

The Premier Science Magazine In Sri Lanka

The Sri Lankan Scientist

The Premier Science Magazine in Sri Lanka

VOLUME 08 | ISSUE 02 | ISSN - 2420-7306

Space Economy, Space Industries and Sri Lanka

Basics of SEM

Rohan Pethiyagoda,
a Sri Lankan
Researcher, wins
“Linnean Medal”

Health, Wellbeing and
its Promotion

IPCC Latest Report
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Higher Rates
of Renal
Injuries
Among
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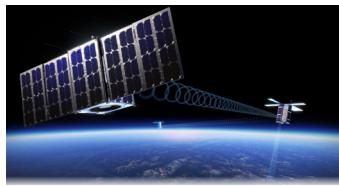
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A Glucose Meter Could Soon Say Whether You Have SARS-CoV-2 Antibodies

Cover Image

Space Exploration Technologies Corp. or most commonly known as SpaceX is an American spacecraft manufacturer, space launch provider, and a satellite communications corporation headquartered in Hawthorne, California. Space X is currently one of the key players in modern-day space industry. The cover image shows a Space X falcon 9 rocket departs the Kennedy Space Center carrying a group of starlink satellites.



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Space Economy – A forbidden industry to Sri Lanka?

Space Industry is fast growing with its recent milestone of USD 450 billion value in 2020. The diversity of the industry is also expanding into various sectors of the global market. The latest addition to the Space industry is space tourism. There are a lot of research, developments and innovations in the world thanks to the race of space industry with the new roles of private sector stakeholders. Meanwhile, the governments' expenditures on Space industry were being criticized as if it was wasting resources that could be used for global priorities.

Space economy and Space Industry were almost neglected terms in Sri Lanka due to many reasons. Uneducated shortsighted political

leaders could never recognize any of the developments in the science and technology world which could uplift the country as a key stakeholder. Without a political will, nothing of any significance can be developed in Sri Lanka as the qualified government officials are mostly blind followers. The weak private sector here can do a limited role only.

As Sri Lanka is in a special macroeconomic situation where every sector gets an opportunity to CHANGE from its lethargic shortsighted mode, the opportunities in the growing world of science and technology could be targeted and an objectively driven system should be implemented.

The solution lies in the educational reforms accommodating futuristic strategies. Space industry requires a lot of human resources like space engineers, research scientists, geologists, meteorologists, pilots and etc etc. Then the focus should be on the industry driven R&D aiming raw materials, intermediary products and services. Sri Lanka has a lot of potentials in the space industry and this should be considered in the national policies now to play a role in 1 trillion USD market in 2040.



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Published by: Dilip K Fernando, Piliyandala
 Designed by: Sisira Kumara,
 On 22th July 2022
 Funded by: Avon Pharma Chem (Pvt) Ltd
 as a CSR initiative
 Produced by: Green Laboratories Lanka (Pvt) Ltd.



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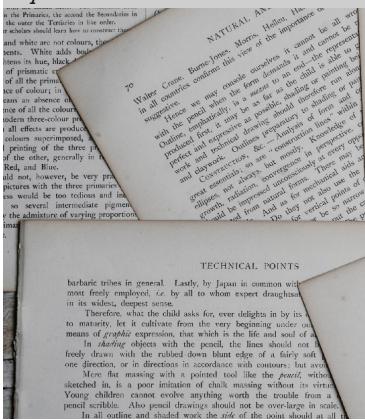
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Lay summaries; an Effective Tool to Win the Challenges in Science Communication

By – Sisira Kumara



Sri Lanka Journal Online, or SLJOL, is a platform maintained by the National Science Foundation to host scientific journals, giving researchers the opportunity to publicize their work to a broader audience. Currently, there are 111 registered journals on this platform, and thousands of new research papers come out each year through this platform alone. But how much of this research work gets out to the general public? This is one of the main questions we have to answer as members of the Sri Lankan science community.

"Not only is it important to ask questions and find the answers, but as a scientist, I felt obligated to communicate with the world what we were learning." Stephen Hawking, expressed these views in his book titled "Brief Answers to the Big Questions". So, as researchers or scientists, we have a big responsibility on our hands to communicate the findings of our research work to the general public.

The General Public has the Right
Most of the research work nowadays is funded by taxpayers' money, so they, the taxpayers, have all the right to know what impact this research work generates and also the potential. At the same time, communicating research findings to the general public gives researchers the opportunity to reach industry people where they can use the findings for



commercially viable initiatives through which both the researcher and the industry get benefits.

Scientific Publications are not Enough!

Despite the fact that we publish thousands of new research findings each year, we rarely have the opportunity to present these findings to the general public. As a result, the information generated by scientists is easily lost among the journals that, for the most part, never leave the shelves. One of the main reasons behind it is that they are written in a too scientific language, making it difficult for the non-scientific community to grasp the information from them. And also, we very rarely see the general public read scientific publications as they most often find them less interesting just because of the very scientific nature of them.

Research Findings for the General Public

A "lay summary" of a research paper is actually an abstract of the research publication written in plain language. This lay summary should be able to convey to the non-scientific community the findings of your research, its significance, and the impact it can have on answering a current problem or issue in simple terms. And also, this gives an opportunity for journalists and communicators to easily grasp the importance of this work and communicate it through mass media to the general public.

A simple lay summary should answer the main questions of "What?/Who?/How? and Why?" about the research. And also, the writer should make sure that the lay summary is free from any jargon whenever possible.

Guidelines to Write an Effective Lay Summary of Your Research

One of the leading scientific publishers in the world, Elsevier, points out the following on how to write a useful lay summary,

- Predict and cover the "so what?" factor; justify your research.
 - Give some background and context to the research. What prompted you to do it?
 - Follow a logical order. This may not always coincide with a temporal order.
 - Explain the impact of the work – what is going to change (especially in relation to wider society)?
 - Use succinct, short sentences—and write in plain English. Imagine you're talking to an undergraduate who's just stepped into your introductory class. Or, better still, pretend you're trying to explain your article to a distant family member who works in retail/fashion/hospitality.
 - Avoid jargon unless absolutely necessary, and explain it if you do have to keep it in.
 - Use first person and active voice ("we agreed" rather than "it was agreed").
 - Use positive, not negative sentences: "You will have repeat appointments at least once a fortnight," rather than "The usual practice is not to schedule repeat appointments more frequently than once a fortnight."
 - Images are very important—try to include one if you can.
- Given below are a few examples taken from some of the world's leading scientific publications.

The Sri Lankan Scientists' Effort at Producing Lay Summaries

With the pure aim of promoting local research, the Sri Lankan Scientist Magazine started publishing lay summaries of selected research papers and publishing them in the print version of the magazine. The lay summaries are published under the section named "Sri Lankan



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Microwear analysis aiding excavation prioritization at the submerged Mesolithic settlement of Orehoved, Denmark

January 2019

R. E. Donahue et al.

Deposits rich in Mesolithic settlement debris were located 4-7 m below sea level off Orehoved, Denmark. Field archaeologists had to determine expeditiously where to focus excavations before the site was destroyed by a major infrastructure project. Through analysis of wear on dorsal ridges of flint flakes it was demonstrated that much of the assemblage from test pits on higher ground were rounded due to redeposition by waves and currents. Follow-up excavation in a low-lying area located a layer with numerous artefacts in stone, bone, and plant material that had remained undisturbed since their days of deposition 8000 years ago.

[Read the article here.](#)

Fig. 1. A lay summary of a research paper from the Journal of Archaeological Science

Research Snippets" and about ten research papers are being added as snippets in this section for an issue. The Sri Lankan Scientist research snippet is a 100-word summary of research written in simple language, and for those who are interested in the research can read the actual research from the source given with the snippet.

SLAAS to Take the Lead.

In a recent workshop organized by the Sri Lanka Association for the Advancement of Science, Prof. Manuj Crishantha stated that the SLAAS will make lay summaries mandatory for the research papers in the research conference this year. So SLAAS will be the first organization to take this step with the aim of popularizing scientific research among lay people.

Press Releases: Longer but more Effective

Just like a lay summary, a press release also acts as a handy tool in science communication. Unlike a lay summary, a press release can be considered a more detailed summary of your research, again written in plain language. Most of the time, press releases are released targeting journalists and media institutes so that they can grab them for their news articles. There are international media platforms dedicated to publishing science news releases. Eurekalert is one such platform, and hundreds of new research findings are added to this site daily in the format of press releases from various sources around the world. The main

advantage of press releases over lay summaries is that the press release gives you the complete picture of the research in plain language, making it easier for the general public to study the research and analyze the real-world impact of the research by themselves. The National Science Foundation started this a few years back, and it seems they have abandoned it for unknown reasons. But the press release section and the link to that section are still available on the SLJOL home page.

Composing a Press Release

One of the main research journals in genetic engineering, **PLOS Genetics**, points out the following guidelines for writing press releases for the research articles they publish in their journal. Your press release should be interesting but must not exaggerate or sensationalize the article's findings.

Do not forget that the release will be one of many on any given day. So your writing should emphasize on why your study is different from others?

Word count - Aim for 200-300 words.

Title - Interesting but accurate.

Paragraph 1 / Sentence 1 - Present the main findings of the article.

Paragraph 1 / Sentence 2 -

Mention the authors and their institution.

Paragraph 2 - Provide more information on the study and mention the article is publishing in PLOS Genetics. Answer the question: Why is this research

important?

Paragraph 3 [Optional] - More details about the study and provide some background information and/or details of how the study was carried out.

What's next? Looking to the future (this can be a single sentence).

Quote from the author(s) [Optional]

Striking image - [Optional]

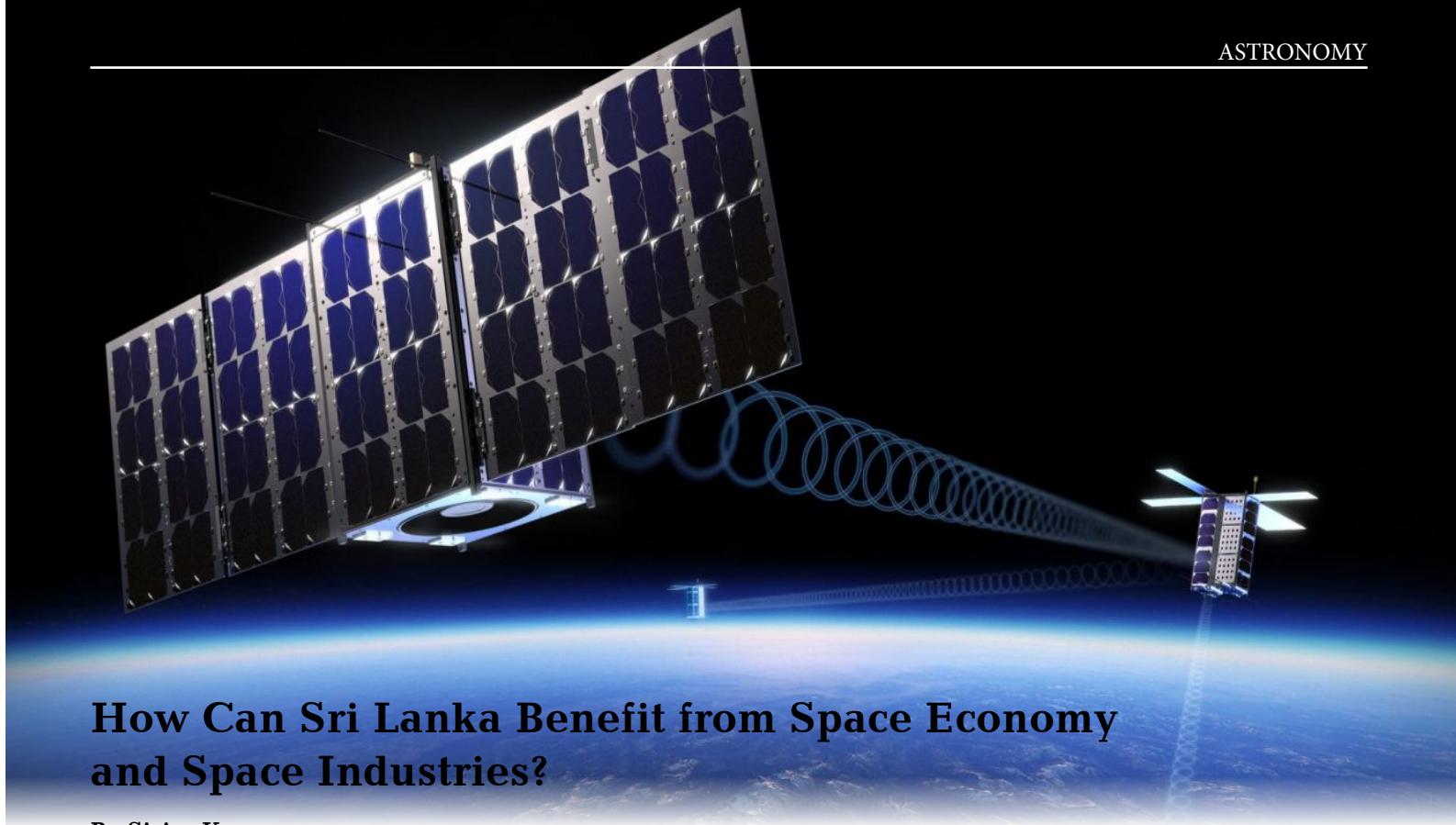
Provide a striking image from the article to accompany the press release. Include a legend and image credit.

As discussed in this article earlier, there are a lot of impactful researches done annually, and most of the time, these become limited to journals. Nowadays scientists use research and research publication as just another qualification in their academic career. But if the country is to reap the benefits of this research, the communication of the research output to the necessary sectors of the general public is essential. It's high time for the institutes that publish research journals to start publishing a set of lay summaries or press releases parallel to the original publication, so that the information available in the journal goes out to the general public in a much simpler manner.



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How Can Sri Lanka Benefit from Space Economy and Space Industries?

By Sisira Kumara

Humans have been active in space exploration for more than six decades since the former Soviet Union and the United States pioneered our species into space in the late 1950s.

Space exploration as we have known it during that time is being transformed today with more economic opportunities opening up. So, we now can see totally new terms like Space Industry, and Space Economy being used more frequently – and not just in the developed countries.

Space Industry and Space Economy?

Wikipedia defines Space Industry as economic activities related to manufacturing components that go into Earth's orbit or beyond, delivering them to those regions, and related services.

So, space industry is limited to physical manufacturing of items that goes to space. But with new economic activities like Space Tourism and Deep Space mining being added to those economic activities, the term Space Economy is being used in a much broader sense.

According to the Statista website, the total turnover of Space Economy for the year 2020 was

approximately 446.9 billion US Dollars. It clearly indicates how big this business already is. Even though these terms may be new to some of us, space related economic activities actually started with the beginning of the satellite era. The launch of Sputnik 1 on 4th October 1957 can be defined as the beginning of space economy. Apart from the military use, most of the Satellites sent to space had some economic or business component behind it. At the same time, all the rockets that have been used in space exploration and all the vehicles used in space transportation also can be included in space industry or the space economy as each and every part that have been used in the development of these massive units have an economically important process behind them.

In earlier days most of those launches and processes were carried out mostly by government agencies. But now the things have changed dramatically, and many private companies have begun their involvement in this industry with a massive competition to deliver the needs in space exploration related activities. According to Statista website Lockheed Martin, Airbus Raytheon

Technologies and Boeing are the four leading companies in Space Industry. They had secured over 50 billion USD each in revenues from aerospace related activities .

Space Economy Landscape is Changing

More interestingly, there are many new avenues that are being opened up in Space Economy. Those have created a vast pool of opportunities for anyone in the world.

So, understanding these opportunities and getting ready to grab them is an essential thing if we are to make our mark in future Space Economy.

Given below are some of those new avenues in modern day space economy.

Space Tourism – A decade back the concept of space tourism was merely science fiction. But in recent months, we saw several companies, namely Space X, Blue origin, Virgin Galactic taking tourists into the space. In the most recent trip, Space X took four civilians in a three-day space trip onboard their Crew Dragon space vehicle. They all paid an undisclosed, high amount for the trip. So, the year 2021 will go in the history books as the year that

began commercial space tourism.

Asteroid Mining – Asteroid mining is the process of reaching asteroids or any other objects in the solar system, land on them and get back to earth with samples obtained from the object. Even though this is still a hypothetical process, few recent projects by Japan Space Agency JAXA have been able to make this a reality. Two recent projects Hyabusa and Hyabusa 2 have been able to return tiny amounts of samples from near earth asteroids. And one on-going project OSIRIS-Rex is expected to return to earth on 2023 with more than 60 grams of samples from the Asteroid Bennu, a near earth asteroid that flew past earth in 2017. Scientists predict this asteroid mining would become a lucrative business in near future with companies hunting for minerals like Gold, Cobalt, Iron, Manganese, Molybdenum, Nickel, Osmium, Palladium, Platinum, Rhenium, Rhodium, Ruthenium and Tungsten.

Space Manufacturing – Research carried out at space stations have proven that there are products that can be manufactured in the orbital space environment which are impossible to manufacture under the gravity on earth. So, there will be opportunities in future to manufacture some innovative products commercially in space environment.

Space-for-earth products – This is the more conventional form of space Industry that we are familiar with. These include goods or services produced in space for use on earth. Telecommunication Services, Mapping Services, and defense related services are some prime examples.

Do we have a Space in Space among the Giants in the business? By mid 2021, there are 72 different government space agencies functioning around the world. Just 14 of them have the launch capability.

Which means most of these space agencies are not major operators but they are doing research and engaging in various possible ways

in space science and astronomy. Even developing countries like Myanmar and Bangladesh already have their own agencies or organizations that are responsible for Space Science and related fields. Bangladesh began their Space Research and Remote Sensing Organization way back in 1980. For many years they had the plan of establishing themselves as a country in Space Industry and space science.

When we look at these countries, it is obvious that a country does not need to have a massive space agency or space programme to begin our own research wing in space science. Around 2009, there were some media report that Sri Lanka had planned its own research wing with the name "Sri Lanka Aeronautics and Space Agency" but we didn't heard of it ever since.

Is it worth investing in Space Science as a medium income country?

We asked this question from a Sri Lankan born Space Engineer Mahilal de Silva who is currently leading a mechanical engineering team in charge of ExoMars rover project by European Space Agency(ESA).

"Most certainly, in my opinion space research/exploration is an ideal investment for a medium scale developing country, where

it will enable to create a massive space exploration community within the country. Investing in Space will enable us to build research centers (ex: Planet Mars research centers), educational institutions, to create specialized skilled jobs, introduce new technologies and bring back revenue to the country and also this will widen the international relationships via technological knowledge share."

There are big challenges ahead!!

Yes, being a country with limited pool of physical, human and technological resources on space science and astronomy, it is a big task for Sri Lanka to establish itself in the space industry. But we have to start somewhere, and keep up with other countries in this fast changing sector.

Challenge No 1 - Human Resources

The first challenge towards a Sri Lankan Space Science and Astronomy research sector and a space industry is to produce much needed human resources. One of the best ways to jump start this is to get the help and guidance from Sri Lankan experts like Dr. Sarath Gunapala, Eng. Mahilal de Silva and astronomer Prof. Chandra Wickramasinghe in empowering Sri Lankans with the latest knowledge in these fields.

At the same time, we should start



Space research/exploration is an ideal investment for a medium scale developing country - Eng. Mahilal De Silva



SpaceX (United States), Blue Origin (United States), Virgin Galactic (United States), Bigelow Aerospace, Inc. (United States), Deep Space Industries (United States), Intelsat (United States), Masten Space (United States), Moon Express (United States) and Skyrora (United Kingdom) are the main stakeholders of the current Space Economy

communicating the basics of space science to the young generation. This can be promoted as an extracurricular activity as some schools already have astronomy societies. Recently, undergraduates at some universities like Moratuwa and Sri Jayawardenapura have started chapters of Students for the Exploration and Development of Space (SEDS), a worldwide movement of youth interested in space exploration and technologies. So, we should capitalize on these initiatives and work towards a broader goal of building up a good human resource pool for the future of space industry in Sri Lanka. Indeed, our University system can play a lead role in developing human resources needed for the space economy and space industries.

But are we prepared for this? Is our Sri Lankan University system capable of managing this issue and produce a good quality pool of human resources?

This is one of the main questions we should have answers if we are to move ahead with securing a good pool of human resources needed for a space economy and a space industry.

sector

Most of the research and development processes involving space science are highly expensive, or are they?

Eng. Mahilal had these to say, *"I would say the capital investment will be a considerable amount to start with, conceptual design, planning, site selection, commissioning and getting the correct expertise will be a challenge, but in the long run it will not be an enormous cost."*

"Most of the developed countries balance out their budgets by allocating a certain percentage for space exploration. Also, they encourage the private sector by introducing a number of incentives and have regular discussions to understand the space demands i.e.

discuss about the climate change/ earthly impacts and how to mitigate by improving the space sector research."

Challenge No 3 –Technology Transfer

Space Industry and Space science as a whole is a sector that is developing rapidly. Many technologies used in these sectors are new. And for a country like Sri Lanka acquiring these technologies would pose budgetary challenges. But if we plan wisely there will be a whole lot of opportunities where we can get the needed technological knowledge absorbed to the local talent. Specially the Sri Lankan talent who are working in these fields would be a great initiative. At the same time technology



We now need to come forward and promote space tech and industries and space economy as a new field for future careers – just like information technology (IT) was initially promoted in Sri Lanka in the 1980s and 1990s - Mr. Nalaka Gunawardena, A science writer and an Astronomy enthusiast

transfer through bilateral agreements also would be a great way to empower our talent with this latest knowledge. And while absorbing those technologies from other sources we have to establish a research facility through which we have to develop our own technologies that can be used in these areas.

Challenge Number 4 - Public perception towards space science

Most of the general public tend to think the Space Science is for wealthy nations and countries like ours have to stay out of it. But if we are to establish ourselves in the space industry, we have to change this and get the public interested. In doing that, science journalism and science communication plays a key role.

"There is considerable enthusiasm among our children and youth in studying astronomy and space and some of them want to pursue careers in space related fields. Right now, they cannot do this unless they leave the country and go to Europe or USA that welcomes very bright young people with talent and skills. Amateur astronomy enthusiasts have kept public interest in this sector going for several decades but we now need to step it up and promote space tech and industries and space economy as a new field for future careers – just like information technology (IT) was initially promoted in Sri Lanka in the 1980s and 1990s," says science writer Nalaka Gunawardene who has been writing about space related issues for many years in the media and

online.

It's not too late to start our journey in space industry and make our mark in modern day space economy. The key to success is in identifying the opportunities we have in these sectors, and make a realistic plan according to the resources and strengths we have as a country and setting our targets. The Fourth Industrial Revolution is already upon us, and space technology will play a major role in the coming years and decades. As a country it's high time to look in to this seriously and get our agenda right.



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Health, Wellbeing and its Promotion

By Helinie Yahampath

What is health? What comes to our mind when we hear the word "health"? Is your answer the absence of "disease"? Hopefully, yes. Then let's start from how the word "disease" came into our vocabulary. As most of origins of words, the term disease too has a fascinating meaning. Let's start from that.

In Old French "des" expressing reversal and "aise" expressing ease combined to form "desaise". "Desaise" in Old French, means lack of ease. The word "disease" came into Middle English with the meaning of lack of ease or inconvenience. Is that the idea come across to our mind when we say the word "disease"? Probably the answer will be a big no. Most of us think of an illness or sickness in that situation rather than lack of ease. That is how the words we use came into play the major role with the misconceptions of the term "health". Now let's move into our topic health and wellbeing without having any judgments with the words which are settled down in our minds years ago.

As per the discussion of diplomats met to form the United Nations in 1945, the world health organization or the WHO was established with its constitution came into force on 7 April 1948. Now the date is celebrated as "The World Health Day" around the globe. The WHO plays the major part to put forward the meaning of health for its promotion in an evolving nature to ensure a better future for all human beings. Therefore the terms, ideologies related to health have been changed time to time dramatically and the actions needed to achieve them and promote health have changed accordingly.

As the etymology of word disease, "health" has a captivating formation from Germanic origin to Old English and then to Middle English which means wholeness, a being whole and sound well. Today, the word "health" is used in day to day life to represent a good physical form, an absence of illness, or injury. Most of us

grasp this intuitive idea with a fixed image of merely absence of a physical or mental disease or disorder.

Without the knowledge of general public, especially the WHO as the global body responsible for promoting healthier lives adopted various strategies, policies, programs to enhance the health in every aspect. The definition of health comes into play a major role in the event to achieve and address the issues to ensure a better life experience for everyone in everywhere without discrimination by any means.

Lately, the WHO together with the nations moved into novel concepts of health, wellbeing and promotion of health to enhance the individuals' life experience in harmony with each other and with nature in a sustainable way as a humane point of view. Not to be forgotten, the theories, ideologies, concepts put forward by varies philosophical leaders, psychologists, individuals, groups and societies years ago, which we are not going to look into details, made an immense impact on present contexts, practices and initiatives of WHO's science based strategies.

In early ages health is defined in a biomedical viewpoint. In this regard, it compromise with a state of normal, where bodily functions are in the expected manner and diseases can interrupt its functions over aging. This medical model view body as a machine. A healthy person is considered as an absence of disease, disorder or disability. With the evolving nature of medical sciences, more knowledge and understanding of bodily functions were identified. As a result of that and with the improvement of technology, more abnormalities in expected bodily functions were diagnosed in a manner with the capability to cure or ability to live a better life with optimum bodily functions with medical treatments or interventions while normal aging. This tends to understand that health is not merely the absence of disease or

infirmity. This is considered as physical health and dependent on bodily functions.

After the evolution of psychological aspects, it considered health in a mind perspective and the idea of mind and body interactions came into play. At that point mental health is recognized as an important factor when estimating one's health.

It is understood that physical and mental health are not the only factors that determines one's health, since person lives in a society and has social interaction, the effect of those interactions shown a considerable effect on health. Therefore with the evolution of social and philosophical view points, social health is identified as another major component attributes with health.

A holistic model of health is defined in 1948. According to the WHO, health is a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity.

According to ideas of some philosophers, to attain optimum wellbeing, spiritual components like self-actualization are considered as a supreme part of one's needs. So, spiritual health can be considered as another important factor that affects health. So one can add the spiritual health as another component for definition as a holistic approach.

However recently the WHO recognized importance of promotion of health and take various steps presently, to let people to achieve a better state of wellbeing.

By considering all above factors, we can define health as a state of complete physical, mental, social and spiritual wellbeing in accordance with the WHO definition. Here the WHO integrated the word "wellbeing" to its definition, which is in use nowadays as the better idea when we try to describe a person's being. This is rather made a controversy between health and wellbeing. And in the western part of the world it is still a debate regarding terms

health and wellbeing. In WHO's definition of health, it indicates the "complete wellbeing" and by socializing the WHO's definition, it leads to an unnecessary complexity where individuals are set back to achieve their own wellbeing and goals due to expectation of complete wellbeing. To overcome this dilemma let's try to establish better concepts for health and wellbeing, which can immensely contribute for promotion of health.

Oh! Isn't it so simple? When we met someone, what is the first thing we tend to say? That is "Hello, how are you?" Our answer to that question is how we express our health at that point. Simply, we can agree that the "health is the person's being". It is not a fixed thing. It is not static but dynamic. It cannot be a perfect one. It

depends on everything going around us at that particular time. It can either be good or bad or even can co-exist both in the same time. Is it measurable? If so we have to take something as reference. If we expect a perfect thing as an absolute, is it the definition we were trying to find out over so

many years? No, definitely not. So how can you define health as complete physical, mental, social and spiritual wellbeing? Can anyone have a complete combination of wellbeing of those? Aren't we going years backward again? According to our parameters, we tend to say someone is healthy or unhealthy. But remember, earlier we discuss that we can live with a disorder or problem and that is included in our definition. So how it becomes a complete thing?

Likewise, what we defined was not what we were seeking to define. This is totally discrimination to a person, who is trying to overcome specially a physical or mental problem to have an optimum wellbeing. This definition adopted by the WHO makes vulnerable such people and persuade the society to come to a judgment on those who are struggling to overcome their problems and to tag them as unhealthy. Isn't it rather a torture than the acceptance of diversity? What we can guess from this is health also in a spectrum.

Secondly, let's discuss how to

explain someone's state on a particular time or over a period of time. There should be a way. Yes, we can say health is the person's being but not the complete wellbeing. Keep in mind, not to come to a conclusion if they are not at your standards. Sometimes it is defined, state of being as physical and state of mind as psychological. Let's forget the word "state" and just say "person's being", so it implies physical, mental, social and spiritual or anything else. There is a point. In that case, we can use term wellbeing and define it without showing any biases for the intention of promotion of health.

Then, what is wellbeing? Why can't we define wellbeing as "living your life productively with satisfaction without bothering others while minimizing your own bothers or problems?" No one can live without having any bother or problem but anyone can live their life without bothering others. So others will always benefit

from us. In that sense, anyone can have a "good life". Most suitable term goes with wellbeing is "well balanced life". It indicates that





you live with you and others with equilibrium and in harmony. The novel concepts like sustainability and living in harmony with nature come into action only if we get used to think in this way. So we can always enhance our wellbeing to promote overall health and it is a life time process, which has no end or defined amount. Also the wellbeing is not some absolute thing, it depends on person's likes, dislikes, goals and purposes etc.

So how can we enhance wellbeing, which eventually leads to promotion of health? According to the definition put forwarded by the WHO on health, we can enhance physical, mental, social and spiritual wellbeing of individuals to enhance our overall wellbeing, which significantly contribute for promotion of health. Another way is promotion of community health, which is a broader way to address the issue, where everyone in the society from top to the bottom and bottom to the top should contribute in the same amount of effort and dedication. It includes nations, international bodies, governments, governors, medical sector, societies, public sector, private sector, schools, politicians, media, religious leaders etc., simply you and me. In that way, we can enhance wellbeing through promotion of health community wise and many absorbing activities take place around the globe, specially the WHO contribute as the leading international body, which is responsible for promotion

of health of all nations all over the world.

Here we are discussing several steps that can potentially enhance personal wellbeing.

There are few needs, good habits and healthy life styles required to improve our physical wellbeing. Those are access to unpolluted water and air, sanitation and hygiene, healthy diet, sports and exercises, adequate sleep and rest, good and natural environment, physical fitness, immunity, activeness, availability and access to medical tests for diagnosis of diseases and treatments to control diseases and reduce the impact to bodily functions, take actions to avoid or mitigate communicable diseases and non-communicable diseases through medical interventions and healthy life styles, education on health science and practices etc.

The mental wellbeing can optimize through exploring your abilities, improving the abilities to face challengers, trying to establish a productive life, helping others, engaging in sports, exercising, carrying out aesthetic activities, having hobbies, spending time meaningfully, practicing a simple life style, getting counselling or medical support in need, meditating, feeling gratitude, being grateful, accepting difficulties, self-understanding, achieving self-esteem and enhancing the abilities in decision making, problem solving, coping with

stresses, critical thinking, creative thinking, emotional balance, being happy and lively, self-discipline, learning new things, contributing to the society productively, being mindful, being an empath etc.

To raise the social wellbeing, one can be a good team worker, listen to others ideas, be flexible, respect others, acknowledge others, be aware of surroundings, understand and accept differences of others, work peacefully with others, have cooperation, be law-abiding, have productive communication, have good leadership qualities, be empathetic, show good followership qualities, have good interpersonal relationships etc.

Spiritual wellbeing is not connected to a religion or philosophy. It means living your life with a purpose, with good interpersonal skills and growing with time and experience, while correctly understanding one's place in the society. By achieving spiritual wellbeing person act in a calm way and it bring forth a satisfied person, who is capable to make others happy. A person with spiritual wellbeing, tend to be mindful, friendly, help others in their troubles, feel happy for others in their successes and poses the ability to bear happiness and sadness in the same way with balance. To strengthen spiritual wellbeing, one can practice activities such as enjoying nature, engage in aesthetic activities, working as groups, doing meditation or yoga exercises, doing

a sport, managing time, getting counselling and guidance in need, being respectful, being kind, being grateful, being optimistic, being peaceful,

being a nature loving person, living according to the religion or moral values without bothering others, living with social norms and ethics etc.

So according to the facts we discussed regarding attaining physical, mental, social and spiritual wellbeing, it is difficult to separate the qualities or actions need to improve particular wellbeing and all are seem to be interconnected. This is finally defined as overall wellbeing of a person and we can understand that the sense of wellbeing is merely a self-oriented context rather than something absolute. So it may vary from person to person both qualitatively and quantitatively, since a person has their own identity. Therefore it is better to adopt a common definition for wellbeing as we formulated earlier, that is living a productive satisfied life without bothering others while minimizing your own bothers. This idea can lead anyone to have a good life without having any judgment and discrimination from others and help the person to achieve an unstoppable wellbeing throughout their life span.

We are not able to increase our wellbeing only by knowing the things we discussed without practicing them. To develop our overall wellbeing, practicing what we are known is essential. Everyone has a unique identity, which may be related to their genes and we can name them as born abilities. One should be able to explore those abilities, which can also named as inert potential that may unseen at present, but can identify and nurture them in a way to improve overall wellbeing. The environmental factors affect the major role on one's life rather than the genes, but you should keep in mind, the adverse effects attribute to the chemistry or chemical interaction related to body and mind can control in a positive way through medicines or medical interventions to lead

a better life by minimizing the malfunctions.

We can improve or facilitate those environmental factors, unlike the genetics which seems impossible to change. Providing and achieving those factors attribute to environment can enhance the person's wellbeing, but it comes into play only if the person is willing to practice and change the things to increase their own wellbeing. Our brain has plasticity or an adjustable nature, so anyone can learn new things and

try them out to enhance their overall wellbeing continually during their entire life. So there is no amount of wellbeing which the person has to complete at some stage, but it has an evolving nature. All these things will help to have a good, well balanced life with increased happiness and productivity. So the person tends to be happier more and more by enhancing their overall wellbeing and it is a lifelong experience.

Finally one can argue that, facilitate and accommodate to achieve a maximum state of wellbeing during one's life span by the governing bodies and societies, is the one and only human right require after the person is born into this world. It includes and concludes all rights of human beings required throughout their entire duration of life.

Written by Heline Yahampath, 2022/01/07. (Please note that the above mentioned ideas are not of the writer but the knowledge accumulated since eras up to the present date, and the references are mentioned below)

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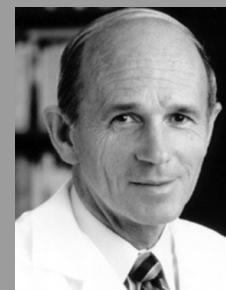
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It's easier and more cost effective to maintain good health, than to regain it once it's lost
- Kenneth H. Cooper

Second Satellite Developed with Sri Lankan Technological Support Launched

By Chinthana Wijayawardena

Sri Lanka entered the active nano-satellite project by Japan's Kyushu Institute of Technology, which has been extended to countries such as Sri Lanka, where satellite technology has never been available.

Accordingly, in 2017, a partnership agreement was reached between the Arthur C. Clark Institute for Advanced Technology and the Kyushu Institute of Technology, Japan, which resulted in the launch of Sri Lanka's first nanosatellite by the Arthur C. Clark Institute on August 17, 2019 from the International Space Station. The second nano-satellite, the kitsune, was designed and developed by five international organizations, including Arthur C. Clarke, to take the nanosatellite project one step further. The satellite was successfully launched into orbit 400 km from the International Space Station (ISS) on March 24, 2022 at 5.40 pm Sri Lanka time.

At 6 times the size of the Rawana-01 satellite, the Kitsune satellite is 30 cm in height, 20 cm in width, and 10 cm in thickness. Engineers from The Arthur C. Clarke Institute provided the engineering and technical support for the project.

The Kitsune Nano Satellite is a state-of-the-art satellite with a built-in sensor camera system that can accurately monitor the Earth's surface up to 5 cm. The nano-satellite research and data obtained from this nano-satellite, which is designed to contribute to a wide range of scientific research, including monitoring the electronic density of the ionosphere around the Earth, will be highly beneficial for the development of science and technology sectors in developing countries, such as Sri Lanka.

Planning and co-designing of the Nano Satellite Project with the international partners were done by Mr. Sanath Panawennage, Director General of Engineering, and other technical contributions were made by the Deputy Director General, Mrs. Kamani



Image 1. Nano-satellite, the kitsune, is a result of combined effort of five international organizations including Arthur C. Clarke Center

Ediriweera (Technical Operations), and the Commanding Director of Engineering, Mr. Kavinder Jayawardena. The communication and other functional systems were developed by Engineer Tharidhu Dayaratne, and the operations at the Arthur C. Clarke Institute's Earth Receiver Center were carried out by Engineer Kavindu Sampath. Sanath Panawennage, Director General of the Arthur C. Clarke Institute, commenting on the success of the project, said:

"The creation and launch of the Kitsune satellite, the second mission of the Nano Satellite Project, is a great achievement for Sri Lanka. This Kitsune satellite is 6 times the size of Ravana 01 and is a technically sophisticated satellite. With the state-of-the-art system onboard, this satellite is capable of examining and photographing an area as small as 5 cm on earth. " "The Kitsune satellite is now in orbit and in successful contact with the Arthur C. Clark Satellite Center at Moratuwa. The Arthur Clark Center is currently working on the third nano satellite, and the center is hoping to further develop its' capabilities and necessary laboratory facilities needed for satellite technology. " "Economists predict that the

value of the space economy will be around US \$1 trillion by 2040. Through projects like this, the Arthur C. Clarke Center hopes to create a workforce in Sri Lanka to fit in with this fast-developing sector, which will allow us to gain a foothold in the space-based economy."

"Satellite technology is a combination of many high-tech fields. In today's world, there is a tendency to use a wave of nanosatellites or high-tech small satellites in large quantities. It is a great achievement for us to have Sri Lanka join the ranks of the world in satellite technology." Mr. Panawennage added further.



**Chinthana
Wijayawardena**
Deputy Director (Media)
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On a Mission Beyond the Realm of Classical Physics

By Ramalka Kasige

We've mapped the world, discovered all the continents and sometimes it feels like there's nothing new to look for, on our little blue planet and beyond. But have you ever thought that this universe is still full of mysteries and burning questions that even step beyond the realm of classical physics?

A stunning disclosure of the late twentieth century was that the universe is not only expanding but expanding with an acceleration. This is in stark contrast to the existing theory that the rate must be slowing down as the universe expanded. Making it more controversial, there was no known mechanism that came up to explain this acceleration at the time of this discovery.

A mysterious driving force known as "Dark Energy" came into play as modern science revelations referred to it as a property of space-time. Another plausible explanation was also brought in to consider dark energy as a quantum effect. This explains that "empty space" is loaded with impermanent particles that materialize and can vanish ceaselessly. Further, it explains that these transient particles are caused by fluctuations of the background field of the universe and are also responsible for carrying electromagnetic, weak, and strong forces between objects. On the contrary, a third interpretation was also brought forward which fabricated dark energy as a completely novel arena, distinct from matter and energy.

However, recent science earns to explain that the accelerating expansion of the universe is the existence of a hypothetical repulsive force that was interpreted as Dark Energy. This powerful repulsion is between normal matter and hidden pockets of antimatter. Accordingly, normal matter and antimatter gravitationally repel each other to create a kind of "anti-gravity" that could replace dark

energy as the cause of universe's expansion.

Thus, the Big Bang Theory and the Dark Energy Theory try to construe the universe's expansion but were not very promising to reveal a clear understanding of the scenario. As per the theories, the universe must shrink together and finally collapse, if gravitational force exists as the only attraction force. Hence, can the logic behind this expansion of the universe with galaxies repelling each other, be directed towards the repulsive force among celestial bodies in the universe?

The current understanding of gravity is based on the attraction between masses in the universe and is one of the fundamental forces identified as the law of universal gravitation by Sir Isaac Newton. Unlike any other forces which are dual in nature, the gravitational field is unique and has no such duality shown to exist, so far.

Even though general relativity does not specifically recognize a repulsive gravity force as "anti-

gravity", a recent attempt by a Sri Lankan physicist rationalizes the concept with clear evidence to support the existence of force against gravity. Dr. C.K. Gamini Piyadasa's pioneering study on Anti-gravity is the first ever practically designed study on this major phenomenon in nature that is yet to be recognized. (Dr. C.K. Gamini Piyadasa is a Ph.D. holder in Instrumentation in laser desorption mass spectrometry from the University of Colombo (UOC), Sri Lanka in collaboration with University of Uppsala (OUU), Sweden and is a recipient of many accolades for this unwavering contribution to the field of science.)

The experimental work was conducted at the Department of Electrical and Computer Engineering, University of Manitoba, Canada with the support of the Natural Sciences and Engineering Research Council (NSERC) of Canada. The preliminary studies were carried out in University of Colombo, Sri Lanka and were funded by the Sri Lanka National Science Foundation (NSF) with the further support of Sri Lanka Institute of Nanotechnology (SLINTEC).

Experiential evidence was put forward through the 'Iodine molecule study' that demonstrated

Dr. C.K. Gamini Piyadasa is a Ph.D. holder in Instrumentation in laser desorption mass spectrometry from the University of Colombo (UOC), Sri Lanka in collaboration with University of Uppsala (OUU), Sweden and is a recipient of many accolades for his unwavering contribution to the field of science.





the force against conventional gravity. The study focused on exploring the upward mobility of iodine molecules (126.9 amu) as they slowly heat-evaporated in a vacuum $\sim 10^{-5}$ mbar. The Iodine vapor deposition pattern which depicted an upward movement was deposited on the top surface of the encircled paper, paving the way to evidence-based repulsive gravity force, "anti-gravity."

The study reveals that this repulsion force, against the direction of gravitational pull is proportional to the thermal energy of the particle. Further, it is also analogous to the gravitational attraction that is proportional to the mass of the particles. Even though the experiment was performed under several geometric clarifications, the altered geometries did not affect the direction of the upward thrust (movement) of the iodine molecules.

This endeavor is well established and exists in nature but, is yet to be recognized in the realm of science. The clouds and cloud particles which are analogs to the universe and galaxies, well depict the basis, although in a cloud, cloud particles are confined to a relatively stationary volume while the elements in the universe are continuously accelerating among each element.

The study results can be explained

by existing scientific knowledge; the Einstein equation ($E = mc^2$) which explains that energy is equal to mass times the speed of light squared. On the most basic level, the equation says that energy and mass (matter) are interchangeable. Hence, the reduction of mass together with the increase of heat energy rises the gravitational repulsion, (or anti-gravity) which grounds for a realistic explanation of the expansion of intergalactic distances (that results in expansion of the universe) with an acceleration. Further, the conversion of mass to energy to a lessening of the attracting gravitational force, conversely increases the repulsive gravitational force known as anti-gravity force. Therefore, it is reasonable and is clear evidence to speculate the existence of both decreasing attractive and increasing repulsive forces in the universe in order to maintain the dynamic nature of the system.

Dr. Piyadasa's study also points out that this anti-gravity exists not only celestial scale (macro scale) but also in microscopic scale. Once the theory is established, this could lead to better explain all most all the physical phenomena known to physics, by using gravitational attraction and repulsive forces.

Research with the potential to produce controversial findings is important to progress in the

sciences. Like the core of any good conspiracy, Dr. Piyadasa's study has the ring of plausibility driven toward one of the outstanding, decades long debatable problems in physics and cosmology today. Thus, coming up with a revolutionary theory of gravity vs. anti-gravity and Dark Energy may highlight a scientific uprising on a par with static, non-Newtonian components of gravity.

Although this can be considered a scientific saga that strengthens modern physical science, there is still a big hoo-ha among the scientific community for a tug-war between gravity and anti-gravity. However, this endeavor is a pivotal point in the scientific arena, as the core concepts of gravity and anti-gravity were challenged, while re-writing a spanking interpretation for Dark Energy as an elusive idea that may encompass anti-gravity while explicating it.

Uncovering a highly anticipated discovery in physics is not something that happens by chance, it requires prior knowledge, dedication, effort, time, money, manpower and much more to make it happen. Dr. Piyadasa and his team sacrificed a lot for this discovery, before getting their research findings published. Sri Lankan Scientist team is, therefore, indeed thankful to Dr. Gamini Piyadasa for sharing the story behind the discovery with us.

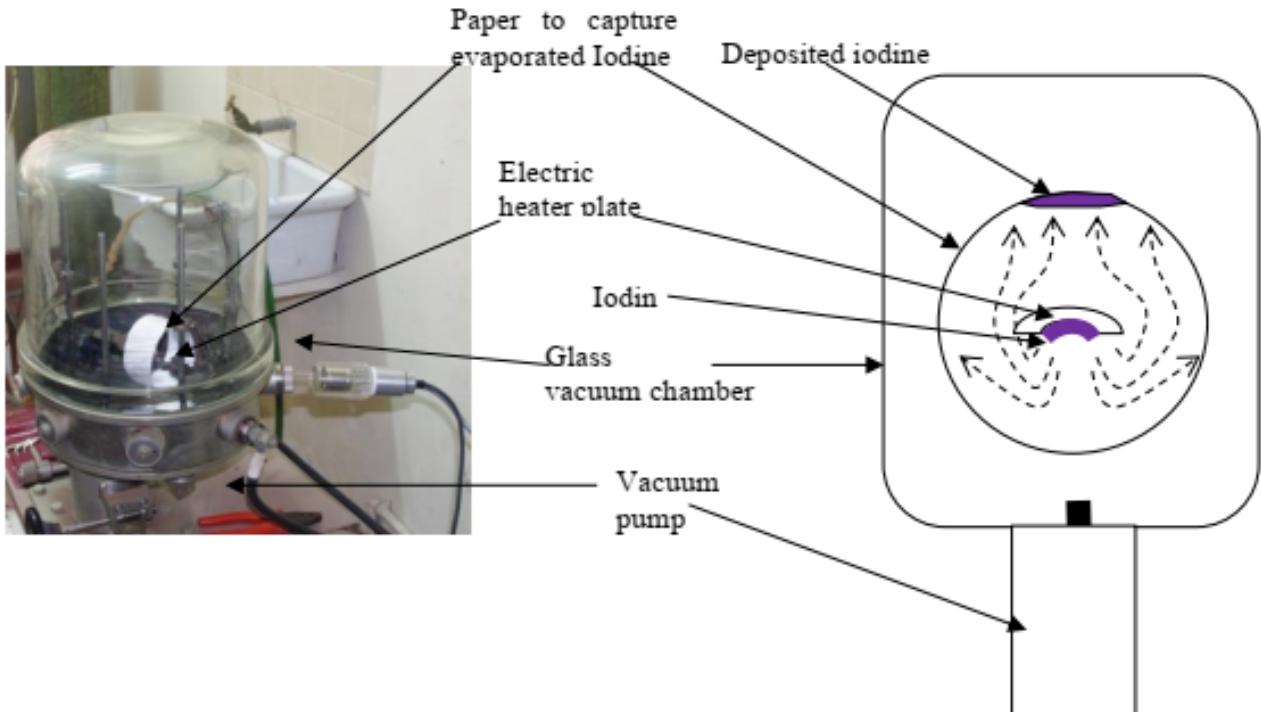


Fig. 1. Experimental set-up to observe movement of heat-evaporated iodine vapor in vacuum. (a). Vacuum deposition chamber (b). A layer of iodine was slowly heat evaporated in downward direction inside the vacuum chamber. A paper was surrounded along the iodine source in order to capture the deposition geometry of iodine. The paper was placed 50 mm radially away from the iodine source.

All eyes are now on this discovery. As Bertrand Russell, in *The Conquest of Happiness* (1930) says, "The happiest in the present day are the men of science." Thus, living in an era of less attention for new science, this versatile physics breakthrough gives us hope and provide us opportunities to for the budding young physicists to change the world with their knowledge and passion. Eventually, they will realize that there is no limit of for the ideas of physics.

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eXtreme space facts

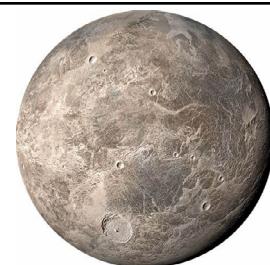
Better stick with a rubber ducky

Saturn is the only planet in our solar system that is less dense than water. It could float in a bathtub if anybody could build a bathtub big enough.



Fastest

True to its namesake (the speedy messenger of ancient Roman gods), Mercury is the fastest planet in our solar system. It zips around our Sun at an average of 172,000 kilometers per hour (107,000 miles per hour) - about 65,000 kph (40,000 mph) faster than Earth. A year on Mercury is equal to 88 Earth days.



Biggest and smallest!

Ceres is the largest, most massive body in the main asteroid belt between Mars and Jupiter, totaling about a third of the total mass of the entire belt. But Ceres is the smallest of the dwarf planets, which include Pluto and Eris, and the only dwarf planet that resides in the asteroid belt.

WORLD ENVIRONMENT DAY—2022

Only One Earth



#OnlyOneEarth



By Sisira Kumara

Every year on June 5th, the world commemorates World Environment Day. It is the most crucial day for environmental action and transformational change in the fight to save the world. Every year on World Environment Day, the United Nations Environment Program (UNEP) hosts events to raise awareness and urge action for environmental protection.

Only One Earth is the theme of World Environment Day 2022.

The first World Environment Day was held on June 5th, with the theme "Only One Earth." (Photo courtesy of the UNEP website)

The first World Environment Day was held 50 years ago with the slogan "Only One Earth." It is still true five decades later, because the Earth is still our sole home, and humanity must protect its precious resources. The global campaign for World Environment Day 2022 uses the hashtag #OnlyOneEarth to push for policy and choice improvements that enable cleaner, greener, and more sustainable living in harmony with nature.

Historical Context and Significance

Indira Gandhi, the Prime Minister of India, attended the first United Nations Conference on

Environment in 1972. Participants endorsed a set of principles, the Stockholm Declaration and Action Plan, and several other resolutions at the meeting. The United Nations Environment Programme was also established at the Stockholm Conference (UNEP).

"The concept of World Environment Day was conceived 50 years ago at the Stockholm United Nations Conference on the Human Environment in 1972.

Inger Andersen, UN under-secretary-general and executive director of the UN Environment Programme, stated in a statement for World Environment Day 2022, "It was born out of the idea that we need to stand up to protect the air, land, and water on which we all rely."

World Environment Day has been observed annually since 1974, and it has grown in importance as a platform for advocating progress toward the Sustainable Development Goals' environmental goals.

Each year, nearly 150 countries take part in the festivities, which are organized by the UNEP. Environmental causes are championed by large corporations, non-governmental organizations,

towns, governments, and celebrities all around the world.

Sweden will Host World Environment Day in 2022.

Every year, a different country hosts World Environment Day, which includes celebrations and meetings. Sweden is the host country this year. With the help of UNEP and other partners, a high-level international gathering commenced yesterday (2nd June 2022).

"Stockholm+50: a healthy planet for the prosperity of all – our responsibility, our opportunity" is the theme of the gathering. The events including this special gathering will highlight the most pressing environmental challenges we face.

Global wellbeing is at risk – and it's in large part because we haven't kept our promises on the environment – UN Secretary-General António Guterres said on Thursday during the opening session of the Stockholm+50 meeting.

Part of the solution lies in dispensing with Gross Domestic Product (GDP) as a gauge of countries' economic clout, the Secretary-General continued, describing it as an accounting system "that reward(s) pollution

There is #OnlyOneEarth. And each of us has the power to spark the change needed for people and planet.



WORLD
ENVIRONMENT
DAY 2022



and waste".

He added: "Let us not forget that when we destroy a forest, we are creating GDP. When we overfish, we are creating GDP. GDP is not a way to measure richness in the present situation in the world."

After calling on all nations to commit further to implementing the 17 Sustainable Development Goals and following the 2015 Paris Agreement to tackle these threats, the Secretary-General also insisted that greater efforts were needed to

bring emissions to net zero by 2050.



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World Ocean Day 2022, Revitalization: Collective Action for the Ocean

By Sisira Kumara

Every year on June 8, the World Oceans Day is commemorated all across the world. Oceans cover more than 70% of the earth's surface and are vital to life's survival. Their deterioration could destabilize the earth's natural resource dynamics.

Theme

On World Oceans Day, June 8, 2022, the United Nations will highlight the theme Revitalisation: Collective Action for the Ocean.

According to the United Nations, seas supply roughly half of the world's oxygen and are home to the majority of the planet's living organisms. It is the world's primary source of protein for over 1 billion people. By 2030, around 40 million people will be employed in ocean-based enterprises.

Oceans also absorb roughly 30% of carbon dioxide created by humans, assisting in global warming mitigation. However, due to irresponsible human actions, oceans have seen 90 percent depletion of large fish populations and 50 percent damage of coral reefs over the years.

Every year, World Oceans Day serves as a reminder of the devastation caused by human activities such as garbage and sewage disposal, as well as oil spills.

The goal of the day is to create public awareness about the "effect of human actions on the ocean" and to mobilize citizens to ensure that it is managed sustainably.

History

The United Nations first suggested World Oceans Day in 1992 at the Rio de Janeiro Earth Summit. It was proposed that a day be set aside to promote awareness about the importance of oceans in our lives and how people can help protect them. The United Nations General Assembly issued a resolution designating this day on December 5, 2008. Other UN agencies, such as the United Nations Environment Programme (UNEP) and the Food and Agriculture Organization (FAO), seek to safeguard marine and coastal ecosystems in addition to UNESCO.

ENVIRONMENT

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**The Sri Lankan
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Sri Lanka and the Ocean

Being an island nation Sri Lanka is blessed to have the vast Indian Ocean around the country. But the actions we have taken to safeguard this vital environment is something we can not be happy about. With major maritime disasters like the "Express Pearl" incident the ocean environment around the country is facing major challenge of survival.

As Sri Lankans, it's our duty and responsibility to protect this important ecosystem and educate the citizens about the importance of the ocean environment for the country and for the earth as a whole.



Unique Internal Transcribe Spacer 1 Gene Region in Ladybird Beetles

By A G B Aruggoda

Ladybirds are known by many people and much familiar to them specially because of their pretty, colorful and harmless nature. They are commonly found in and around dwellings at most of the time of year when most insects are not in evidence. Popular interests in the ladybirds go back at least to the fifth century and probably much further, together with the stories of superstitions in many parts of the world being famous specially for fine weather, foretelling the harvest of the year, deciding the future of the young girls and being a lovable phrase of the children's poems. When a ladybird landed on the arms children in European countries use to say,

Ladybird, ladybird, fly away home! Your house is on fire, your children all gone,

All but one, and her name is Ann, and she crept under the pudding pan

Apart from all ladybird beetles are important for farmers and agriculturists because of their predaceous nature being very beneficial from the viewpoint of the biological control of the insect pests, feeding during both larval and

adult stages upon aphids, scale insects, psyllids, phytophagous mites etc. which are injurious to various crops and forest plants. Most of the traditional classifications of ladybird beetles recognize six or seven subfamilies each with numerous tribes. Among these tribes Coccinellini commonly referred to as 'true ladybirds' are generally viewed as predators of aphids, but their diet is much more diverse and often includes other hemipteran insects (i.e., heteropterans, psyllids), beetle and moth larvae, fungal spores, pollen, and even plant tissues. Further, Ladybird beetles are frequently used as material in various fields of biological science, genetics, cytology, evolutionary biology, population ecology, biogeography etc.

The feeding behavior of ladybird beetles are identified as either herbivores or carnivores. These feeding behaviors decide interrelationships; similarities, and differences among individuals. Understanding these interrelationships or phylogenetic positions is important to decide the predaceous nature of these insects. Therefore, considering

the importance of ladybird beetles for biological control, attention has been given to identify the feeding behaviors within the family. At present, we have a rudimentary understanding of the food preferences for many species. However, broad scale evolutionary patterns of these insects remain unclear. The modern phylogenetic theory and practice, specially molecular phylogeny have been given a few attempts to address the higher-level phylogenetic relationship by interpreting the evolution of feeding patterns of the family. COI, 18S, 28S, 5S, ITS 1 and ITS II are popular molecular markers among scientists to resolve the different classification levels of organisms. The first internal transcribed spacer 1 (ITS1) is a part of the eukaryotic cistron of ribosomal DNA located between the genes coding for 18S and 5.8S rRNA. ITS 1 is responsible for the relatively high rate of evolution giving interesting evidence across the spacer region for different taxonomic groups. The most important is ITS 1 region generally provides sufficient levels of nucleotide variation for phylogenetic evidence below the species and genus level. However, the extents of genetic variation vary between closely related taxa. In some organisms, ITS 1 cistron

is conserved resolving phylogenetic relationships even within subfamilies. The observed differences in the gene sequence variation in these spacers between taxonomic groups would tell us a story about their evolutionary histories. The most prominent feature identified in ITS 1 gene region of some genera is having long internal repetition as well as simple repeats which leads to extreme length variation. These repetitive sequences are given concerted evolution through molecular processes such as unequal crossing over, replication slippage and biased gene conversion, which leads to length variation of the gene regions. The majority of Eukaryotes usually show ITS 1 lengths of no more than 800 base pairs (bp), and almost all of them are shorter than 1,100 bp. Some ladybird beetles were reported having ITS 1 gene region with 1671 bp. The ITS 1 cistron of the ladybird beetles had shown amazing variation in lengths, it is reported some having more than 1600 bp. Apart from that, numerous simple repeats of bases were identified along with the sequences. Some of the ladybird beetles had shown high accumulation of Adenine (A) and Thiamine (T) content

repeats in 5' flanking region, while high accumulation of G (Guanine) and C (Cytosine) repeats in 3' flanking region. DNA sequences with high GC content, particularly in repeat units considered structurally stable, plays an important role in ribosome biogenesis through the processing of the pre-RNA. Moreover, in the base composition analysis of the ITS I regions of ladybird species, all four bases were found in equal frequencies. This suggests indeed, that the repeat regions are having an accumulation of GC bases across the spacers. These observations, taken together, suggest that simple repetitions in these insects ITS I are representing functional regions basically in the 3' flanking region.

In addition, similarities were observed among numerous simple repeats along the sequences of similar species, however, the frequency of occurring repeatability shows some difference between two species of belong to two genera. Moreover, for two subfamilies, species were included from more than one tribe; does not show any significant simple repetitions. Taken together all the above observations suggest that sequence simple repetition in ladybirds

do not share similarities above the genera level. However, the similarity of simple repetitive regions is closer to the species-specific or sometimes specific among the closely related group of species only. This possibility would also explain a common AT bias in different length-variable regions of rRNA molecule, most probably considered as this has happened during evolution. The discovery of these Significant Simple Repeat's with location and the type of repeats definitely would be helpful to expand the current knowledge of the evolutionary dynamics of this spacer with regard to the future understanding of amazing discoveries about ladybirds on their food preferences thereby opening new possibilities of applying biological control to the Agriculturally important crops and to the forest plants.



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Sri Lankan Scientist Magazine to be Issued as an Online Magazine Due to the Ongoing Crisis

With the sky rocketing printing and paper costs the Sri Lankan scientist magazine will be issued as an online magazine from this issue onwards. The magazine copies will be available for download from the online shop of the www.scientist.lk website. For the time being the magazine will be free to download from the website. And also all the subscribers of the magazine will be notified via an email and they will be updated with the download link.

The management of the Sri Lankan Scientist Media Network informs the readers of the magazine that the magazine will be issued as a printed version when this situation eases-up and become normal. Until such time the magazine will be issued as an online/digital version. And also the articles on the magazine will be posted directly in the scientist.lk website for those who like to read them online.

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VOLUME 08 | ISSUE 02 | ISSN - 2420-7306

Space Economy, Space Industries and Sri Lanka

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a Sri Lankan
Researcher, wins “
Linnean Medal”

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IPCC Latest Report
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IPCC Releases the Latest Report on Climate Change:

Warns a Threat to Human Wellbeing and Health of the Planet

by Sisira Kumara

On 28th February 2022, Intergovernmental Panel on Climate Change (IPCC) released their latest report on Climate Change. The report predicts the unavoidable multiple climate hazards over the next two decades with global warming of 1.5°C (2.7°F). The report themed Climate Change 2022: Impacts, Adaptation and Vulnerability is the Working Group II contribution to the IPCC Sixth Assessment Report which assesses the impacts of climate change, looking at ecosystems, biodiversity, and human communities at global and regional levels. It also reviews vulnerabilities and the capacities and limits of the natural world and human societies to adapt to climate change.

This report summarizes the current understanding of observed climate change impacts on ecosystems, human societies and their cities, settlements, infrastructures and industrial systems as well as vulnerabilities and future risks tied to different socioeconomic

development pathways. The report is set against a current backdrop of rapid urbanisation, biodiversity loss, a growing and dynamic global human population, significant inequality and demands for social justice, rapid technological change, continuing poverty, land degradation and food insecurity, and risks from shocks such as pandemics and increasingly intense extreme events from ongoing climate change. The report also assesses existing adaptations and their feasibility and limits. Any success of adaptation is dependent on the achieved level of mitigation and the transformation to global and regional sustainability outlined in the Sustainable Development Goals (SDGs). Accordingly, adaptation is essential for climate-resilient development. Compared to earlier IPCC assessments, this report integrates more strongly across the natural, social and economic sciences, highlighting the role of social justice and diverse forms of knowledge, such as Indigenous knowledge and local knowledge,

and reflects the increasing importance of urgent and immediate action to address climate risk.

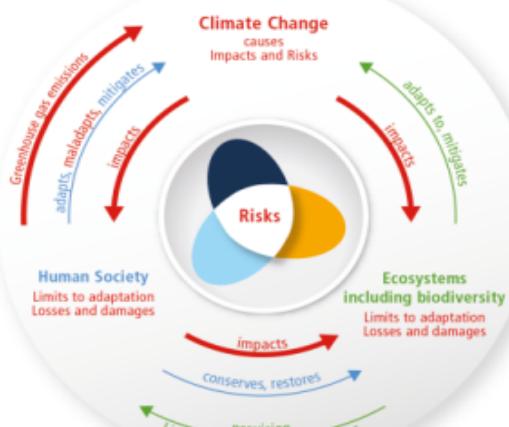
"This report is a dire warning about the consequences of inaction," said Hoesung Lee, Chair of the IPCC. "It shows that climate change is a grave and mounting threat to our wellbeing and a healthy planet. Our actions today will shape how people adapt and nature responds to increasing climate risks."

Urgent action required to deal with increasing risks

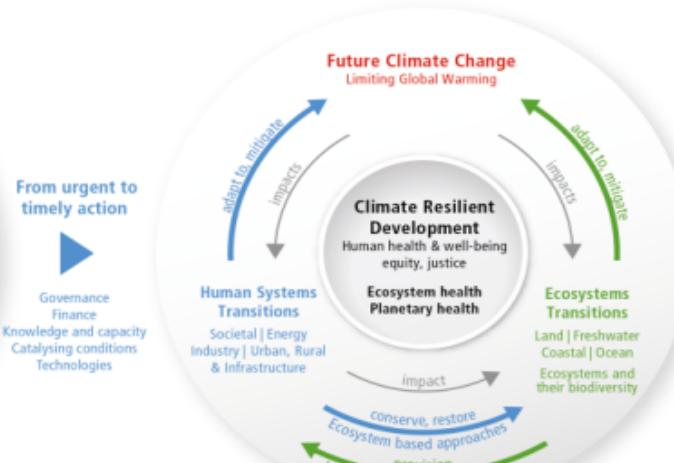
Increased heatwaves, droughts and floods are already exceeding plants' and animals' tolerance thresholds, driving mass mortalities in species such as trees and corals. These weather extremes are occurring simultaneously, causing cascading impacts that are increasingly difficult to manage. They have exposed millions of people to acute food and water insecurity, especially in Africa, Asia, Central and South America, on Small Islands and in the Arctic.

From climate risk to climate resilient development: climate, ecosystems (including biodiversity) and human society as coupled systems

(a) Main interactions and trends



(b) Options to reduce climate risks and establish resilience



The risk propeller shows that risk emerges from the overlap of:



Fig 1. This report has a strong focus on the interactions among the coupled systems climate, ecosystems (including their biodiversity) and human society. (Source – IPCC AR6 WGII Summary For Policymakers)

To avoid mounting loss of life, biodiversity and infrastructure, ambitious, accelerated action is required to adapt to climate change, at the same time as making rapid, deep cuts in greenhouse gas emissions. So far, progress on adaptation is uneven and there are increasing gaps between action taken and what is needed to deal with the increasing risks, the new report finds. These gaps are largest among lower-income populations.

The Working Group II report is the second instalment of the IPCC's Sixth Assessment Report (AR6), which will be completed this year.

"This report recognizes the interdependence of climate, biodiversity and people and integrates natural, social and economic sciences more strongly

than earlier IPCC assessments," said Hoesung Lee. "It emphasizes the urgency of immediate and more ambitious action to address climate risks. Half measures are no longer an option."

Safeguarding and strengthening nature is key to securing a liveable future

There are options to adapt to a changing climate. This report provides new insights into nature's potential not only to reduce climate risks but also to improve people's lives.

"Healthy ecosystems are more resilient to climate change and provide life-critical services such as food and clean water", said IPCC Working Group II Co-Chair Hans-Otto Pörtner. "By restoring degraded

ecosystems and effectively and equitably conserving 30 to 50 per cent of Earth's land, freshwater and ocean habitats, society can benefit from nature's capacity to absorb and store carbon, and we can accelerate progress towards sustainable development, but adequate finance and political support are essential."

Scientists point out that climate change interacts with global trends such as unsustainable use of natural resources, growing urbanization, social inequalities, losses and damages from extreme events and a pandemic, jeopardizing future development.

"Our assessment clearly shows that tackling all these different challenges involves everyone – governments, the private sector, civil society – working together to prioritize risk reduction, as well as equity and justice, in decision-making and investment," said IPCC Working Group II Co-Chair Debra Roberts.

"In this way, different interests, values and world views can be reconciled. By bringing together scientific and technological know-how as well as Indigenous and local knowledge, solutions will be more effective. Failure to achieve climate resilient and sustainable development will result in a sub-optimal future for people and nature."

Cities: Hotspots of impacts and risks, but also a crucial part of the solution

This report provides a detailed assessment of climate change impacts, risks and adaptation in cities, where more than half the world's population lives. People's health, lives and livelihoods, as well as property and critical infrastructure, including energy and transportation systems, are being increasingly adversely affected by hazards from heatwaves, storms, drought and flooding as well as slow-onset changes, including sea level rise.

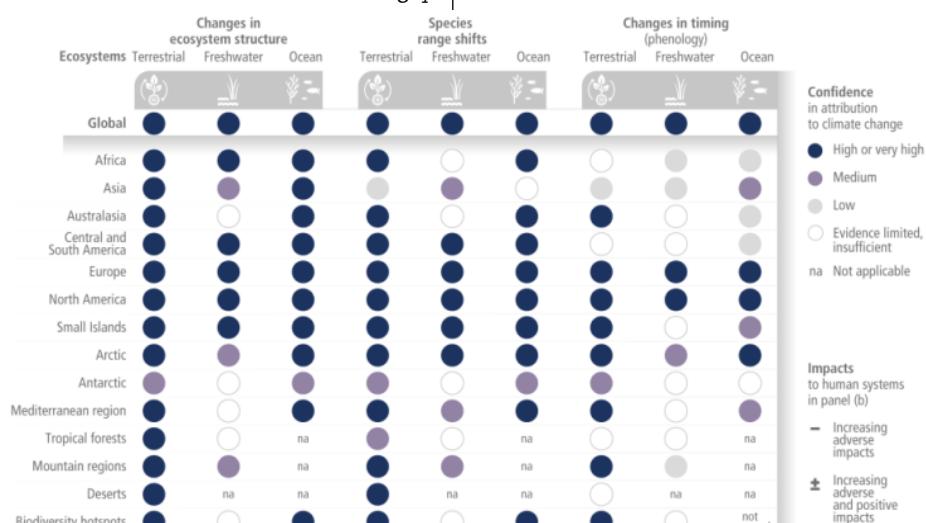


Fig 2. Observed global and regional impacts on ecosystems attributed to climate change

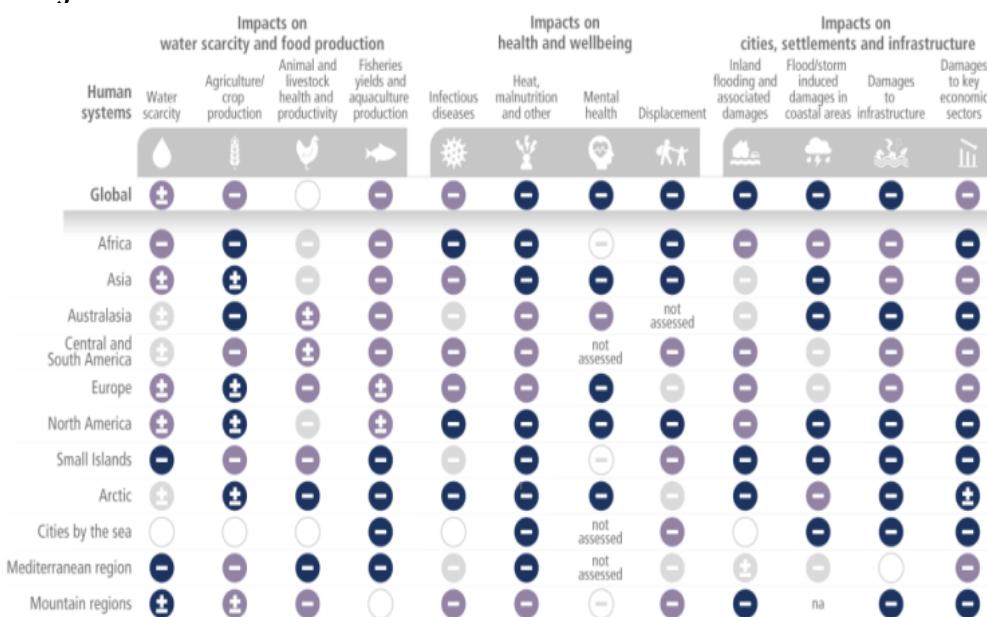


Fig 3. Observed global and regional impacts on human systems attributed to climate change

ENVIRONMENT

"Together, growing urbanization and climate change create complex risks, especially for those cities that already experience poorly planned urban growth, high levels of poverty and unemployment, and a lack of basic services," Debra Roberts said.

"But cities also provide opportunities for climate action – green buildings, reliable supplies of clean water and renewable energy, and sustainable transport systems that connect urban and rural areas can all lead to a more inclusive, fairer society."

There is increasing evidence of adaptation that has caused unintended consequences, for example destroying nature, putting peoples' lives at risk or increasing greenhouse gas emissions. This can be avoided by involving everyone in planning, attention to equity and justice, and drawing on Indigenous and local knowledge.

A Narrowing Window for Action

Climate change is a global challenge that requires local solutions and that's why the Working Group II contribution to the IPCC's Sixth Assessment Report (AR6) provides extensive regional information to enable Climate Resilient Development.

The report clearly states Climate Resilient Development is already challenging at current warming levels. It will become more limited if global warming exceeds 1.5°C (2.7°F). In some regions it will be impossible if global warming exceeds 2°C (3.6°F). This key finding underlines the urgency for climate action, focusing on equity and justice. Adequate funding, technology transfer, political commitment and partnership lead to more effective climate change adaptation and emissions reductions.

"The scientific evidence is unequivocal: climate change is a threat to human wellbeing and the health of the planet. Any further delay in concerted global action will miss a brief and rapidly closing window to secure a liveable future," said Hans-Otto Pörtner.

An Eye Opener for Sri Lanka

Sri Lanka is facing the imminent adverse effects of global warming with the fast faced destruction of Sri Lankan environmental hotspots in the name of development. These devastation can already be seen in the form of agricultural, industrial, and residential developments. Thousands of acres around the

country are being cleared of natural vegetation, natural waterways are being blocked to create reservoirs, and so many pollutants are being added to the natural ecosystems, creating favorable conditions for climate change. Even though Sri Lanka is a small island, it is home to areas with many different climatic conditions, and the country has been very lucky to have a weather pattern that has a unique bond with the agriculture-based living systems in the country. This delicate climatic conditions and weather patterns have shown a significant change that can be attributed to climate change, which has been accompanied by the destruction of the natural environment in and around the country.

But one of the most alarming facts is that neither the Sri Lankan people nor the policy makers seem to have any concern about climate change, so they seem to keep a blind eye towards the destruction happen



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Influential Sri Lankan Astronomers Of All Time

Allen Abraham

Professor Allen Abraham (1865 – 9 July 1922), born Ambalavanar Subramaniar was an Astronomer, Ceylon Tamil academic, Tamil Pundit, Poet and Christian lay preacher. Ambalavanar was born in 1865 on the island of Karaitivu (Karainagar) in northern Ceylon. He taught Astronomy to the B.A classes for over twenty years. It was also his hobby throughout his life.[2] He wrote several articles on the subject for the Morning Star and the Jaffna College Miscellany, the college journal. He took a keen interest in the 1910 appearance of the Halley's comet and made two important predictions. These predictions were recorded in the 28th March 1910, Ceylon Observer newspaper and later proven true. He was elected Fellow of the Royal Astronomical Society on 12 January 1912, having been proposed by A. V. Jugga Row, in 1911.



Cyril Ponnamperuma

Cyril Ponnamperuma was born in Galle, Sri Lanka on 16 October 1923. He studied at St. Aloysius' College, Galle and subsequently at St. Joseph's College, Colombo. He obtained his Bachelor of Arts degree in philosophy from the University of Madras. He obtained a Bachelor of Science degree in chemistry in 1959 at Birkbeck, University of London. In 1962, he received a doctorate in chemistry from the University of California, Berkeley under the direction of the Nobel Laureate Melvin Calvin. In 1962, he was honored with a National Academy of Science resident associateship with NASA at Ames Research Center. In 1963 he joined NASA's Exobiology Division and took over the helm of the Chemical Evolution Division. He was selected as the principal investigator for analysis of lunar soil brought to earth by Project Apollo. Thereafter, he was closely involved with NASA in the Viking and Voyager programmes and was offered membership in both the Space Science Advisory Council and Life Sciences Advisory Council of NASA.

According to Arthur C. Clarke, "No other scientist of Sri Lankan origin was internationally known and respected as he was". He produced over 400 scientific publications and held a number of prestigious academic posts during his rather short lifespan.

Sarath Gunapala

Sri Lanka Ranajana Sarath Gunapala, was born in Yatiyantota, Kegalle. He studied at Nalanda College, Colombo, Sri Lanka (1966 – 1974/ Grade 6- 12). He obtained his Ph.D. for Physics from University of Pittsburgh, 1985, M.S. in Physics from University of Pittsburgh and B.S. in Physics from University of Colombo, Sri Lanka, 1979.

Gunapala joined NASA in 1992 after working at AT&T Bell Laboratories. He is a solid-state physicist, senior research scientist and group supervisor at NASA's Jet Propulsion Laboratory. He works primarily in Quantum Well Infrared Photo Detecting. He is also a board member of Quantum Well Infrared Photodetector Technologies LLC.



Chandra Wickramasinghe

- Nalin Chandra Wickramasinghe (born 20 January 1939, Colombo) is a Sri Lankan-born British mathematician, astronomer and astrobiologist. He studied at Royal College, Colombo. he graduated in 1960 at the University of Ceylon with a BSc First Class Honors in mathematics, and obtained his PhD and ScD degrees at Trinity College and Cambridge respectively. His research interests include the interstellar medium, infrared astronomy, light scattering theory, applications of solid-state physics to astronomy, the early Solar System, comets, astrochemistry, the origin of life and astrobiology.

Wickramasinghe published the first definitive book on Interstellar Grains in 1967. He has made many contributions to this field, publishing over 350 papers in peer-reviewed journals, over 75 of which are in Nature. Fred Hoyle and Wickramasinghe ((As a student and collaborator of Fred Hoyle) further proposed a radical kind of panspermia that included the claim that extraterrestrial life forms enter the Earth's atmosphere and were possibly responsible for epidemic outbreaks, new diseases, and genetic novelty that Hoyle and Wickramasinghe contended was necessary for macroevolution.

Dr. Nalin Samarasinha

Dr. Nalin Samarasinha is a Sri Lankan born Astronomer based in United States of America. Nalin earned a BSc First Class Honors in Physics from University of Colombo after schooling at Nalanda College Colombo. Later he gained a MSc in astronomy from University of Maryland, College Park USA and followed it up furthering studies graduating with a PhD in Astronomy from the same University in USA.



Currently he works as a Senior Scientist for Planetary Science Institute. Dr. Samarasinha's research interests are focused on the study of comets and other small bodies of the solar system. His studies include understanding the physics and chemistry of cometary nuclei and comae, including rotational studies of nuclei and interpretation of coma morphologies, the structural properties of small bodies in the solar system, the rotational and physical properties of Trans-Neptunian objects, and the physical properties of asteroids. In 2002, The International Astronomical Union renamed Asteroid (12871) 1998 ML37 found by Lowell Observatory as Asteroid (12871) Samarasinha in honor of Dr Nalin Samarasinha. Dr Samarasinha is the first native born citizen of Sri Lanka to gain the distinction of having an Asteroid named after him.



Rohan Pethiyagoda, a Sri Lankan Researcher, has been awarded the prestigious "Linnean Medal" by The Linnean Society of London.

Rohan Pethiyagoda, Sri Lanka's leading naturalist and a taxonomist of freshwater fish of Sri Lanka, won the prestigious "The Linnean Medal" award by the Linnean Society of London, which is the world's oldest active society devoted to natural history. This medal is awarded annually by the council of the Linnean Society alternately to one or two biologists (in any field), as an expression of the society's esteem and appreciation for service to science. Mr. Pethiyagoda is the first Sri Lankan scientist, and the second Asian scientist honored with this award since the program began way back in 1888.

The Linnean Society of London is the oldest functioning natural history society in the world. The Society takes its name from the Swedish naturalist Carl Linnaeus (1707–1778), whose botanical, zoological, and library collections have been in our care since 1829. It was founded in 1788 by Sir James Edward Smith (1759–1828), who served as its first President. These unique collections will continue to be vital as a key source of plant and animal naming information. They are complemented by the

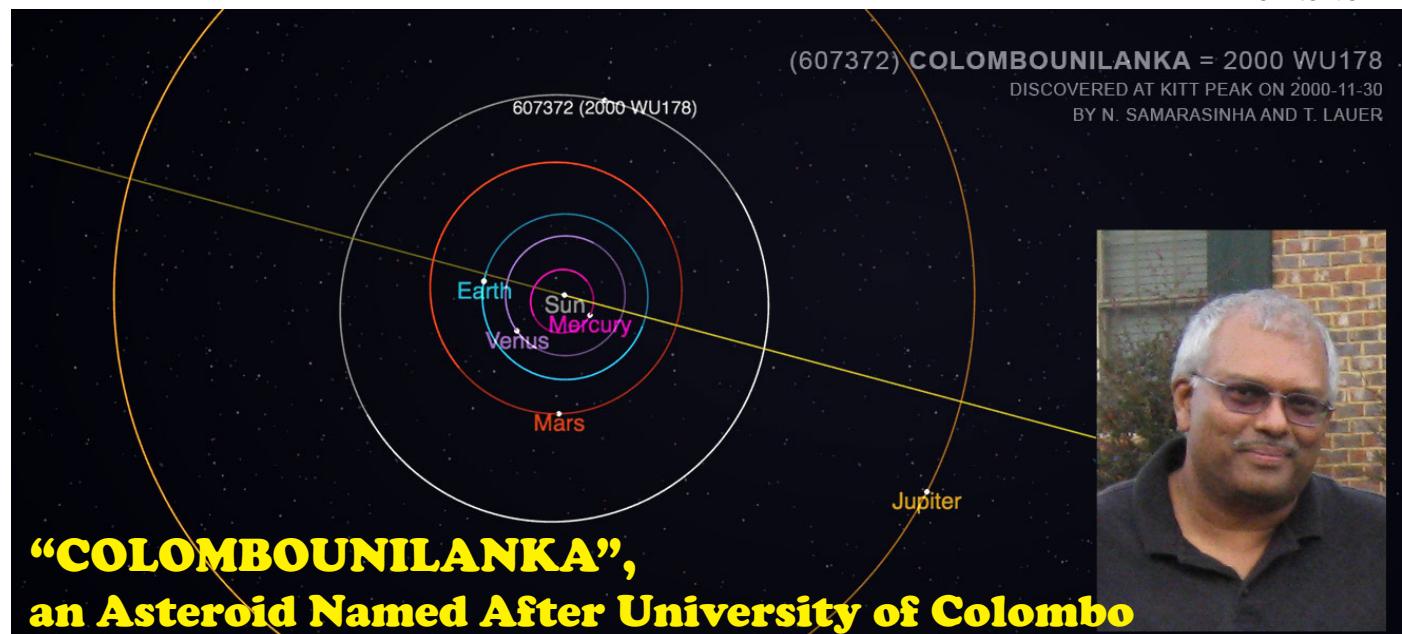
society's extensive library, which has important scientific and cultural resources.

Announcing the award, the official website of the Linnean Society of London highlighted the contributions of MR. Pethiyagoda towards the biodiversity of Sri Lanka.

Mr. Rohan Pethiyagoda has been an employee and advisor to the government of Sri Lanka, serving as Chairman of the Water Board in the 1980s. His 1991 monumental Freshwater Fishes of Sri Lanka was hailed as a landmark achievement, treating the island's diverse ichthyofauna more comprehensively and authoritatively than ever before. Over the next decade, both Rohan and his Wildlife Heritage Trust (WHT), set up with the profits from the book, became synonymous with the exploration, discovery, and documentation of Sri Lanka's biodiversity and the wider application of this to enhance the biogeography of the broader region. His program of original and collaborative research (both Sri Lankan and overseas) has resulted in publications on many zoological groups in addition to fishes. His

impact on biodiversity research in Sri Lanka and beyond through his output and catalytic influence cannot be overestimated."

Through his research, he has contributed immensely towards the conservation of the biodiversity of Sri Lanka. His work in identifying new fresh water fish species has been recognized globally. As of now, Mr. Pethiyagoda and his research partners have discovered and described almost 100 new species of vertebrates from Sri Lanka, including fish, amphibians, and lizards, together with 43 species of freshwater crabs. Honoring his contribution to the biodiversity research, many newly discovered animal species have been named after Mr. Pethiyagoda. Those include fishes Dawkinsia rohani and Rasboroides rohani; the microhylid frog Uperodon rohani; the dragon lizard Calotes pethiyagodai; the jumping spider Onomastus pethiyagodai and the dragonfly Macromidia donaldi pethiyagodai. Very recently, in 2020, a team of scientists led by S. D. Biju named a new genus of South and Southeast Asian tree frogs Rohanixalus, in Pethiyagoda's honour.



"COLOMBOUNILANKA", an Asteroid Named After University of Colombo

The International Astronomical Union (IAU) formally named an asteroid after the University of Colombo on March 21, 2022. Dr Nalin Samarasinha, a University of Colombo alumnus, and Dr Tod Lauer, a fellow astronomer, found this asteroid in 2000 from the Kitt Peak National Observatory in Arizona, USA. The asteroid was recently given the number 607372 and the discoverers were given official discovery credit once its orbit was thoroughly established. A numbered asteroid's discoverers are allowed to name it according

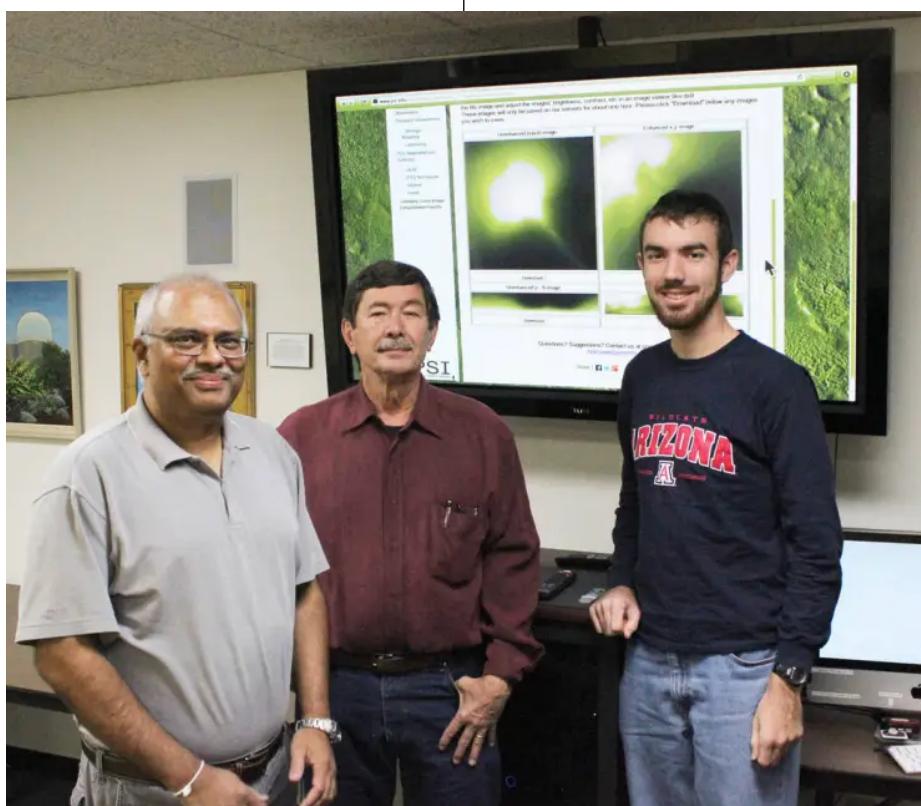
to a set of rules. Following these standards, the IAU designated the asteroid "Colombounilanka." This is the first time a scientist of Sri Lankan descent has been given credit for naming an asteroid. Only a few institutions throughout the world have asteroids named after them, and the University of Colombo is now one of them. Colombounilanka is a 1-2 kilometer asteroid located in the middle of our Solar System's asteroid belt. As a result, it is never on the verge of colliding with Earth and is always more than 1.4 astronomical units (i.e.

more than 210 million kilometers) away. In a slightly elliptical orbit, Colombounilanka takes 4.2 years to complete a full round around the sun. Only a strong telescope will be able to observe this asteroid.

Dr. Samarasinha stated he named the asteroid after the University of Colombo, which recently celebrated its centennial, in honor of the university's contributions to higher education, as a tribute to his university lecturers, and as an inspiration to the future generation of students in Sri Lanka.

In a special message Prof. Chandrika Wijeyrathne, Vice Chancellor of University of Colombo congratulated the team of scientists behind this discovery and thanked them for taking the name of the university to a remarkable height.

"This story of our university "joining the cosmos" has brought home two fundamental facts, viz. what an amazingly humble, professional, capable and committed group forms our UoC community when reaching such astounding heights, and the wonderful tribute paid to his alma mater by our reputed alumnus. Most importantly, our future generations can be greatly inspired by such gratifying stories of value-added education that paves the way for even more discoveries by such true sons and daughters of Lanka." Prof Chandrika stated in her message.



Planetary Science Institute senior scientist Dr Nalin Samarasinha (Left) with two other scientists (Image – NASA)



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Study Shows Higher Rates of Renal Injuries Among Children in CKDu Endemic Areas

By Sisira Kumara

Chronic Kidney Disease of Unknown Etiology/Uncertain Cause (CKDu) is a type of chronic kidney disease that primarily affects impoverished agricultural communities in dry zone of Sri Lanka where a substantial number of people develop an inexplicable, fatal form of kidney disease.

Because the affected population is one of the most important groups of the Sri Lankan economy and are exposed to many occupational and environmental dangers, as well as the disease's current status as a "medical mystery," CKDu has gotten a lot of attention from the science community locally and internationally. As of now several groups of scientists are continuing research on CKDu.

Results of one such study have been published recently in Nature Scientific Reports Journal. According to this study, a significantly higher rate of renal injury has been observed among the school children of the CKDu endemic areas. In this study urine samples of 804 children aged between 10-18 years have been tested for kidney injury molecule (KIM-1) and Neutrophil Gelatinase-associated Lipocalin (NGAL) biomarkers to determine the presence of early renal injury. KIM-1 is a useful biomarker for renal proximal tubule injury facilitating the early diagnosis of the disease and serve as a diagnostic discriminator while urine NGAL has also been used as an early predictor for acute kidney injury.

For this research, school children had been selected from Padaviya, Medirigiriya, Ampara, Sewanagala and Udawalawa areas. According to the publication these locations represent CKDu endemic (En), emerging (Em) and non-endemic (NE) regions in the country. Early morning first voided urine sample was obtained from each participant and the supernatant taken from the centrifugation of these samples were assessed for KIM-1 and NGAL using specific Enzyme-Linked Immunosorbent Assay

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Image 1 - Research team collecting urine samples of children in one of the schools.

(ELISA) kits.

According to the results of the study it has been revealed that pediatric urinary KIM-1 expression increased with increasing CKDu burden in residential area, even in the absence of albuminuria. But, urinary NGAL in children did not demonstrate noteworthy variations with residential CKDu prevalence.

Speaking of this results, Prof. Mangala De Silva said, "This study is the first study that focused on

pediatric renal injury among school children in Sri Lanka. Our results indicate that children living in CKDu hotspots may exposed to the same risk factors as adult farmers and reported possible early renal injury. However, ongoing cohort studies in the same geographical locations may predict the disease progression. We hope that current study alone with mixture toxicity studies will certainly help to solve the mystery behind the disease."

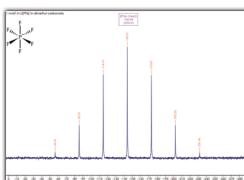


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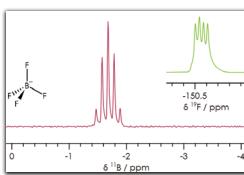
Image 2 - Prof. Mangala De Silva was one of the scientists of the team carried out this study (pic Isini Ranawake)

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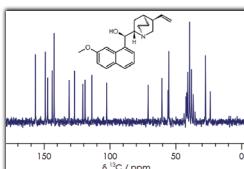


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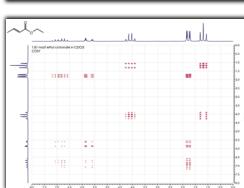
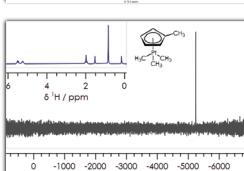
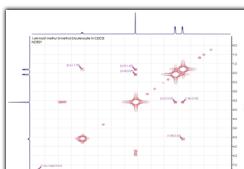
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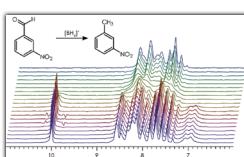
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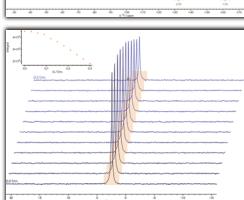
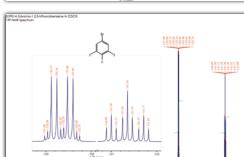
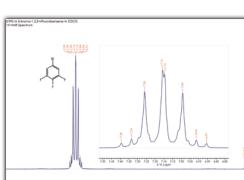
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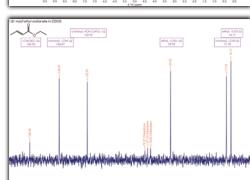
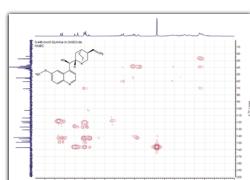


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| Cs | Ba | V | |
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The Sri Lankan Scientist

RESEARCH SNIPPETS



Low-cost Microfluidic Electrochemical Paper-Based Device to Detect Glucose
With the increasing number of diabetic patients in our society, checking blood glucose level has become a normal practice for many. Most of the available methods are invasive methods that require blood samples from body tissues. A team of scientists from University of Colombo has come-up with a solution to change this in a recent research. In their research published in Journal of Science of the University of Kelaniya they have introduced a novel low-cost electrochemical microfluidic paper-based analytical device (μ PAD) suitable to monitor glucose levels using sweat and saliva. According to their publication this device uses a paper matrix and varnish for the fabrication of paper. Prior research data have been used to correlate the saliva and sweat glucose level to the blood glucose level.

Authors - Fernando, W.T.H., Jayarathna, H.K.V.S. and Kaumal, M.N., 2022.

Source - Low-cost microfluidic electrochemical paper-based device to detect glucose. Journal of Science of the University of Kelaniya Sri Lanka, 15(1), pp.21-33.

DOI: <http://doi.org/10.4038/josuk.v15i1.8043>



Pasta from Jackfruit

A research team from University of Peradeniya has developed a novel process to manufacture pasta from a composite flour made from Jackfruit seed flour (JFS) and Jackfruit Bulb flour (JFB). In this research the researchers have used dried and ground Jackfruit Bulbs and seeds to make flour and these two types of flour have been used in different ratios with cassava flour (CF), corn flour and semolina to test the different compositions. According to the research publication the team have selected JFS: JFB: semolina: CF: corn flour, at the ratio of 40:40:10:5:5. By looking at the physical properties and cooking characteristics the research team is hopeful of value added jackfruit flour pasta as a product with a higher potential for commercialization as a convenient food for the consumers with busy lifestyles.

Authors - Lakmali, H.D.S. and Arampath, P.C.,

Source - Development of jackfruit (*Artocarpus heterophyllus*) bulb and seed flour-based pasta. Journal of Dry Zone Agriculture, 7(2), pp.97–113.

DOI: <http://doi.org/10.4038/jdza>



Long Lost species of Dragonflies Re-Discovered in Sri Lanka

A group of scientists from the University of Colombo and university of Sri Jayawardenapura have rediscovered Sri Lankan Clubtail (*Anisogomphus ceylonicus*), one of the rarest species of dragonflies in the country. According to lead scientist Amila Sumanapala Sri Lankan Clubtail is one of the rarest species of dragonflies. This discovery was done during a field survey done in Nikapotha, a village situated in the foothills of Haputhale. *Anisogomphus ceylonicus* is one of the rarest of the Sri Lankan odonatan with very few recorded sightings after its' first discovery in 1878.

Source - TAPROBANICA, ISSN 1800-427X. May, 2022. Vol. 11, No. 01: pp. 35–37, pl. 9.

Authors - Amila Prasanna Sumanapala, Tharindu Ranasinghe, Dilani Rachitra Sumanapala

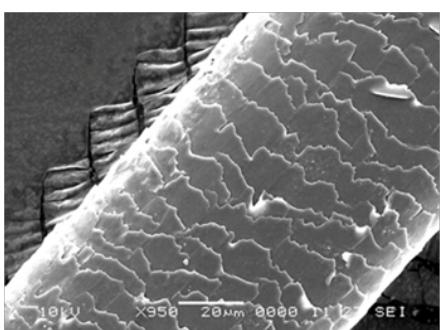
DOI: [10.47605/tapro.v11i1.276](https://doi.org/10.47605/tapro.v11i1.276)

Basics of Scanning Electron Microscopy

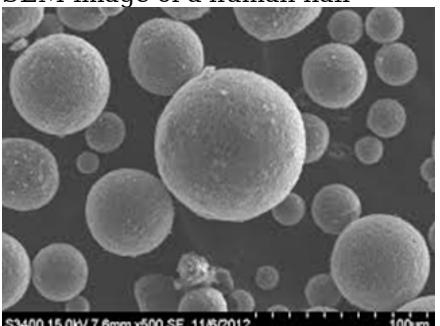
by Dr. R Chinthaka L De Silva



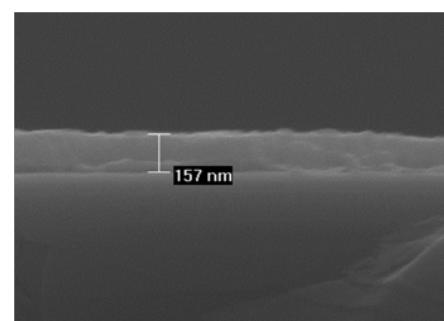
In material science a common insitu method of analyzing the surface morphology of a sample is by using a scanning electron microscope. A Scanning Electron Microscope (SEM) analyses sample surface well beyond optical microscope. It is a very useful technique in the materials characterization with the advantage of incorporating very little sample amounts and it is a non-destructive technique which implies that the samples are not being damaged and could be recovered. The electrons interact with atoms in the sample, producing various signals that contain information about the surface morphology and composition of the particular sample.



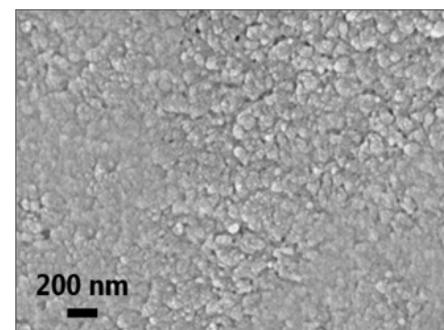
SEM image of a human hair



SEM image of fly ash

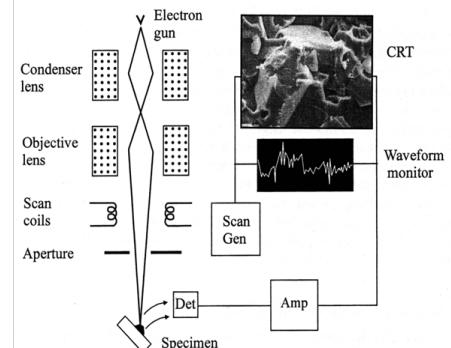


SEM image Alumenium sheet thickness



SEM image of Zn Nano composite

The only requirement for this technology is that the sample must be conductive, since the method has to have interactions with the electrons emitted by the equipment and the sample. If not a sample metallizer could be used on nonconductive samples to get them conductive by depositing a few nanometer layer to get the sample conductive by means of physical vapor deposition, mainly gold particles are commonly used in this regard. SEM produces High resolution images. It allows us to know what type of surface topology our sample has, its defects and its composition.



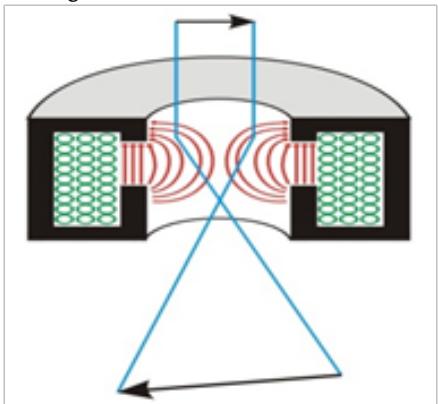
Schematic diagram of the SEM

The resolution of modern SEMs is of the order of 2 nm. This compares with a resolution of about 1 mm for a conventional optical microscope. However it is to be said that the next type of electron microscope which is the transmission electron microscope (TEM), in which electrons pass through a very thin sample, has a higher resolution compared to the SEM (~ 0.1 nm). Individual atoms can be imaged in the TEM but not with the SEM. Basically a heated cathode filament feeds with a voltage difference produces an electron beam and is accelerated through another voltage difference (averaging around 5-20KV) towards a center hole anode enabling minus charged electrons to run through. It is then directed at the surface of the sample. As the sample collides with the electron beam the minus electrons are scattered and will be collected using a plus charged detector where then it will be photo multiplied before feeding it to the computer system. Some use photo scintillators. Different types of detectors are used to capture different types of signals generated after the electron collision. The electron beam uses a rectangular scanning pattern called razor scanning to scan a specific location of a sample. The actual size could be magnified up to may be 30,000 or more with an SEM and nano scales too could be achieved with modern SEMs.

Two other main components located in between the sample and the gun is the Condenser lenses and scanning coil. The scanning coil delivers electromagnetic data as a secondary feed to the computer system. SEM must be carried out under vacuum conditions, where mostly two

LAB TECHNOLOGY

chambers are employed with the vacuum status. To insert samples the vacuum should be released with air and samples holders which carries samples are located inside before turning on the vacuum pumps. This is done mainly because electrons cannot travel through air.



Electromagnetic lenses

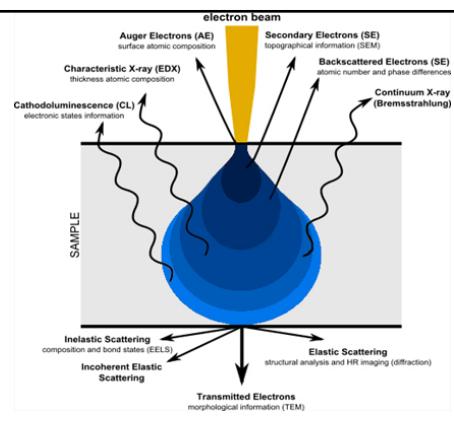
Condenser renders a divergent beam from a point source into a parallel or converging beam to illuminate an object. All modern SEMs use electromagnetic lenses. These consist of a coil of copper wires inside iron pole pieces. Solenoid of wire together with a magnetic pole piece creates and concentrates a magnetic field.



SEM filament

The standard filament of an SEM electron gun is mostly the tungsten filament used due to its low cost however Lanthanum hexaboride (LaB₆) and Cerium hexaboride (CeB₆) filaments are also available associating higher costs.

Types of signals scattered after electron collide with the sample



Electron signal generation

A basic SEM produces two main types of signals named as back scattering signal and the secondary signal.

Secondary Electrons (SE)

Unlike BSEs, SEs originates from the surface or the near-surface regions of the sample. They are a result of inelastic interactions between the primary electron beam and the sample and have lower energy than the backscattered electrons. Secondary electrons are very useful for the inspection of the topography of the sample's surface.

Backscattered Electron Imaging (BSE)

BSEs come from deeper regions of the sample, whereas SE originates from surface regions. BSE images show high sensitivity to differences in atomic number; the higher the atomic number, the brighter the material appears in the image. SE imaging can provide more detailed surface information

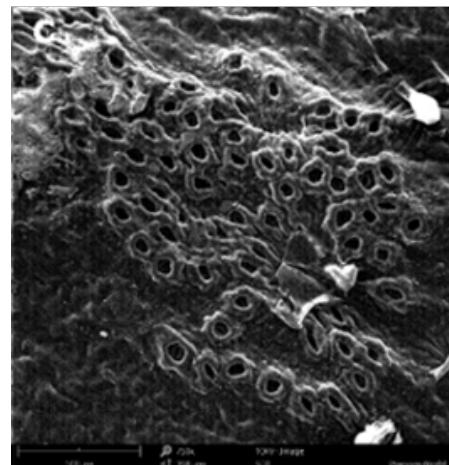
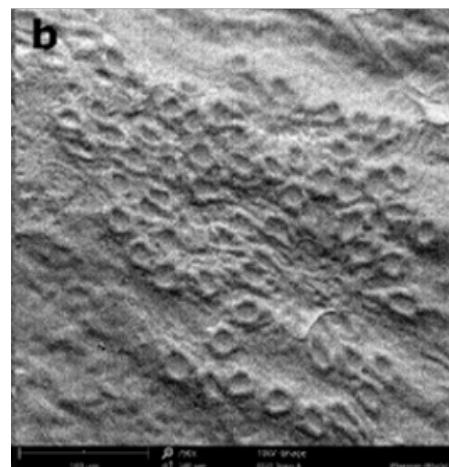
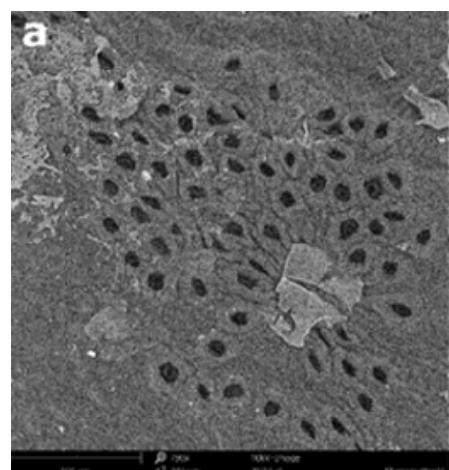
BSEs originate from a broad region within the interaction volume. They are a result of elastic collisions of electrons with atoms, which result in a change in the electrons' trajectories.

When electrons collides with larger atoms much stronger electrons scatters compared to light atoms, which produce a higher signal. The number of the backscattered electrons reaching the detector is proportional to their atomic number. This dependence of the number of BSEs on the atomic number helps us differentiate between different phases, providing imaging that carries information on the sample's composition. BSE images can also provide valuable information on

crystallography, topography, and the magnetic field of the sample. However depending on the additional SEM facility further signals from deeper layers could capture other information as depicted below

X-ray detector (EDX, EDS or EDAX)

These detectors capture the energy from the X-rays generated on the surface (third layer of the 'pear') and they are characteristic of each element of the sample so they provide us with information about elemental composition. Unlike the



(a) SE Detector (b) back scatter
(c) BSE Detector

BSE, they provide us with more information on the sample allows us to know in a semi-quantitative way the composition of the surface of our sample.

X-ray Detector (WDS)

Similar to EDX, but instead of receiving the energy of all X-rays at once, it only measures the signal generated by a single element. It is a slower but more sensitive and precise technique.

Diffracted backscattered electron detector (BSED)

This detector receives the energy of electrons diffracted by the surface that comply with Bragg's law and provide information on the crystal structure of the sample

Differences of SEM, FE-SEM or FIB-SEM

SEM: Conventional SEMs that we have already explained and have a thermal source of electrons.

FE-SEM : (field emission SEMs): they have electron source with a field emission gun to provide the high and low energy electron beams. Much focused beams allow better resolution.

Dual Beam/ FIB-SEM : (double beam microscope or focused ion beam SEMs): This has two columns, one of ions and the other at 52° of electrons. The ion column uses a Gallium (Ga +) ion beam. Ga + ions are 130,000 heavier than electrons, so the interaction with the sample is stronger although its penetration is less. Additionally,

ion slices can be made to visualize the inner layers

Electron microscopy can be used for **applications** as varied as:

- Product design failure analysis:** to know why a failure has occurred, for example is it a fatigue force that appeared to brake of a metal rod. The morphology and composition of defects that appeared in the quality tests of a product could be characterized. Another type of failure that can be studied are delaminations (material fractures into layers) and adhesion (tendency of dissimilar particles or surfaces to cling to one another).

- Characterization of surface texturing :** when the topography and structure that has been generated wants to be known

- Analysis of surface defects and quality control :** by means of the SEM it is possible to visualize the defects, to know the typology, for example the defects that appear under the normal behavior of use of the products.

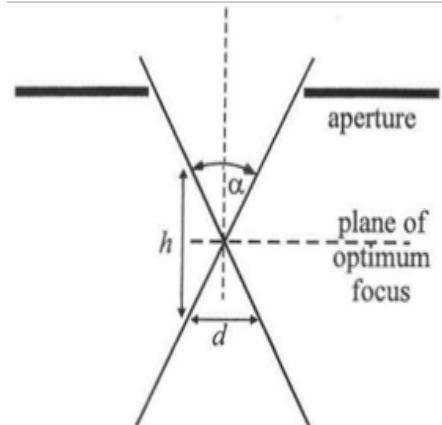
- Study of contaminants :** EDX detector is possible to find unwanted contaminants in the samples, which cause adhesion problems, painting or structural failures.

- Morphological and structural study :** it involves the identification and analysis of crystalline phases and transitions in different materials such as metals, polymers, ceramics, minerals or composites. To study the type of degradation

such as fatigue, corrosion, cracks, ...

- Competitor analysis :** the SEM technique is also used to study competitive products and perform benchmarking.

SEM technology talks about the depth of field which is the distance above and below the plane of optimum focus within which the image is in focus. The focussing of the image is vital part of the SEM test.



Depth of field diagram

In the diagram above, d represents the diameter of the electron beam at the specimen. The depth of field is h, since it makes no difference to the sharpness of the image if the object is anywhere within the range h



Dr. R Chinthaka L De Silva

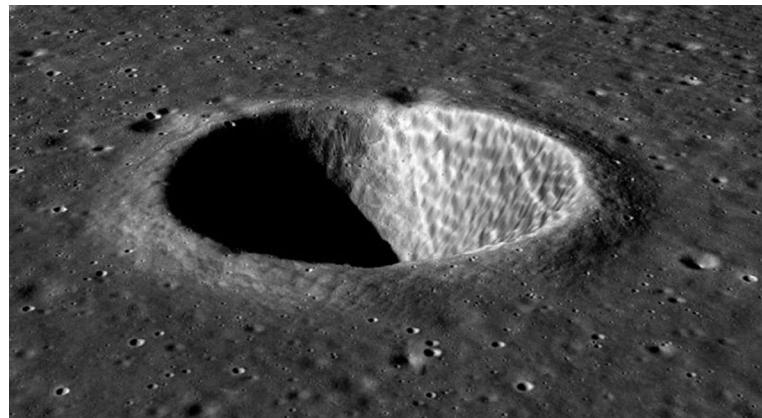
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Member : Sri Lanka Association for the
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Institute of Physics Sri Lanka (IPSL)

eXtreme space facts!



Pizza?

Jupiter's moon Io is the most volcanically active body in our solar system. The moon's bizarre, blotted yellowish surface looks like a pepperoni pizza!



Chill out!

Craters at the Moon's south pole may be the frostiest locale in the entire solar system. In the permanently shadowed crater floors, "daytime" temperatures may never rise above minus 238 degrees Celsius (minus 397 degrees Fahrenheit).



Sizzling Venus

The average temperature on Venus is more than 480 degrees Celsius (about 900 degrees Fahrenheit) — hotter than a selfcleaning oven.

Chronic Renal Disease in Dry and Intermediate Zones of Sri Lanka: Some Perspectives

By S.H.N.P. Gunawickrama

Initial information about a widespread chronic kidney disease in the north central province (NCP) of Sri Lanka became available in the mid 1990s. The cases emerged in unusually large numbers as compared to regular chronic kidney disease. Between 2003 and 2010, more than thirty thousand cases were documented in NCP alone [1]. The disease received recognition as a new form of CKD, which is now known as chronic kidney disease of unknown etiology (CKDu) in Sri Lanka. Initially, the disease was prevalent in Medawachchiya, Kebithigollewa, and Padaviya, Girandurukotte, Mahiyanganaya, and Dehiatthakandiya, as well as in the Medirigiriya and Nikaweawa areas [2]. The areas affected fell into adjacent climatic zones of the island known as the dry and intermediate zones.

Risk factors

The terminology "CKDu" is used when the medically accepted CKD risk factors do not describe the possible cause of the chronic kidney disease. The term "risk factor" is defined as a condition that increases the likelihood of developing a particular disease. It may be any physical, chemical, or biological agent, or perhaps a combination of them. Major CKD risk factors [3] include hypertension, diabetes mellitus, and urinary tract infections or obstructions, which, unless controlled or eliminated by medical treatment, would lead to kidney damage. Cardiovascular disease, a family history of kidney disease, a low nephron number, and systemic infections are also risk factors. A family history of kidney diseases indicates increased vulnerability to CKD due to the genetic predisposition of the individual. Nephrons are the functional units of the kidney, and their number per kidney is set before birth in humans. When the number is low, the individual has a risk of developing hypertension and chronic renal damage after

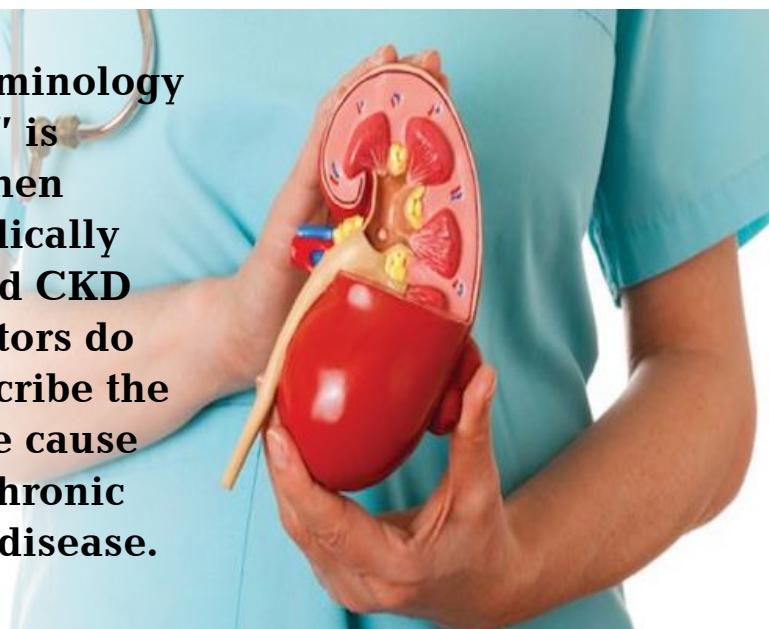
about 35 years of age. These are in fact termed "initiation risk factors" (IRF) as they could cause the disease themselves. However, notably, CKDu prevalence in NCP is associated with certain factors such as vocation as a paddy farmer, certain water quality parameters, and gender with male predominance. Multiple episodes of malaria are probably the most well known systemic infections in the CKDu endemic Padaviya and Nachchaduwa areas of Sri Lanka, which qualify as an IRF of the disease in statistical determinations [4].

Pathology and disease progression

CKDu is, however, quite similar to CKD, which is cosmopolitan and not endemic to a particular area. However, both in Sri Lanka appear to share the same histopathology, which is described as tubulointerstitial damage, and are diagnosed with the same clinical thresholds of estimated glomerular filtration rate (eGFR), and urine albumin to creatinine ratio (UACR). Kidney damage progresses with common symptoms and complications, particularly from CKD stage G3 onwards (anemia, immunodeficiency, and homeostasis failure) that culminate in what is known as end stage renal disease (ESRD). At ESRD (i.e., CKD stage G5), the patient

has to undergo either routine dialysis or a kidney transplant for survival. For these reasons, the Sri Lankan medical community in their patient diagnosis or management does not appear to pay much attention to the terminology difference. However, the question of what brought the disease to epidemic proportions within the dry zone, can not be disregarded as the culprit has to be a hitherto unidentified risk factor that prevails in the area. Perhaps a known CKD-IRF with such geoclimatic demarcation as autoimmunity [3] merits consideration. Autoimmunity refers to the situation where one's own immune system mounts reactions against self-components by mistaken identity. It results in targeted tissue damage that often has no permanent cure. Irrespective of the way CKD initiates itself, two major factors contribute to sustaining and propagating the damage from initiation onwards. Those are oxidative stress and inflammation, mostly within the renal setting. Both are inevitable outcomes of initial renal damage, and demolishers that drive and sustain disease progression towards ESRD. It has to be noted that management of these processes may improve the wellbeing of the people affected by the disease.

**The terminology
"CKDu" is
used when
the medically
accepted CKD
risk factors do
not describe the
possible cause
of the chronic
kidney disease.**



In the common scenario of proteinuric CKD/CKDu, chemical agents that trigger oxidative damage emerge right after blood albumin starts to pass through malfunctioning nephrons during early renal impairment. The reabsorbed albumin leads to what is known as increased generation of ROS (reactive oxygen species) inside tubule cells. ROS production beyond local antioxidant defense capacity causes oxidative damage to macromolecules. In the inflammatory pathway, initial tissue damage induces protective immune reactions against liberating self-antigens and, of course, for tissue-repair. The former, as we know, involves pro-inflammatory chemical messengers and recruitment of inflammatory cells into renal tissue. These agents and activities persist and become deleterious when the immune reaction is not resolving itself due to continued renal tissue damage. This creates a situation where renal tissue damage paves the way for further damage in an unending vicious cycle.

Distinguishing CKDu from CKD

In research, a way to identify CKD and CKDu with certainty remains a valid motivation. When symptoms and pathology do not differ, the only option is to rely on individual risk factor history, as CKDu cases should lack medically established IRF that existed prior to diagnosis. Such an endeavor may prove difficult as information may not be available in medical records and subject interviews may not always be dependable.

The validity of considering all cases with chronic renal failure in endemic areas as CKDu is a serious drawback evident in current work in the area. One of the efforts of the writer in this regard showed that in the Padaviya and Girandurukotte/Mahiyanganaya areas, about 3.5% and 14.5% of total CKD/CKDu patients, respectively, did not reveal any IRF prior to initial diagnosis with poor renal outcomes [4]. Estimates and IRFs taken into account differ between authors [5]. Experience in CKDu endemic areas points to the fact that a sizable fraction of cases could be

attributed to their own IRF, hence CKD.

Proteinuria, nonproteinuria and screening programs

Renal dysfunction is primarily followed and even the disease progression stage is identified by determination of eGFR. It is based on the concentration of a metabolic byproduct known as creatinine in the serum. When kidneys malfunction, creatinine accumulates in the blood without being removed via urine, so that eGFR decreases accordingly. However, the renal damage suggested by eGFR needs to be verified. People in good renal health do not excrete proteins in their urine. When proteins, in particular albumin, appear in trace amounts, it is referred to as proteinuria, which confirms renal damage. People that develop CKD fall into two categories depending on whether they are proteinuric or not. CKD can exist without proteinuria (also referred to as normoalbuminuria) as well. Disease initiation pathways and IRFs are believed to have distinct etiologies (disease initiation pathways). It was reported that nonproteinuria prevailed among 23.29% and 35.66% of total CKDu subjects recruited from endemic GK/MH and PDV, respectively [6]. Some researchers even believe that nonproteinuric mechanisms are the most common cause of end-stage renal disease (ESRD) worldwide [7]. Proteinuria may develop in nonproteinuric cases during the course of CKD progression, even as late as stage G4.

CKD cases are detected and directed to hospitals in north central, Uva and in emerging areas by community screening programs that essentially measure urine albumin and other indicators for the purpose. The campaigns may easily overlook nonproteinuric individuals with renal impairment as they are not proteinuric. Therefore, the country is in need of a screening and diagnostic strategy that may identify nonproteinuric CKD during the first encounter.

CKD/CKDu; the way forward

The boundaries of the chronic kidney disease of unknown

etiology have expanded well into the intermediate zone by now. High prevalences have been reported from Minipe, Rideemaliyadda, Moneragala, and Wellawaya in UVA province, Thanamalwilla and Suriyawewa in the Southern Province, and Embilipitiya in Sabaragamuwa province, implying a gradual spread of chronic renal failure to the south-east along the dry zone and into the intermediate zone [8].

Three decades of living with the disease have gone by. There is still a need for a scientific strategy to contain the epidemic and to improve the wellbeing of the affected people. Risk factors also provide information on how to monitor the disease, but the actual proportion of CKDu in total CKD is unknown. Screening for major IRFs such as hypertension and diabetes mellitus from 35 years of age with subsequent management may prove useful in this regard and for more health related achievements as a country.

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Defence University,
Ratmalana

PUZZLE

Across

2. The First human to journey into outer space
4. This most famous comet was discovered by the British astronomer Edmund
7. This robotic spacecraft with a roving probe was landed on Mars in 1997
9. It is the only planet in the Solar system found by mathematical prediction rather than by empirical observation and the fourth largest planet by diameter
13. This planet is named after the Roman goddess of love and beauty
14. This space shuttle crashed in 1st February 2003 killing all 7 crew members
15. This planet has 82 moons (53 moons are confirmed and named and 29 moons are waiting for confirmation of discovery and official naming)
16. This planet has the shortest orbit around the Sun of all the Sun's Planets
19. The First artificial satellite successfully placed in orbit around the Earth
21. The Commander of Apollo 11

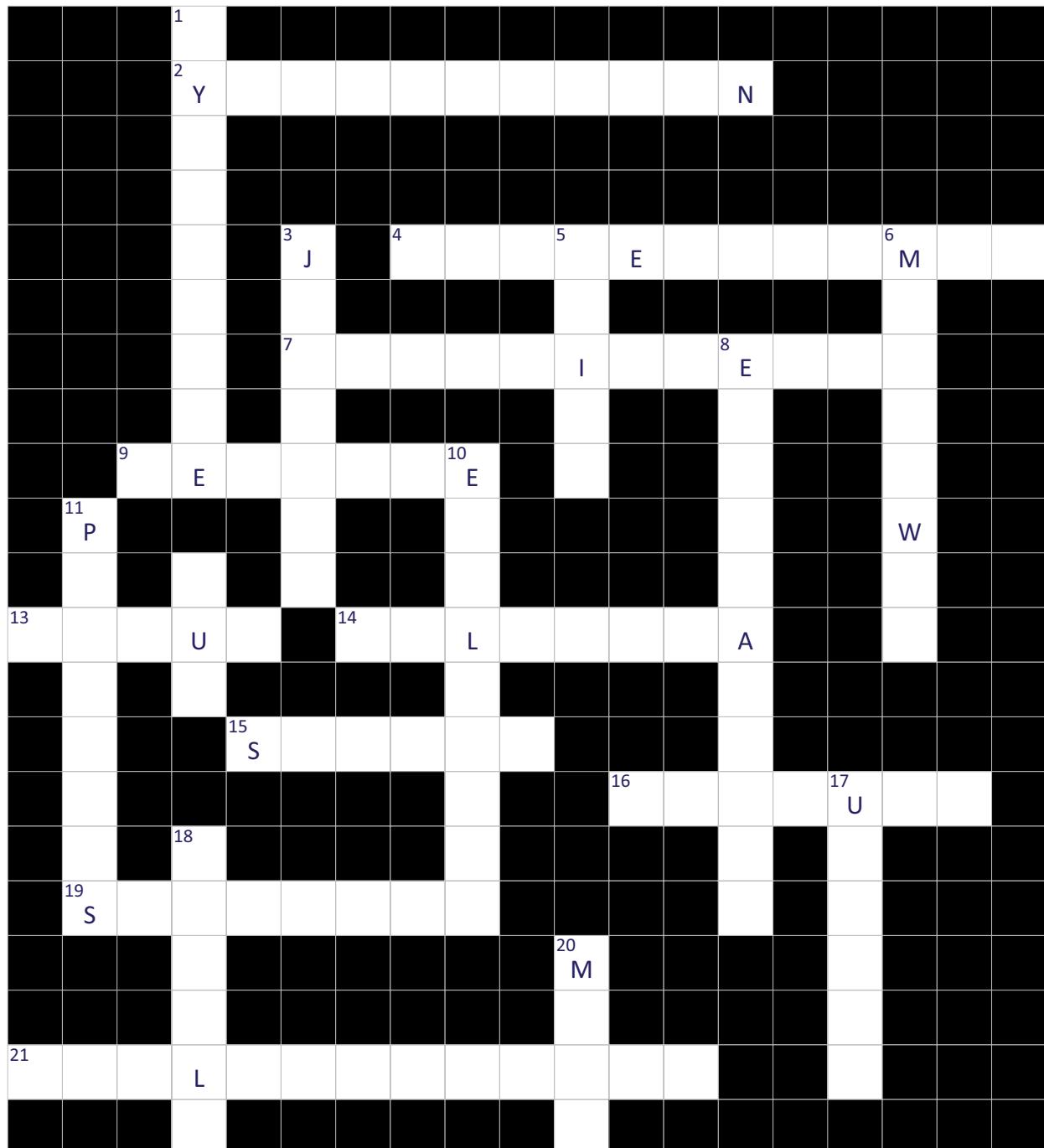
Down

1. This comet was discovered in 31st January 1996 and passed very close to the Earth in March 1996 and it was dubbed the Great comet of 1996
4. Io, Europa, Ganymede and Callisto are moons to this planet
5. She is the first mammalian conquer the space
8. The second human being to walk on the Moon
11. Seven sisters
17. The first planet found with the aid of a telescope
20. One and only natural satellite to the Earth
6. The galaxy that includes our solar system named as
10. The first satellite launched by United state
12. This star is located at the center of the solar system
18. This is the first space telescope

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A Glucose Meter Could Soon Say Whether You Have SARS-CoV-2 Antibodies

Press release by Journal of the American Chemical Society

Over-the-counter COVID tests can quickly show whether you are infected with SARS-CoV-2. But if you have a positive result, there's no equivalent at-home test to assess how long you're protected against reinfection. In the Journal of the American Chemical Society, researchers now report a simple, accurate glucose-meter-based test incorporating a novel fusion protein. The researchers say that consumers could someday use this assay to monitor their own SARS-CoV-2 antibody levels.

Vaccines against SARS-CoV-2 and infection with the virus itself can guard against future infections for a while, but it's unclear exactly how long that protection lasts. A good indication of immune protection is a person's level of SARS-CoV-2 antibodies, but the gold standard measurement – the enzyme-linked immunosorbent assay (ELISA) – requires expensive equipment and specialized technicians.

Enter glucose meters, which are readily available, easy to use and can be integrated with remote clinical services. Researchers have been adapting these devices to sense other target molecules, coupling detection with glucose production. For example, if a detection antibody in the test binds to an antibody in a patient's blood, then a reaction occurs that produces glucose – something the device detects very well. Invertase is an attractive enzyme for this type of analysis because it converts sucrose into glucose, but it's difficult to attach the enzyme to detection antibodies with chemical approaches. So, Netzahualcóyotl Arroyo-Currás, Jamie B. Spangler and colleagues wanted to see whether producing a fusion protein consisting of both invertase and a detection antibody would work in an assay that would allow SARS-CoV-2 antibody levels to be read with a glucose meter.

The researchers designed and produced a novel fusion protein containing both invertase and a mouse antibody that binds to human immunoglobulin (IgG) antibodies. They showed that the fusion protein bound to human IgGs and successfully produced glucose from sucrose. Next, the team made

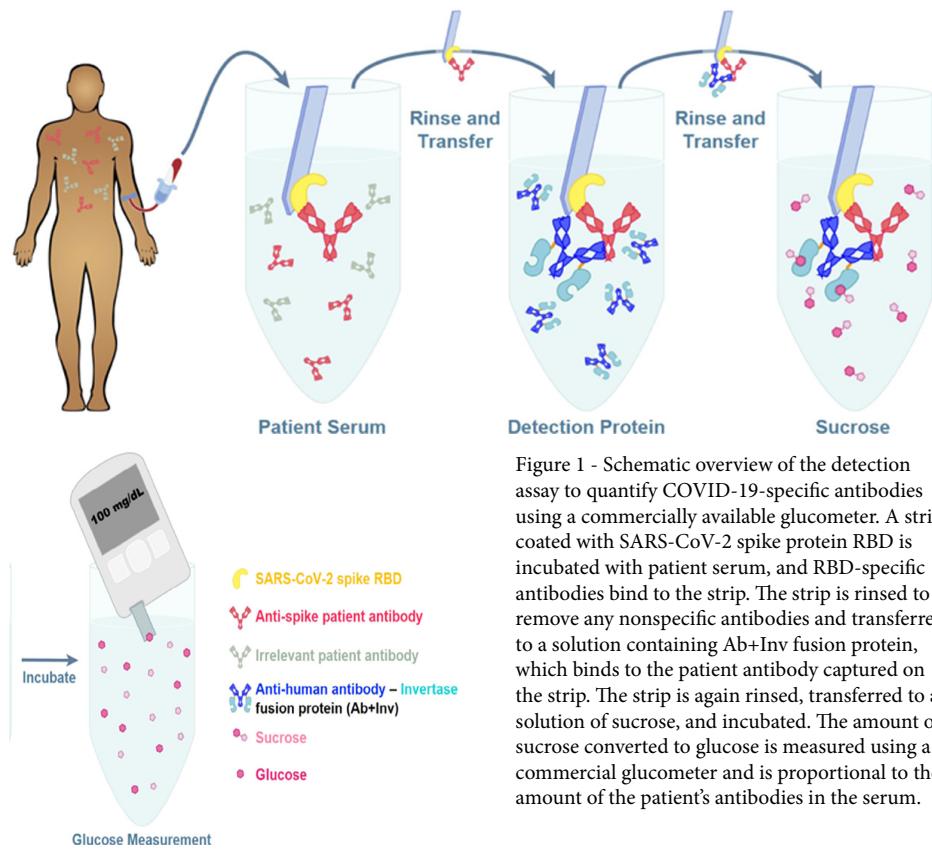


Figure 1 - Schematic overview of the detection assay to quantify COVID-19-specific antibodies using a commercially available glucometer. A strip coated with SARS-CoV-2 spike protein RBD is incubated with patient serum, and RBD-specific antibodies bind to the strip. The strip is rinsed to remove any nonspecific antibodies and transferred to a solution containing Ab+Inv fusion protein, which binds to the patient antibody captured on the strip. The strip is again rinsed, transferred to a solution of sucrose, and incubated. The amount of sucrose converted to glucose is measured using a commercial glucometer and is proportional to the amount of the patient's antibodies in the serum.

test strips with the SARS-CoV-2 spike protein on them. When dipped in COVID-19 patient samples, the patients' SARS-CoV-2 antibodies bind to the spike protein. Adding the invertase/IgG fusion protein, then sucrose, led to the production of glucose, which could be detected by a glucose meter. They validated the test by performing the analysis with glucose meters on a variety of patient samples, and found that the new assay worked as well as four different ELISAs. The researchers say that the method can also be adapted to test for SARS-CoV-2 variants and other infectious diseases.

The authors acknowledge funding from The Johns Hopkins University School of Medicine, the Emerson Collective Cancer Research Fund and the National Institutes of Health.

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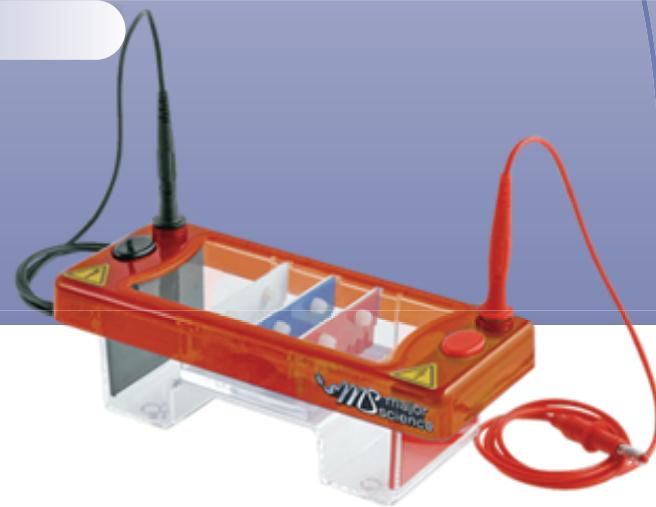
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