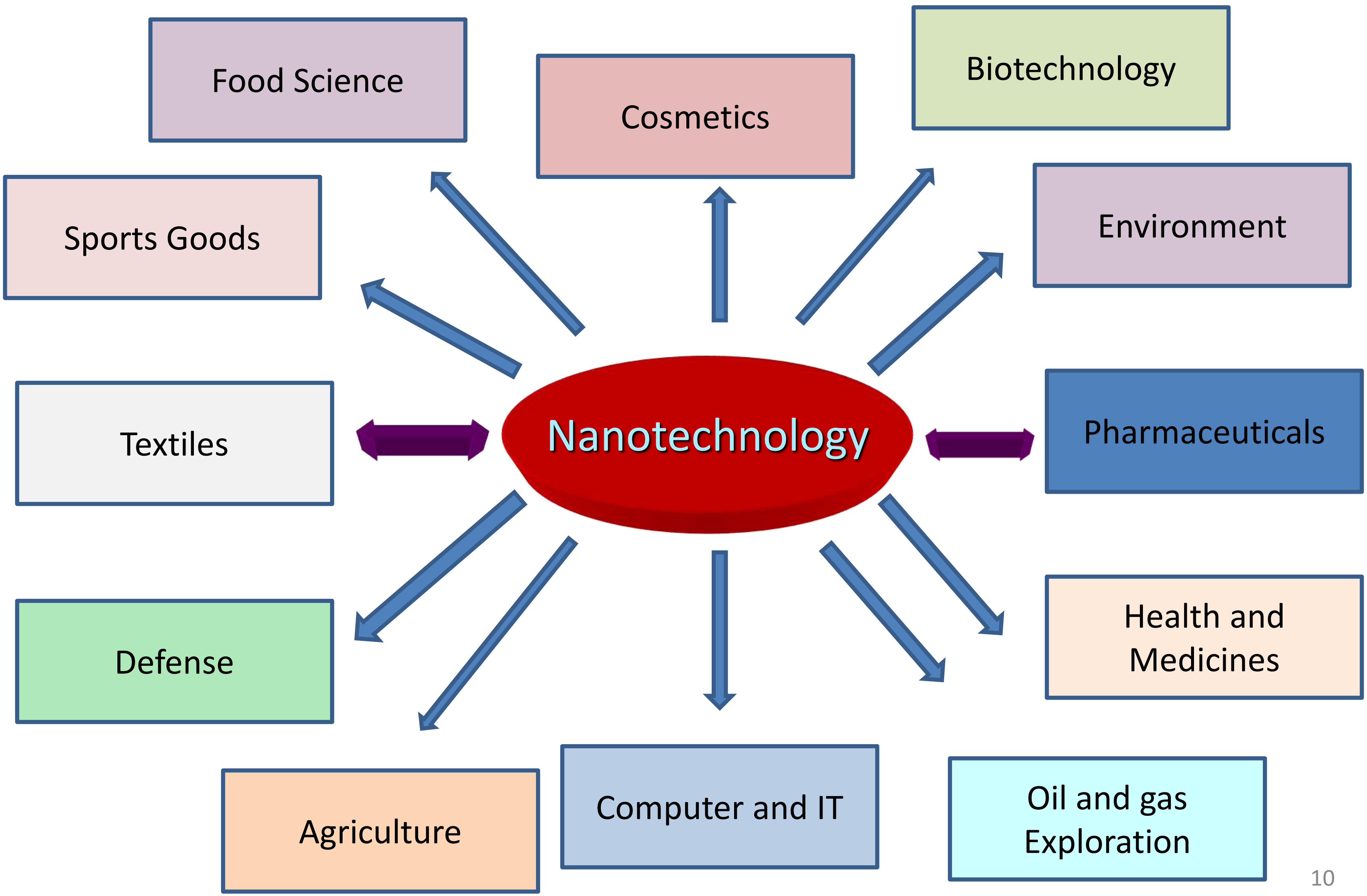
- **Another *"Industrial Revolution"* in the making & Part of 4th Industrial Revolution:**

including (i)robotics, (ii)artificial intelligence,(iii) **nanotechnology**,(iv) quantum computing,(v) biotechnology, (vi)The Internet of (IoT), (vii)decentralized consensus, (viii)3D printing and (ix)autonomous vehicles. **World Economic Forum(WEF):**

- **Profound effect on the socio-economic scenario of the world for 40-50- years.**

Nanotechnology and Industries :

Need of Nano-Qualified Graduates



Career in Nanotechnology

1. Electronics/semiconductor industry
2. Materials science including textiles, polymers, packaging.
3. Auto and aerospace industries
4. Sports equipment
5. Pharmaceuticals including drug delivery, cosmetics.
6. Biotechnology
7. Medical fields
8. Optoelectronics
9. Environmental monitoring and control
10. Food science including quality control and packaging
11. University lab research/R&D in govt and private research Institutes
12. National security
13. Military
14. Agriculture
15. Academic & Teaching
16. Forensic science & many other new industries emerging as a result of advances in nanotechnology.

http://www.nnin.org/nnin_careers.html

➢ NEED FOR Formal NANO EDUCATION : Why ?

1. Nanotechnology as INDUSTRIAL REVOLUTION to influence the Socioeconomic Structure of Society for next 40-50 years.
2. To meet the needs of industry, R & D Institutions, Universities, IPRS. Patent offices, Legal offices, Society Awareness etc,
3. There is a dire Need of properly qualified and trained Human Resource in nanotechnology for their best contributions : essential for all countries .

Nano-Human Resource Development

Nano Degree Programs Worldwide

Country wise Breakup: BS-MS-PhD

Country	BS	MS	PhD	Country	BS	MS	PhD
Australia	12	05	2	Malaysia	02	01	01
Belgium	-	02	-	Mexico	09	07	06
Brazil	03	04	03	Netherlands	-	05	03
Canada	09	01	01	New Zealand	02	01	-
Czech republic	01	01	-	Norway	03	04	-
Denmark	05	05	05	Russia	05	05	-
Egypt	-	02	-	Singapore	01	-	-
France	-	10	09	Spain	01	03	-
Pakistan	01	04	01	Singapore	01	01	01
Germany	07	05	01	Poland	02	02	01

Greece		01	-	Switzerland	01	02	02
Sweden	02	04	-	U S A	14	10	09
Hong kong	-	01	01	Taiwan	-	02	01
Srilanka	-	-	01	Hongkong	-	-	01
India	03	28	06	Thailand	01	03	02
Ireland	02	-	-	Turkey	01	07	06
Israel	-	04	03	UK	04	15	07
Japan	-	01	01	Egypt	-	02	-
Italy	-	01	-				
Korea	08	06	02	Total	100	155	76

Some International Nanotechnology Multidisciplinary BS Degree Programs: 2010=30, 2016=100

1. **Universidade Federal do Rio de Janeiro - Bachelor Program Nanoscience and Nanotechnology (Brazil)**

The Nanotechnology undergraduate course at the Federal University of Rio de Janeiro was created in 2010. After teaching the basic concepts of **chemistry, physics and biology,** students will learn concepts of nanotechnology applied to one of the three specific areas:

2. **University Hamburg - Bachelor in Nanosciences (Germany)**

Fächern Chemie, Biochemie und Molekularbiologie, Informatik, Mathematik und Physik.

3. **University of Aarhus - Bachelor's Program in Nanoscience (Denmark)**

During the first three years, students receive basic interdisciplinary training in physics, chemistry, biology, molecular biology, mathematics, and computer science. In addition, a number of courses address issues specific to the nano-area.

4. **University of Basel - Bachelor of Science (BSc) in Nanosciences (Switzerland)**

The University of Basel is the first Swiss university to provide a programme in nanosciences. From the very beginning of studies, the interdisciplinary curriculum in nanosciences combines the three disciplines **of biology, chemistry and physics** nto the word of nano systems. After three years a BSc with a Major in Nanosciences can be awarded.

5. **University of Chicago - B.Sc. in Molecular Engineering (USA)**

The BS degree program in Molecular Engineering offers undergraduates a cutting-edge engineering curriculum built on a strong foundation in **mathematics, physics, chemistry, and biology**

6. **University of Leeds - BSc Nanotechnology (UK)**

You will study key topics from all the **core sciences - chemistry, biology, physics, material science and electronics** - alongside specialist modules in nanoscience and nanotechnology.

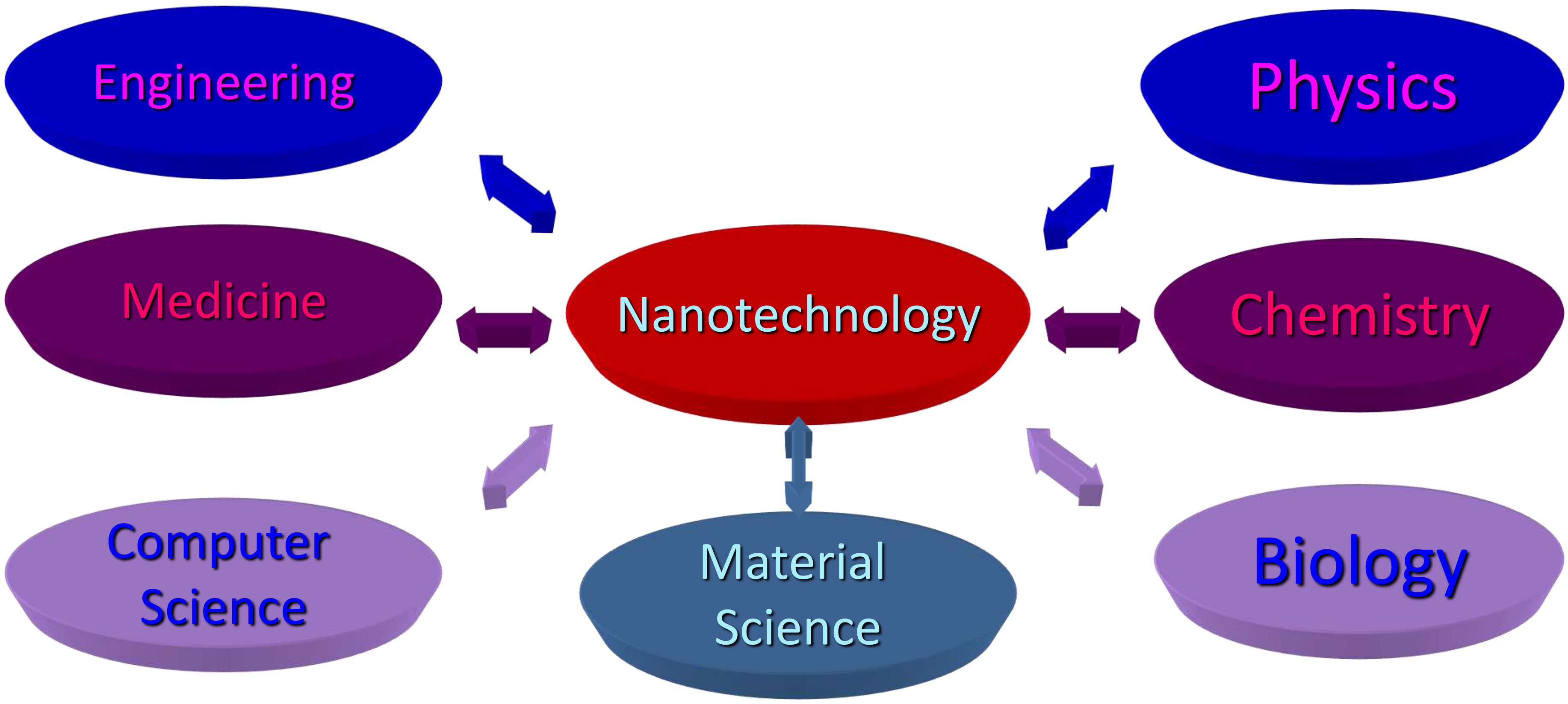
7. **University of Toronto - BASc in Engineering Science (Nanoengineering Option) (Canada)**

This option transcends the traditional boundaries **between physics, chemistry, and biology.** Starting with a foundation in **materials engineering** and augmented by research from the leading-edge of nanoengineering,

8. **University of Western Australia - Bachelor of Science (Nanotechnology) (Australia)**

This program investigates the basic theory and applications of nanotechnology in **the biological , chemical sciences, physics and engineering science.**

Nanotechnology is Multidisciplinary



Nanotechnology Education
in
Pakistan

Nanotechnology Education in Pakistan

B.S(Nanoscience &Nanotechnology)
4 year Multidisciplinary BS-Degree: Only one in Pakistan
(majors: Phys,Chem,Bio & Mat.Sci)
at
Preston Institute of Nano Science and Technology (PINSAT).

Preston University Kohat,
Islamabad Campus. Islamabad.

******

First initiative in Pakistan
Admissions :Fall-2010

Summary:-BS (Nanoscience and Nanotechnology)-
Multidisciplinary Degree(Nano-based):Phys,Chem,Bio,Mat Sci,Math.

1. PINSAT Scheme of Studies as per HEC--- 43 Courses –132 Cr.Hr
(Also Courses on Nano Economy, Ethics,Social Sci,IPR ,Psychology)

2. PINSAT Faculty with 6 Full Professors with 25-30 years Experience .
[Rtd, from PAEC & Q.A.Univ.:High Quality Institutions of Pakistan.]

BS Students Annually: 10-15 Annually.

Imp: Very High Professor : Student Ratio.

Subjects	Science Subjects	CH
1.	Mathematics	3+3
2.	Basic IT	2 +1
3.	Chemistry	3+3+3+1
4.	Physics	3+3+3
5.	Nanoscience and its Industrial Applications	3 +0
6.	Nanomaterials -I,II,III (Materials Science)	3+3+3
7.	Cell Biology	2+1
8.	Synthesis and Characterization Techniques of Nanomaterial's	3+1
9.	Biochemistry	2+1
10.	Electronics	3+1
11.	General Microbiology	3 +0
12.	Environment & Ethics in Nanotechnology	2 +0
13.	Nanocomposite Materials	2 +0
14.	Nanochemistry	3 +0
15.	Nanobiotechnology	3 +0
16.	Nano Sensors and Devices	3 +0
17.	Research Methods	3+0

18. Quantum Mechanics	3 +0
19. Nanocatalysis	2 +0
20. Social Impact of Nanotechnology	3 +0
21. Nanoelectronics	3 +0
22. Applied Mathematics	3 +0
23. Laboratory-I,II,III	2+2+2
25. Nanobiology	2+0
26. Research Project (Last 8th Semester)	6+0
27. Internship	6+0(Not counted in CGPA)
Total CH	**107**

Social Subjects

29. Introduction to Psychology	3+0
30. English	3 +3+3
31. Pakistan Studies	3+0
32. Islamic Studies	3+0
33. Statistics	3+0
34. Technical Project Managemet	3 +0
35. Seminar	1+0
Total CH	**25**

****

Preston University Islamabad
PINSAT Faculty-2017
(7 Professors+1 Assoc Prof)

L to R : Mr Asad Ali, Lecturer, Prof.Dr.M.Fayyaz Ch (QAU-Dean Retd), Prof.Dr.M.Javed Iqbal (QAU Prof .Retd), Prof.Dr.K.Yaldram(Chief Scientist PAEC- Retd), Prof.Dr.N.M.Butt(Chairman PINSAT), Prof.Dr.J.I.Akhter(D.G Pinstech-Retd), Prof.Dr.Qamar Javed(QAU Prof -Retd), Visiting Prof.Dr.M.Afzal Sh(Chief Scientist PAEC-Retd), Assoc Prof.Dr.Shahid Bilal Butt(Chief Scientist PAEC-Retd).

PINSAT Islamabad: Success Story- 10 years Experience

Excellent Success

Success of Multidisciplinary BS(Nanoscience&Nanotechnology)Program

****

1. 65 BS Graduates won 59 Fully Funded MS/PhD (59/65=97%)Foreign Scholarships in 11 Countries [USA,China,Germany,Japan,Australia,Canada,Belgium ,Norway, Hong Kong,South Africa, Saudi Arabia].

[Total Amount of Scholarships= **Rs430** million-Highest of all Univs in Pakistan].

2. Won Awards during MS and PhD abroad and Medals /First positions at home .
3. MS/PhD in variety of areas: Cancer, Solar Energy, Brain Materials Studies, Biology, BioChemistry , Composite Materials etc.,
4. Published high quality Papers in PhD, [3 students PhD with 19,16,16 Papers].
5. Preston Alumnus Addressed Graduates -2021 Ceremony UCAS Beijing students. [Great Honour for Pakistan]

Reasons of Success:

1. High Quality Faculty : 6 Full Professors
2. Well Euipped Labs: Empasis on Practica
3. Professor: Students Ratio 1:15
4. Emphasis on Personality formation

Pakistan

****

(i) : PINSAT Alumni Awards.

1. NUST-Islamabad (MS-Gold Medal).
2. Bahria Univrsity Islamabad (MBA Gold Medal).
3. CUST Islamabad (Chancellor's Roll of Honour)

****

(ii) : PINSAT Alumni Cash Prizes:

1. MS(Nanotechnology) :CSSP(P.U) - Lahore, Director's Prize -2016.
2. NUST (SCME): MS-2017

Shazra Shahzad(Preston BS graduate)

*****

- ➢ **NUST-SCME :MS(**2018)
- ➢ **FIRST Position- Gold Medal.**

Serial No: 170

National University of Sciences and Technology, Pakistan

Gold Medal Certificate

This is to certify that

Mr. / Ms.	Shazrah Shahzad
Son / Daughter of	Shahzad Ali Khan
Registration No.	00000119312
Student of	School of Chemical and Materials Engineering

has been awarded

President's Gold Medal

for securing First position

in

Master of Science in Nanoscience and Engineering

Dated: 07 November 2018

Registrar

President of Pakistan awarding Gold Medal MBA -Bahria University Islamabad to PINSAT Alumna , Ms Bakhtawar Mahmood

****

Faiza Nadeem- Preston Alumna– ReceivingCUST Chancellor's Honor Roll—
MS-2017-Engg Management.

International Wards

National & International Excellent Success

of

Preston BS(Nanoscience and Nanotechnology) Graduates.

****

1.Fully Funded MS/PhD Scholarships

&

2. Outstanding Research Awards

PINSAT, Preston University 65 BS Graduates Passed
[2014-2021]

Won: 59-Fully funded MS/Ph.D Scholarships/Fellowships won in 11 Countries.
(Australia, Canada, Saudi Arabia, USA, China/Hong Kong, Germany, Japan, Belgium,Norway, Russia, South Africa)

****

59 Scholarships & Fellowships;
(MS=27, Ph.D=23 & Fellowships=9)

Total Amount = Rs 430.23 million

****

65 BS graduates passed & 59/65= 90.7% won Fully Funded Scholarships in 11 Countries

HIGHEST of All Universities in Pakistan

****

PINSAT, Preston University 65 BS Graduates passed
and
59 Fully funded MS/PhD Scholarships/UNESCO Fellowships won in 11 Countries

(Australia, Canada, Saudi Arabia, US, China/ Hong Kong, Germany, Japan, Belgium,Norway,Russia, South Africa)

****

Summary:

S.No	Country	Scholarships/ Fellowships	Amount
1	**Australia** Chaudhry Muhammad Furqan (cmfurqan@connect.ust.hk) **(University of New South Wales, Dept. of Engineering)**	**Ph.D = 1**	**Rs. 12.2 million**
2	**Canada** Humza Javed (humza333@outlook.com) **(University of Calgary, Dept. of Chemical & Petroleum Engineering)**	**Ph.D = 1**	**Rs. 17.82 million**
3	**Saudi Arabia** Nawal Mughal <nawalmughal88@gmail.com> **(King Abdullah University of Science and Technology (KAUST),** **Material Science & Engineering**	**Ph.D = 1**	**Rs. 41.85 million**
4	**US** Jabran Saleem (jabran55555@gmail.com) **(Raleigh, North Carolina, Dept. of Chemistry)**	**Ph.D = 1**	**Rs. 9.972 million**
5	**China /** 30 students – List attached **(NCNST)**	**MS = 22** **Ph.D = 15**	**Rs 230.376 million**
	Hong Kong **Humza Javed**(humza333@outlook.com) **Ch M. Furqan** (cmfurqan@connect.ust.hk) **(The Hong Kong University of Science and Technology)**	**MS = 2**	**Rs 21.112 million**
6	**Norway** Muhammad Ibrahim (muhammad.ibrahim20@gmail.com) **(Norwegian University of Science and Technology)**	**Ph.D = 1**	**Rs 23.04 million**

7	**Germany** Mishal Khan (khanmishal798@gmail.com) **(Institute for Molecular Systems Engineering (IMSE), Ruprecht Karl University of Heidelberg)**	**Ph.D = 1**	**Rs 19.8846 million**
8	**South Africa : UNESCO Fellowships** **(iThemba Labs Cape town)**	**9 students**	**Rs 6.46 million**
9	**Russia :** Mr. Muhammad Owais (mohammadowais001@gmail.com) **(Skoltech Institute of Science and Technology)**	**MS = 1** **Ph.D = 1**	**Rs 10.08 million**
10	**Japan** Ms.Arouba Iftikhar (aroobaiftikhar9@gmail.com) **(Japan advance institute of science and technology JAIST), Advance Science & Technology**	**MS = 1**	**Rs 5.011 million**
11	**Belgium** Momina Amir (momina.amir30@gmail.com) **(KL Leuven), Engineering Science**	**MS = 1** **Ph.D = 1**	**Rs32.522million**
	Total	**59 Scholarships & UNESCO Fellowships**	**Amount = Rs 430.23 million**

Alumnus Kamran Amin –Prestom Alumnus

Receiving Special Contribution Award

NCNST Beijing , Chinese Academy of Sciences.

研精闡微

為民闢用

This certificate awarded to

Kamran Amin

“Special Contribution Award”

For Promoting the International Students Culture

In 2018-2019

Date 2019-8-28 By Graduate Education Office

国家纳米科学中心

National Center for Nanoscience and Technology, China

Muhammad Abdullah Adil – Pinsat Alumnus-2015

[Wins NCNST Beijing Excellent International PhD Student "Achievement Certificate" for Excellent Performance-2019].

- **He published 19 PhD papers(5-FIRST author) in high Impact Factor Journals, IF=27,15,12 ......etc.,**

研精闡微

為民闢用

NCNST Director Scholarship is awarded to:

Kamran Amin

On his outstanding research performance in

National Center for Nanoscience and Technology

(NCNST), China

2018

国家纳米科学中心

National Center for Nanoscience and Technology, China

Kamran Amin-Pinsat Alumnus-2015

[Wins NCNST Beijing Director’s Scholarship for Outstanding Research-2018].

He published 16 PhD papers(4-FIRST author) in high Impact Factor Journals, IF=27,15,12 ,7……etc.,

研精闡微
爲民闢用

This certificate awarded to

Kamran Amin

"Special Contribution Award"

For Promoting the International Students Culture

In 2018-2019

Date 2019-8-28 By Graduate Education Office

国家纳米科学中心

National Center for Nanoscience and Technology, China

Kamran Amin-Pinsat Alumnus-2015.

[Wins NCNST Beijing "Special Contribution Award"2018-2019].

Dr Kamran Amin –Preston Alumnus

Addressing NCNST Graduation Ceremony-2021 NCNST

Representing International students at the University of Chinese Academy of Sciences(UCAS).

PINSAT Alumnus: Kamran Amin

Excellent International Graduate 2021

UCAS(University of Chinese Academy of Sciences)

CERTIFICATE

No.2021UCASEIG010

This certifies that

KAMRAN AMIN

has been awarded as

2021 Excellent International Graduate

中国科学院大学

University of Chinese Academy of Sciences

WU Yueliang, Vice President (Academic)

University of Chinese Academy of Sciences

July 6th, 2021

Future BS Degrees : CONVERGENCE of Science, Engineering and Social Sciences

****

- **Different disciplines of science are converging as scientists have common and overlapping interests.**

- **Nanotechnology will promote the unification of most branches of Science, Engineering, Technology, based on unity of nature at the nanoscale and Social Sciences. CURRICULA for INTEGRATED Degrees.**

- **Social, Ethics, Safety, Standards, Regulations, IPRS**

****

Conclusion

Multidisclinary BS Degree (Nanoscience and Nanotechnology) has proved an important success at home and abroad.

****

BS(Nano) Degree

1. Most suitable for Nanotechnology Institutions worldover.

2.Imporatnt stage of Formal degree entry to:

3. Entry for Most Jobs, Private , Public Institutions

4.Entry to Higher degrees of MS /PhD

5. Entry to Industries, IPRS

6. Entry to other subjects for second under-graduation .

(Project Management-MBA –Media ,etc.,)

The Future of Nanotechnology:
Balancing Potential benefits and Risks.

****

Nanotechnology has emerged as a game-changing field that has the potential to transform almost every aspect of our lives.

Nanotechnology has already demonstrated **significant impacts in** various **industries,** including **healthcare, energy, electronics**,Defence,**Aeospace** and **materials science & Engg, etc.,**

In Conclusion:

Nanotechnology is shaping the **next industrial revolution, which will have far-reaching consequences for society as a whole**

****

Ref: Nano Magazine : March 01, 2023

(Good 2p summary).

Some Game Changing Emerging Technologies

1.Picotechnology

2. Artificial Intelligence-A and Machine Learning

3. Robots

4.Gene Technology

5-D Printing

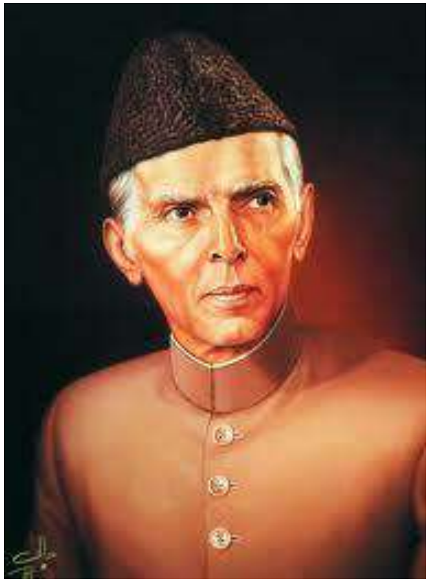
6. Computer-Human Interface

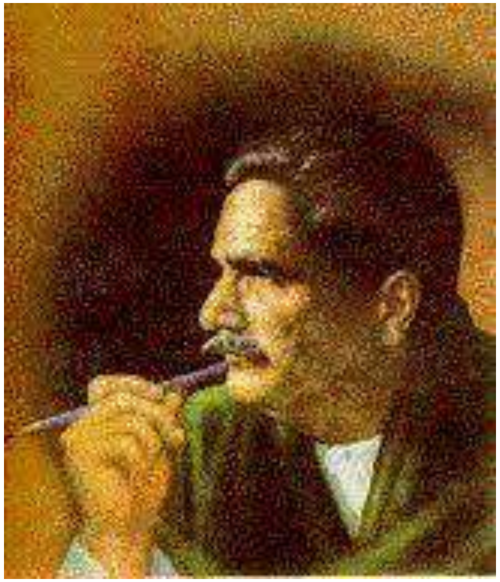
Acknowledegment

I am grateful to the Chancellor, Preston University
Dr. Abdul Basit for his all time support.

I appreciate heartily the strong support of
Professor Atta-ur-Rahman to my
Nanotechnology initiative in Pakistan.

And to the excellent PINSAT Faculty for their dedication.





Thank you

&

God Bless you

APPENDIX A

CONFERENCE ORGANIZING COMMITTEE

ISLAMIC WORLD ACADEMY OF SCIENCES (IAS), JORDAN

Prof. Adnan Badran	President. & Director General, IAS.
Ms. Taghreed Saqer	Executive Secretary, IAS.
Ms. Najwa F. Daghestani	Programs Manager, IAS.

INTERNATIONAL CENTER FOR CHEMICAL AND BIOLOGICAL SCIENCES (ICCBS), UNIVERSITY OF KARACHI, KARACHI, PAKISTAN

Prof. Atta-ur-Rahman *FRS*	Patron-in-Chief, ICCBS.
Prof. M. Iqbal Choudhary	Coordinator General, COMSTECH/ Director, ICCBS.
Dr. Humera Jahan	Associate Professor, ICCBS.
Prof. Farzana Shaheen	Professor, ICCBS.
Prof. M. Raza Shah	Professor, ICCBS.

COMSTECH, ISLAMABAD, PAKISTAN

Prof. Mohammed Ali Mahesar	Consultant, COMSTECH.
Mr. Aftab Zaidi	Director, HR & Administration, COMSTECH.
Mr. Abdul Haleem Asghar	Focal Person (Awards & Programs - Africa), COMSTECH.
Mr. Muhammad Haris Akram	Programme Manager, COMSTECH.
Ms. Khazima Muazim	Programme Manager, COMSTECH.
Mr. Umer Ali	Program Officer, COMSTECH.

24th Islamic World Academy of Sciences Conference

Challenges to Promote Science & Technology for Socio-Economic Development in OIC Countries

List of Participants
7-8 March 2023

	Name	Designation	Country
1.	Abdelhafid Lahlaidi	Vice President, Islamic World Academy of Sciences (IAS)	Morocco
2.	Abdul Haleem Asghar	Focal Person (Awards & Africa Program), COMSTECH	Pakistan
3.	Abdullah Al Musa	Secretary General, Higher Council for Science and Technology (HCST)	Jordan
4.	Adnan Badran	President & DG, Islamic World Academy of Sciences (IAS)	Jordan
5.	Aftab Hussain Zaidi	Senior Director HR & Administration, COMSTECH	Pakistan
6.	Ahmed Azad	Chief Research Scientist, CSIRO Division of Biomolecular Engineering	Australia
7.	Ali Moosavi-Movahedi	Professor of Biophysics, University of Tehran, Inst of Biochemistry Biophysics	Iran
8.	Atta-ur-Rahman	Patron-in Chief, UNESCO Science Laureate, International Centre for Chemical and Biological Sciences, University of Karachi, Pakistan	Pakistan
9.	Ayaz Ahmad	Assistant Professor, ICCBS	Pakistan
10.	Aziz Latif Jamal	Chairman, Husein Ebrahim Jamal Foundation (HEJ)	Pakistan

11.	Birgit van Munster	founder of 'Only One Earth Science'	UK
12.	Elias Baydoun	Treasurer, IAS American University of Beirut	Lebanon
13.	Fatimah Al Musa	Wife of Dr. Abduallah Al Musa	Jordan
14.	Hala El-Khozondar	Professor, Islamic University of Gaza	Palestine
15.	Hasan Mandal	President of TUBITAK	Turkey
16.	Hina Siddiqui	Associate Professor, ICCBS	Pakistan
17.	Humera Jahan	Associate Professor, ICCBS	Pakistan
18.	Ilkay Erdogan Orhan	Dean of Faculty of Pharmacy, Gazi University	Turkey
19.	Irfan Ahmad	Executive Director for Interdisciplinary Initiatives, the Grainger College of Engineering; and Executive Director for the Health Maker Lab, the Carle Illinois College of Medicine, University of Illinois at Urbana-Champaign	USA
20.	Irshad Hussain	Lahore University of Management Sciences Syed Babar Ali School of Science and Engineering	Pakistan
21.	Ishtiaq Baig	Honorary Consul General, Consulate of Morocco in Karachi	Pakistan
22.	Jackie Ying	Founding Executive Director, NanoBio Lab, Institute of Materials Research and Engineering	*USA*
23.	June Kuncoro Hadiningrat	Consul General, Consulate of the Republic of Indonesia in Karachi	Indonesia

24.	Khalid Mahmood Iraqi	Vice Chancellor, University of Karachi	Pakistan
25.	Khatijah Yusoff	Vice President, Islamic World Academy of Sciences (IAS)	Malaysia
26.	Liaquat Ali	Honorary Chief Scientist & Advisor Pothikrit Institute of Health Studies (PIHS)	Bangladesh
27.	M. Iqbal Choudhary	Coordinator General, COMSTECH / Director ICCBS	Pakistan
28.	Mahnaz Kaffash Tehrani	Wife of Prof. Moovahedi	
29.	Malik Maaza	Fellow, Islamic World Academy of Sciences (IAS)	South Africa
30.	Michael Wadleigh	Founder, The Homo Sapiens Foundation (UNESCO), Science Activist, Oscar-winning Director.	USA
31.	Mohammed Ali Mahesar	Assistant Coordinator General, COMSTECH	Pakistan
32.	Mohammed Besri	Institut Agronomique et Vétérinaire Hassan II	Morocco
33.	Muhammad Ameen Kalroo	Executive Secretary, COMSTECH	Pakistan
34.	Muhammad Raza Shah	International Center for Chemical and Biological Sciences (H.E.J. Research Institute of Chemistry), University of Karachi	Pakistan
35.	Muhammad Yusuf Farrukh	Honorary Consul General, Consulate of Jordan in Karachi	Pakistan
36.	Mukhtar Ahmed	Chairman, Higher Education Commission	Pakistan
37.	Nadira Panjwani	Chairperson, Dr. Panjwani Memorial Trust	Pakistan

38.	Najwa Daghestani	Programs Manager, Islamic World Academy of Sciences (IAS)	Jordan
39.	Noor M. Butt	Professor & Chairman, Preston Institute of Nano Science & Technology (PINSAT), Preston University Kohat.	Pakistan
40.	Rabia Hussain	Professor, The Aga Khan University	Pakistan
41.	Sammer Yousef	Professor, ICCBS	Pakistan
42.	Shabbir Hussain	Media Coordinator, COMSTECH	Pakistan
43.	ShahNor Basri	Professor, University Malaysia Kelantan	Malaysia
44.	Shazia Anjum	Fellow, Islamic World Academy of Sciences (IAS)	Pakistan
45.	Shovosil Ziyodov	Director, Imam Bukhari International Scientific-Research Center (IBISRC)	Uzbekistan
46.	Syed M. Qaim	Professor, Institute of Neuroscience and Medicine, Nuclear Chemistry, Forschungszentrum Jülich	Germany
47.	Syed Murad Ali Shah	Chief Minister, Government of Sindh	Pakistan
48.	Taghreed Saqer	Executive Secretary, Islamic World Academy of Sciences (IAS)	Jordan
49.	Tasawar Hayat	Secretary General, Islamic World Academy of Sciences (IAS)	Pakistan
50.	Zabta Shinwari	Vice President, Islamic World Academy of Sciences (IAS)	Pakistan
51.	Zakri Abdul Hamid	Founding Chair, IPBES; Ambassador/Science Advisor, Campaign for Nature	Malaysia

52.	Zulfiqar Ali	Director of the Programs and Projects Department, Islamic Organization for Food Security (IOFS)	Kazakhstan
53.	Zulfiqar Bhutta	Professor and Founding Director of the Institute for Global Health and Development and the Centre of Excellence in Women and Child Health	Canada

APPENDIX C
Patrons of the Islamic World Academy of Sciences

His Excellency the President of the Islamic Republic of Pakistan.
His Royal Highness Prince El-Hassan bin Talal of the Hashemite Kingdom of Jordan, Founding Patron.

Honorary Fellows of the Islamic World Academy of Sciences

(in alphabetical order)

1. Dr. Mohammad **Abdolahad**, The 2019 Mustafa Prize Laureate, Iran.
2. Mr. Fouad **Alghanim**, President, Alghanim Group, Kuwait.
3. Prof. Hossein **Baharvand,** The 2019 Mustafa Prize Laureate, Iran.
4. Prof. Sami Erol **Gelenbe,** The 2017 Mustafa Prize Laureate, Turkey.
5. Prof. M. Zahid **Hasan**, The 2021 Mustafa Prize Laureate, Bangladesh.
6. Prof. Ekmeleddin **Ihsanoglu,** Former OIC Secretary General, Turkey.
7. Prof. Umran S. **Inan,** The 2019 Mustafa Prize Laureate, Turkey.
8. Prof. Ali **Khademhosseini,** The 2019 Mustafa Prize Laureate, Iran.
9. Tun Pehin Sri Haji Dr. Abdul Taib **Mahmud**, the Governor of Sarawak (Yang di-Pertua Negeri), Malaysia.
10. Dr. Adnan M. **Mjalli**, Chairman, MIG, USA.
11. His Excellency Dato' Seri Dr. Mahathir **Mohamad**, Former Prime Minister of Malaysia.
12. Prof. Ferid **Murad**, 1998 Nobel Laureate (Medicine), USA.
13. His Excellency Nursultan **Nazarbayev**, Former President of the Republic of Kazakhstan.
14. Prof. Ugur **Sahin,** The 2019 Mustafa Prize Laureate, Turkey.
15. Prof. Mohamed El-**Sayegh**, The 2021 Mustafa Prize Laureate, Lebanon.
16. His Excellency Mr. Mintimer **Shaimiev**, Former President of the Republic of Tatarstan/ Russian Federation.
17. Prof. M. Amin **Shokrollahi**, The 2017 Mustafa Prize Laureate, Iran.
18. Prof. Yahya **Tayalati**, The 2021 Mustafa Prize Laureate, Morocco.
19. His Excellency Sheikh Hamad Bin Jassim Bin Jabr Al **Thani**, Former Prime Minister of Qatar, Qatar.
20. Prof. Cumrun **Vafa,** The 2021 Mustafa Prize Laureate, Iran.

List of Fellows of the Islamic World Academy of Sciences
(February 2023)

1.	Prof. Mohammad **Abdollahi**	Iran	Toxicology/Pharmacology
2.	Prof. Zakri **Abdul Hamid**	Malaysia	Genetics
3.	Prof. Omar **Abdul Rahman**	Malaysia	Veterinary Medicine
4.	Prof. Farhan Jalees **Ahmad**	India	Pharmaceutics
5.	Prof. Bobomurat **Ahmedov**	Uzbekistan	Physics
6.	Prof. Askar **Akayev**	Kyrgyzstan	Computer Engineering
7.	Prof. Liaquat **Ali**	Bangladesh	Medicine
8.	Prof. M. Shamsher **Ali**	Bangladesh	Physics
9.	Prof. Qurashi Mohammed **Ali**	Sudan	Medicine/Anatomy
10.	Prof. Huda Saleh **Ammash**	Iraq	Biology
11.	Prof. Shazia **Anjum**	Pakistan	Chemistry
12.	Prof. Muhammad **Asghar**	France	Physics
13.	Prof. Muhammad **Ashraf**	Pakistan	Botany-Salt Tolerance
14.	Prof. Allaberen **Ashyralyev**	Turkmenistan	Mathematics
15.	Prof. Saleh A **Al-Athel**	Saudi Arabia	Mechanical Engineering
16.	Prof. Ahmad Abdullah **Azad**	Bangladesh/ Australia	Biochemistry
17.	Prof. Agadjan **Babaev**	Turkmenistan	Geography
18.	Prof. Adnan **Badran**	Jordan	Biology
19.	Prof. Shah Nor Bin **Basri**	Malaysia	Mechanical Engineering
20.	Prof. Elias **Baydoun**	Jordan	Biochemistry
21.	Prof. Farouk **El-Baz**	USA	Geology
22.	Prof. Kazem **Behbehani**	Kuwait	Immunology
23.	Prof. Azret **Bekkiev**	Balkar/Russia	Physics
24.	Prof. Rafik **Boukhris**	Tunisia	Medicine
25.	Prof. David (Mohamed Daud) A. **Bradley**	UK	Physics
26.	Prof. Noor Mohammad **Butt**	Pakistan	Physics
27.	Prof. Mohamed Thameur **Chaibi**	Tunisia	Agriculture/ Climate Technologies
28.	Prof. Muhammad Iqbal **Choudhary**	Pakistan	Organic Chemistry
29.	Prof. Abdallah **Daar**	Oman/ Canada	Medicine
30.	Prof. Ali Al-**Daffa'**	Saudi Arabia	Mathematics
31.	Prof. Mamadou **Daffe**	Mali/France	Biochemistry
32.	Prof. Ramazan **Demir**	Turkey	Biology
33.	Prof. Oussaynou Fall **Dia**	Senegal	Geology
34.	Prof. Dilfuza **Egamberdieva**	Uzbekistan	Biology
35.	Prof. Mehmet **Ergin**	Turkey	Chemical Engineering
36.	Prof. Sehamuddin **Galadari**	UAE	Biochemistry

37. Prof. Nesreen **Ghaddar**	Lebanon	Metallurgical Engineering
38. Prof. Mehdi **Golshani**	Iran	Physics
39. Prof. Kadyr G **Gulamov**	Uzbekistan	Physics
40. Prof. Ameenah **Gurib-Fakim**	Mauritius	Chemistry
41. Prof. Hashim M **El-Hadi**	Sudan	Veterinary Medicine
42. Prof. Kemal **Hanjalic**	Bosnia-Herzegovina	Mechanical Engineering
43. Prof. Mohamed H A **Hassan**	Sudan	Mathematics
44. Prof. Tasawar **Hayat**	Pakistan	Mathematics
45. Prof. Bambang **Hidayat**	Indonesia	Astronomy
46. Prof. Rabia **Hussain**	Pakistan	Microbiology
47. Prof. Aini **Ideris**	Malaysia	Veterinary Medicine
48. Prof. Asma **Ismail**	Malaysia	Biotechnology
49. Prof. Mohammad Shamim **Jairajpuri**	India	Zoology
50. Prof. Mohammad Qasim **Jan**	Pakistan	Geology
51. Prof. Afaf **Kamal-Edin**	Sudan	Chemistry
52. Prof. Hamza **El-Kettani**	Morocco	Physics and Chemistry
53. Prof. Idriss **Khalil**	Morocco	Mathematics
54. Prof. Hameed Ahmed **Khan**	Pakistan	Physics
55. Prof. Mostefa **Khiati**	Algeria	Medicine
56. Prof. Hala **El Khozondar**	Gaza/ Palestine	Physics
57. Prof. Abdelhafid **Lahlaidi**	Morocco	Medicine
58. Prof. Zohra Ben **Lakhdar**	Tunisia	Physics
59. Prof. Malek **Maaza**	Algeria	Neutronics
60. Prof. Ahmed **Marrakchi**	Tunisia	Electronic Engineering
61. Prof. Akhmet **Mazgarov**	Tatarstan/ Russia	Petrochemistry
62. Prof. Amdoulla **Mehrabov**	Azerbaijan	Materials Science
63. Prof. Shaher **Al-Momani**	Jordan	Mathematics
64. Prof. Ali Moosavi-**Movahedi**	Iran	Chemistry
65. Prof. Sami **Al- Mudhaffar**	Iraq	Biochemistry
66. Prof. Zaghloul **El-Naggar**	Egypt	Geology
67. Prof. Ibrahim Saleh **Al- Naimi**	Qatar	Chemistry
68. Prof. Anwar **Nasim**	Pakistan/ Canada	Genetics
69. Prof. Munir **Nayfeh**	Jordan/ USA	Physics
70. Prof. Robert **Nigmatulin**	Tatarstan/ Russia	Physics/ Mathematics
71. Prof. Shekoufeh **Nikfar**	Iran	Pharmacoeconomics/ Pharmaceutical
72. Prof. Gulsen **Oner**	Turkey	Medicine
73. Prof. Ilkay Erdogan **Orhan**	Turkey	Pharmacognosy
74. Prof. Ramdane **Ouahes**	Algeria	Chemistry
75. Prof. Munir **Ozturk**	Turkey	Biology
76. Prof. Iqbal **Parker**	South Africa	Biochemistry
77. Prof. Syed Muhammad **Qaim**	Germany	Nuclear Chemistry
78. Prof. Atta-ur-**Rahman**	Pakistan	Chemistry

79. Prof. Hussein Samir **Salama**	Egypt	Entomology
80. Prof. Eldar Yunisoglu **Salayev**	Azerbaijan	Physics/ Mathematics
81. Prof. Jawad A. **Salehi**	Iran	Electronic Engineering
82. Prof. Boudjema **Samraoui**	Algeria	Biology
83. Prof. Lorenzo **Savioli**	Italy	Medicine
84. Prof. Mohammed Musa **Shabat**	Gaza/ Palestine	Biology
85. Prof. Muhammad Raza **Shah**	Pakistan	Nanotechnology
86. Prof. Misbah-Ud-Din **Shami**	Pakistan	Chemistry
87. Prof. Ali **Al-Shamlan**	Kuwait	Geology
88. Prof. Ahmad **Shamsul-Islam**	Bangladesh	Botany
89. Prof. Muthana **Shanshal**	Iraq	Chemistry
90. Prof. Zabta Khan **Shinwari**	Pakistan	Biology
91. Prof. Ahmedou M **Sow**	Senegal	Medicine
92. Prof. Mahmoud **Tebyani**	Iran	Electronic Engineering
93. Prof. Ahmet Hikmet **Ucisik**	Turkey	Materials Science
94. Prof. Gulnar **Vagapova**	Tatarstan/ Russia	Medicine
95. Prof. Omar M. **Yaghi**	Jordan/USA	Chemistry
96. Prof. Jackie **Ying**	Singapore/USA	Chemical Engineering
97. Prof. Bekhzad **Yuldashev**	Uzbekistan	Physics/ Mathematics
98. Prof. Khatijah Mohd **Yusoff**	Malaysia	Microbiology
99. Prof. Salim **Yusuf**	Canada	Medicine
100. Prof. Mikhael **Zalikhanov**	Balkar/Russia	Glaciology/Biology

APPENDIX D

LAUREATES OF THE IAS-COMSTECH IBRAHIM MEMORIAL AWARD

Prof. Ugur **Dilmen**	1996	Turkey.
Prof. Mohammad **Abdollahi**	2005	Iran.
Prof. Mohammed Manna **Al-Qattan**	2007	Saudi Arabia.
Dr Faris **Gavrankapetanovic**	2009	Bosnia.
Dr Saima **Riazuddin**	2011	Pakistan.
Prof. Liaquat **Ali**	2013	Bangladesh.
Prof. Jackie **Ying**	2015	Singapore.
Prof. Ameenah **Gurib-Fakim**	2017	Mauritius.

APPENDIX D

THE COUNCIL OF THE
ISLAMIC WORLD ACADEMY OF SCIENCES
(2023-2027)

President:	**Adnan Badran**	Jordan
Vice-President:	**Khatijah Yusoff**	Malaysia
Vice-President:	**Abdelhafid Lahlaidi**	Morocco
Vice-President:	**Zabta Shinwari**	Pakistan
Treasurer:	**Elias Baydoun**	Jordan
Secretary General:	**Tasawar Hayat**	Pakistan
Member:	**Malek Maaza**	Algeria
Member:	**Farhan Jalees Ahmad**	India
Member:	**Mohammad Abdollahi**	Iran
Member:	**Aini Ideris**	Malaysia
Member:	**Dilfuza Egamberdieva**	Uzbekistan

IAS EXECUTIVE STAFF

Prof. Adnan Badran	President & Director General.
Ms. Taghreed Saqer	Executive Secretary.
Ms. Najwa F. Daghestani	Programs Manager.
Mr. Ahmad Nassar	Finance Officer.
Mr. Hamdi Bader Ahmad	Driver.

APPENDIX E

PUBLICATIONS OF THE ISLAMIC WORLD ACADEMY OF SCIENCES

CONFERENCE PROCEEDINGS

- *The Islamic Academy of Sciences.* Proceedings of the Founding Conference (1986). Published by the Islamic Academy of Sciences, **Editor: A. Kettani (Morocco).**
- *Food Security in the Muslim World.* Proceedings of the first international conference, Amman (Jordan) (1987). Published by the Islamic World Academy of Sciences, **Editor: S. Qasem (Jordan).**
- *Science and Technology Policy for Self-Reliance in the Muslim World.* Proceedings of the second international conference, Islamabad (Pakistan) (1988). Published by the Islamic World Academy of Sciences, **Editors: F. Daghestani (Jordan), H. El-Mulki (Jordan), and M. Al-Halaiqa (Jordan).**
- *New Technologies and Development of the Muslim World.* Proceedings of the third international conference, (Kuwait) (1989). Published by the Islamic World Academy of Sciences, **Editors: F. Daghestani (Jordan), and S. Qasem (Jordan).**
- *Technology Transfer for Development in the Muslim World.* Proceedings of the fourth international conference, Antalya (Turkey) (1990). Published by the Islamic World Academy of Sciences, **Editors: F. Daghestani (Jordan), A. Altamemi (Jordan), and M. Ergin (Turkey).**
- *Science and Technology Manpower Development in the Islamic World.* Proceedings of the fifth international conference, Amman (Jordan) (1991). Published by the Islamic World Academy of Sciences, **Editors: F. Daghestani (Jordan), A. Altamemi (Jordan), and H. El-Mulki (Jordan).**
- *Environment and Development in the Islamic World.* Proceedings of the sixth international conference, Kuala Lumpur (Malaysia) (1992). Published by the Islamic World Academy of Sciences, **Editors: S. Al-Athel (Saudi Arabia), and F. Daghestani (Jordan).**
- *Health, Nutrition and Development in the Islamic World.* Proceedings of the seventh international conference, Dakar (Senegal) (1993). Published by the Islamic World Academy of Sciences, **Editors: N. Bor (Turkey), A. Kettani (Morocco), and Moneef R. Zou'bi (Jordan).**

- *Water in the Islamic World: An Imminent Crisis.* Proceedings of the eighth international conference, Khartoum (Sudan) (1994). Published by the Islamic World Academy of Sciences, **Editors: M. Ergin (Turkey), H. Dogan Altinbilek (Turkey), and Moneef R. Zou'bi (Jordan).**
- *Science and Technology Education for Development in the Islamic World.* Proceedings of the ninth international conference, Tehran (Iran) (1999). Published by the Islamic World Academy of Sciences, **Editors: M. Ergin (Turkey), M. Doruk (Turkey), and Moneef R. Zou'bi (Jordan) (ISBN 9957-412-7).**
- *Information Technology for Development in the Islamic World.* Proceedings of the tenth international conference, Tunis (Tunisia) (2000). Published by the Islamic World Academy of Sciences, **Editors: M. Ergin (Turkey), M. Doruk (Turkey), and Moneef R. Zou'bi (Jordan) (ISBN 9957-412-03-5). Online.**
- *Biotechnology and Genetic Engineering for Development in the Islamic World.* Proceedings of the eleventh international conference, Rabat (Morocco) (2001). Published by the Islamic World Academy of Sciences, **Editors: A. S. Majali (Jordan), M. Ergin (Turkey), and Moneef R. Zou'bi (Jordan) (ISBN 9957-412-07-8). Online.**
- *Materials Science and Technology and Culture of Science.* Proceedings of the twelfth international conference, Islamabad (Pakistan), (2002). Published by the Islamic World Academy of Sciences, **Editors: M. Ergin (Turkey), and Moneef R. Zou'bi (Jordan) (ISBN 9957-412-06-x). Online.**
- *Energy for Sustainable Development and Science for the Future of the Islamic World and Humanity.* Proceedings of the thirteenth international conference, Kuching, Sarawak (Malaysia), (2003). Published by the Islamic World Academy of Sciences, **Editors: M. Ergin (Turkey), and Moneef R. Zou'bi (Jordan) (ISBN 9957-412-08-6). Online.**
- *Science Technology and Innovation for Socioeconomic Development of OIC-Member Countries Towards Vision 1441.* Proceedings of the fourteenth international conference, Kuala Lumpur (Malaysia), (2005). Published by the Islamic World Academy of Sciences, **Editors: M. Ergin (Turkey), and Moneef R. Zou'bi (Jordan) (ISBN 9957-412-11-6). Online.**
- *Higher Education Excellence for Development in the Islamic World*. Proceedings of the fifteenth international conference, Ankara (Turkey), (2006). Published by the Islamic World Academy of Sciences, **Editors:**

M. Ergin (Turkey), and Moneef R. Zou'bi (Jordan) (ISBN 978-9957-412-18-0). Online.

- *Science, Technology and Innovation for Sustainable Development in the Islamic World: The Policies and Politics Rapprochement*. Proceedings of the Sixteenth international conference, Kazan (Tatarstan), (2008). Published by the Islamic World Academy of Sciences, **Editors: M. Ergin (Turkey), and Moneef R. Zou'bi (Jordan) (ISBN 978-9957-412-19-7). Online.**
- *Towards the Knowledge Society in the Islamic World: Knowledge Production, Application and Dissemination,* Proceedings of the seventeenth international conference, Shah Alam *(Malaysia),* (2009). Published by the Islamic World Academy of Sciences, **Editors: M. Ergin (Turkey), and Moneef R. Zou'bi (Jordan) (ISBN 978-9957-412-22-7). Online.**
- *The Islamic World and the West: Rebuilding Bridges through Science and Technology,* Proceedings of the eighteenth international conference, Doha (Qatar), (2011)**.** Published by the Islamic World Academy of Sciences, **Editor: Moneef R. Zou'bi (Jordan) (ISBN 978-9957-412-24-1). Online.**
- *Science and Technology in Muslim World: Achievements and Prospects,* Proceedings of the IAS Symposium, Astana (Kazakhstan), (2012). Published by the Islamic World Academy of Sciences, **Editor: Moneef R. Zou'bi (Jordan)**. **Online**.
- *Achieving Socioeconomic Development in the Islamic World through Science, Technology and Innovation*, Proceedings of the nineteenth international conference, Dhaka (Bangladesh), (2013). Published by the Islamic World Academy of Sciences, **Editors: Moneef R. Zou'bi (Jordan), and Najwa F. Daghestani (Jordan) (ISBN 978-9957-412-25-8). Online.**
- *Science, Technology and Innovation: Building Humanity's Common Future,* Proceedings of the twentieth international conference, Tehran (Iran), (2015). Published by the Islamic World Academy of Sciences, **Editors: Moneef R. Zou'bi (Jordan), and Najwa F. Daghestani (Jordan) (ISBN 978-9957-412-26-5). Online.**
- *Science, Technology and Innovation for Global Peace and Prosperity,* Proceedings of the twenty-first international conference, Konya (Turkey), (2017). Published by the Islamic World Academy of Sciences, **Editors: Moneef R. Zou'bi (Jordan), and Najwa F. Daghestani (Jordan) (ISBN 978-9957-412-27-2). Online.**
- *Landscape of Science, Technology and Innovation in the Islamic Countries,* Proceedings of the twenty-second international conference,

Amman (Jordan), (2020) *Virtual Conference*. Published by the Islamic World Academy of Sciences, **Editors: Abdullah Al Musa (Jordan), and Najwa F. Daghestani (Jordan). Online.**

- *Biodiversity Conference,* Proceedings of the IAS conference on Biodiversity, Amman (Jordan), (2021) *Virtual Conference*. Published by the Islamic World Academy of Sciences, **Editors: Abdullah Al Musa (Jordan), and Najwa F. Daghestani (Jordan). Online.**
- *Science, Technology and Innovation Under Ever Changing Global Events,* Proceedings of the twenty-third international conference, Rabat (Morocco), (2022). Published by the Islamic World Academy of Sciences, **Editors: Abdullah Al Musa (Jordan), and Najwa F. Daghestani (Jordan). Online.**
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