

GUJARAT
SCIENCE
ACADEMY

Estd. 1978 | Regn. F 659, Ahmedabad

॥ विज्ञानसारथिर्जयति ॥

"Science Chariots to Victory."

From President's desk



Gujarat Science Academy (GSA) was established in **1978**. It is an academy of leading scientists in Gujarat from various disciplines including physical and life sciences, education, broad spectrum of engineering sciences, environmental sciences as well as industry and technology areas.

Its activities address a wide spectrum of academic and societal issues with an emphasis on promotion and development of science. At present, the Academy has more than **257** fellows and **13** associate members from various disciplines. **GSA** strives to promote understanding of science in society, to create public awareness, and to contribute to the development and planning of science and technology in Gujarat. To this end, **GSA** undertakes many activities including lectures, conducting advanced courses, award lectures and medals, and a very vibrant annual **GSA** Congress that is very well attended by students and faculty from throughout Gujarat, and eminent scientists from the country.

All these activities basically represent three fundamental goals of the Gujarat Science Academy. The first is to encourage creativity and innovation amongst the youth, students, and enlighten citizens of Gujarat. We aim to do this by inviting novel ideas and projects from colleges and universities. Secondly, as we are all aware, there is so much to do for education and its development in Gujarat as well as the nation. We need to create an impact on our education, and **GSA** tries to do this with help from their eminent fellowship, thus influencing education and its policies in Gujarat. Finally, we aim to develop the scientific temper of our people, which should lead to a better, healthy, and holistic lifestyle. **GSA** solicits cooperation from all, and we hope this Newsletter that we launch herewith will serve our efforts in a big way.

Professor Pankaj S Joshi

President, Gujarat Science Academy

Editorial Board of GSA Newsletter

Dr Anjali Bahuguna, Ex-ISRO Scientist
Shri Harshal A. Sanghvi, Gujarat University

Dr Ratna Ghosal, Ahmedabad University
Dr Vrajesh Parikh, Founder- VOICE OF THE EARTH

Contact address of GSA: **Gujarat Science Academy**

ESTD 1978 (Registration No.: F 659, Ahmedabad)

(An organization to promote Science & Technology in Gujarat)

Department of Physics, Gujarat University Navarangpura Ahmedabad – 380 009 India

Contact Number - 079-26303041, Email for Newsletter: gsa.nl.2020@gmail.com

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Science Highlights

A Rare Astronomical Event

A newly discovered Comet C/2020 F3, also known as NEOWISE, which has been spotted from several parts of the world, is now visible over India, in the north-western sky from 14th July onwards for the next 20 days (until mid-August). It will be visible after sunset for around 20 minutes.

Neowise came from the outermost reaches of our solar system. It's orbit took it dangerously close to the Sun on July 3, 10 million miles closer than Mercury's orbit, but it survived and made its way towards Earth. It's close proximity to the Sun caused dust and gas to burn off its surface and create an even bigger debris tail (two brightly coloured tails of gas and dust). NASA's infrared space telescope discovered the comet in March. Scientists involved in the mission said the comet is about 5 kilometres across and its nucleus is covered with sooty material dating back to the origin of our solar system 4.6 billion years ago. It will be about 7000 years before the comet returns said the telescope's deputy principal investigator of NASA's Jet Propulsion Laboratory in Pasadena, California.

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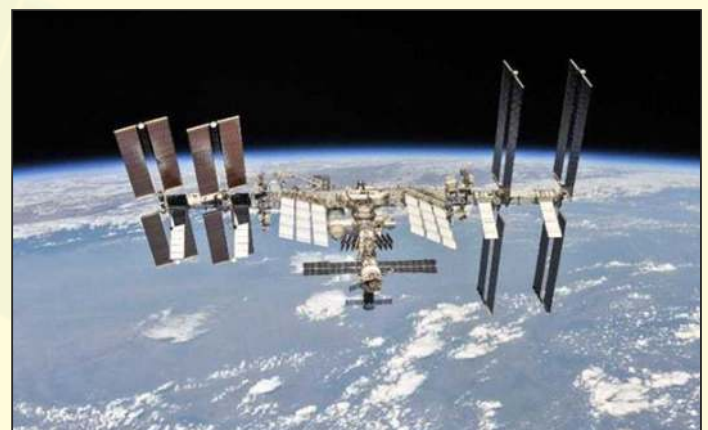
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Comet Neowise appears over Mount Washington in the US.

International Space Station in the Ahmedabad Sky

The International Space Station (ISS) has been orbiting our planet since 1998. From most locations on Earth, assuming you have clear night skies, you can see ISS for yourself. To us on Earth, it looks like a bright star moving quickly from horizon to horizon. It is traveling in space at a speed of 17,500 miles per hour. Unlike stars, the ISS doesn't flicker. As suddenly as it appears, it disappears. How do you know when to see ISS pass overhead from your location? NASA has a great tool to help – the Spot the Station program lets you sign up to receive alerts to let you know when ISS will be visible from your location – anywhere in the world. Plus there's a map-based feature to track when to look for the station as it flies over you in your night sky. Sightings can last as little as one minute or as long as six minutes, depending on the ISS's angle of travel relative to viewers on the ground. The brightness of the ISS comes from its massive solar panels, which reflects the light of the Sun. As the third brightest object in the sky after the sun and moon, the ISS becomes easy to spot once you know when and where to look.



The ISS is a modular space station in low Earth orbit

The **International Space Station (ISS)**, sky after the sun and moon, passed some 400 kilometres over Gujarat on Tuesday, 14th July night, giving people, especially in Ahmedabad and Rajkot, a glimpse of the space technology marvel.

In the Ahmedabad sky, the ISS was visible as a bright dot when it emerged from the south-west horizon at 8:35 pm on 14th July, and vanished some six minutes later in the opposite direction. "Due to its current path, ISS was clearly visible today for the people living in Ahmedabad and Rajkot. People in other cities of Gujarat may not have seen it this clearly mainly because the ISS did not pass directly overhead and remained at an angle," said Narottam Sahoo, an adviser with the Gujarat Council of Science and Technology (GUJCOST).

Free Online Course on Geoinformatics in Ecological Studies

ISRO centre Indian Institute of Remote Sensing at Dehradun, as part of its outreach programme, offers various live and interactive courses. Free online course on "Application of Geoinformatics in Ecological Studies" for organizations, students, NGOs and other stakeholders engaged in ecological studies. The course aims at giving learners an understanding of geoinformatics that can be used to give a better understanding of ecological systems. Participants will get to learn about an overview of the application of geoinformatics in ecological studies; ecological niche-based species distribution modelling; ecological studies using LiDAR; biodiversity assessment with geoinformatics; geostatistical analysis in ecological studies; biodiversity informatics and citizen science; satellite telemetry for wildlife studies; and ecological studies using cloud computing. Similar such courses outlined for August are Remote sensing applications for agriculture water management (1 week), Basics of RS, GIS and Global navigation satellite systems (14 weeks)

Source: <https://www.iirs.gov.in/>

IGNOU, New Delhi, is organizing Special Virtual Sessions for Post Graduate Certificate in Geoinformatics, School of Sciences. It covers topics ranging from basics of

geoinformatics, geospatial data, data sources, maps and mapping, topographic maps, GNSS and several applications including drone based Remote Sensing. Resource persons are drawn from several institutions across India. Virtual sessions are conducted through Google Meet Platform (meet.google.com/jji-qvfz-egn)

Elevation of BISAG

The Union Cabinet has recently approved Elevation of Bhaskaracharya Institute of Space Applications and Geoinformatics (BISAG), Gujarat as Bhaskaracharya National Institute for Space Applications and Geoinformatics (BISAG(N)) under Ministry of Electronics & Information Technology (MEITY), Government of India. The Institute endeavors to augment and enhance the applications of space technology and geoinformatics to support various developmental activities through creatively organized, comprehensive multi-purpose geo-spatial databases, web services and satellite communication. BISAG is the designated nodal agency for several national and state level projects including Department of Space, Govt. of India, sponsored NNRMS, IMSD project, Wasteland Mapping, Wetland Mapping, CAPE etc.

Source: <https://www.manifestias.com/2020/04/23/bhaskaracharya-national-institute-for-space-applications-and-geo-informatics-bisagn/>

Privatization of Space sector in India

Opening up of the space sector is part of the larger vision of transforming India to become self-reliant through a set of socio-economic reforms. The reforms in the space sector are aimed at tapping the potential of entire country for unlocking its potential by enabling private enterprises and start-ups to undertake end-to-end space activities. In addition, the reforms are also aimed at mitigating the large and upfront investments required to set up facilities for undertaking space activities through sharing of such existing facilities under ISRO. Under these reforms, an autonomous nodal agency called

Indian National Space Promotion and Authorisation Center (IN-SPACe) is being established under Department of Space as a separate vertical for permitting and regulating the activities of private industry in space sector. IN-SPACe will act as a national nodal agency to hand-hold and promote private endeavours in space sector and for this ISRO will share its technical expertise as well as facilities. A webinar on Space Sector Reforms will be conducted shortly wherein more details on IN-SPACe mechanism and application requirements, Announcement of Opportunities and role of NSIL will be shared with all stake holders.

Source: <https://www.isro.gov.in/update/25-jun-2020/briefing-secretary-dos-chairman-isro>

Space Technology for Societal Benefits

In this issue, we will discuss about using Space Technology for understanding, studying, monitoring and knowing the status of the natural resources. These studies are being carried out primarily by the Indian Space Research Organization. In Gujarat, Space Applications Centre (SAC) is one of the major centres of the Indian Space Research Organisation (ISRO), located at Ahmedabad. SAC focuses on the design of space-borne instruments for ISRO missions and development and operationalisation of applications of space technology for societal benefits. The applications cover communication, broadcasting, navigation, disaster monitoring, meteorology, oceanography, environment monitoring and natural resources survey. Besides these, the centre also contributes significantly in scientific and planetary missions of ISRO like Chandrayan-1, Mars Orbiter Mission etc. SAC has designed payloads for Earth observation satellites beginning with the Indian Remote sensing satellite series (IRS), Linear Imaging Self Scanner series (LISS I, LISS II, LISS III, LISS IV), CARTOSAT payloads, Ocean Colour Monitor series, etc. Earth observation applications include Geosciences, Agriculture, Environment and climate change, Coastal zone,

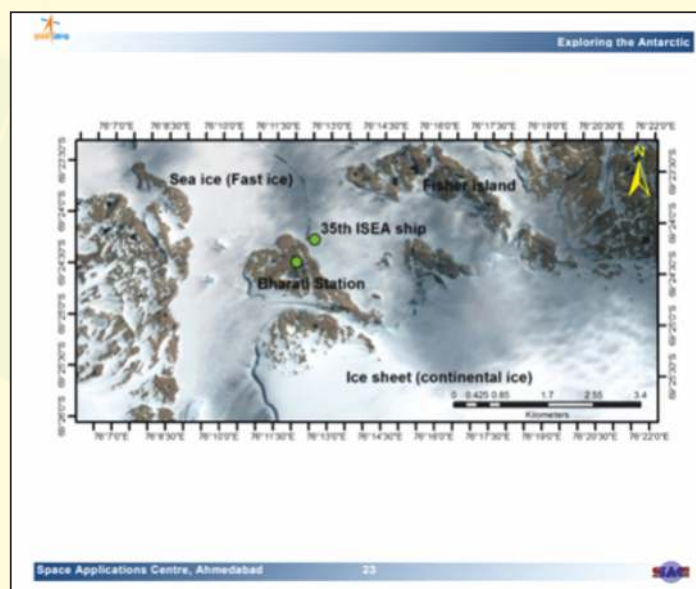
Coastal Ecosystems, Physical oceanography, Biological oceanography, Atmosphere, Cryosphere, Hydrosphere, etc.

Source: <https://www.sac.gov.in/Vyom/index.jsp>

SAC has launched Visualization of Earth observation Data and Archival System (VEDAS) VEDAS is an online geoprocessing platform using optical, microwave, thermal and hyperspectral Earth Observation data covering applications particularly meant for academia, research and problem solving, like, Renewable Energy, Coastal & Marine Resources, Hydrology, Climate Studies, Cryosphere, Atmospheric and Ocean Sciences, Planetary Sciences and so on. Image differencing, geospatial query & analysis and temporal classification are some of the tools available for analysis. It also offers Mobile Applications particularly Solar and Wind Calculator, which can be downloaded and used for computing, roof top solar insolation and energy potential for individual household. SAC has also launched Atlas of various themes, and are available in the VEDAS portal, such as,

Exploring the Antarctic (recently launched) : This book presents the highlights of various scientific studies in the Antarctic region undertaken by Space Applications Centre (SAC-ISRO) using the earth observation data and decade long experience (2009-2019) of participation in the expeditions to Antarctica coordinated by National Centre of Polar and Ocean Research (ESSO-NCPOR).

Source : <https://vedas.sac.gov.in/vcms/en/home.html>.



MOSDAC is a data repository for all the meteorological missions of ISRO and deals with weather related information, oceanography and tropical water cycles. Relevant data and information are disseminated from MOSDAC web portal of SAC, ISRO for the users to visualize and use as part of experimental forecasts and model inputs. MOSDAC also hosts and disseminates weather related information services and alerts over Mobile devices. The portal provides a variety of products and services on a wide spectrum of applications comprised of weather forecasting, cyclone prediction and other vital ocean and atmospheric parameters needed by national/international forecasting agencies, research organisations, educational institutions, individual researchers and students for advanced research.

Source: <https://www.isro.gov.in/earth-observation/mosdac>

Dr Anjali Bahuguna is an ex-ISRO scientist.

Ongoing Programmes for Students

SAC-Academic Associate Programme (SAC-AAP): The in-plant training programme (ITP) is open for students from academic institutes located in different parts of the country. It has been renamed as "SAC-Academic Associate Programme (SAC-AAP)" in 2014. SAC-AAP provides an opportunity for students to work with scientists/engineers on SAC projects and it has the following three schemes.

Work-Experience Internship (WEI): It is offered to engineering graduate (BE/BTech) students who are studying in India for their final year/semester project work for a period of minimum 4-6 months.

Dissertation Internship (DI): It is offered to post-graduate (ME/MTech/MSc/MCA) students who are studying in India for their final year/semester dissertation for a period of 6-12 months.

Research Internship (RI): It is offered to PhD scholars who are registered in Indian institutes for doing their thesis work which are relevant to SAC for a period of 4-12 months

Career Opportunities in Science

Fellowships and Funding Opportunities for School Students at national level:

The booklet published by the Indian National Science Academy (INSA) is aimed for the students in remote areas who have limited access to information on emerging possibilities for their career growth in Science. The book provides simple to understand flow charts and guidelines to help a student decide on his/her career trajectory. A list of various possibilities that exist in each area of science, the sources of fellowships, list of competitive examinations and web links of various programs and institutions is provided.

You may download the information booklet from the below link:

http://www.insaindia.res.in/pdf/INSA_School_Student_Opportunity.pdf

The 9R's of sustainability for circular economy

Sustainable development requires disruptive changes in the way our societies and businesses are organized. The circular economy (CE) model offers a new chance of innovation and integration between natural ecosystems, businesses, our daily lives, and waste management.

Find out below the definition, meaning, principles, advantages, and barriers to a circular economy model.

What Is A Circular Economy?

In the linear economy, raw natural resources are taken, transformed into products and get disposed of. On the opposite, a circular economy model aims to close the gap between the production and the natural ecosystems' cycles – on which humans ultimately depend upon.

This means, on one hand, eliminating waste – composting biodegradable waste or, if it's a transformed and non-biodegradable waste, reusing, remanufacturing and finally recycling it. On the other hand, it also means cutting off the use of chemical substances (a way to help regenerate natural systems) and betting on renewable energy.



"A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems, and business models."

"Looking beyond the current take-make-dispose extractive industrial model, a circular economy aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. It is based on three principles: design out waste and pollution; keep products and materials in use; regenerate natural systems."

The circular economy model makes a distinction between technical and biological cycles. Consumption happens only in biological cycles, where biologically-based materials (such as food, linen or cork) are designed to feed back into the system through processes like anaerobic digestion and composting.

These cycles regenerate living systems, such as soil or the oceans, which provide renewable resources for the economy. By their turn,

technical cycles recover and restore products (e.g. washing machines), components (e.g. motherboards), and materials (e.g. limestone) through strategies like reuse, repair, remanufacture or recycling.

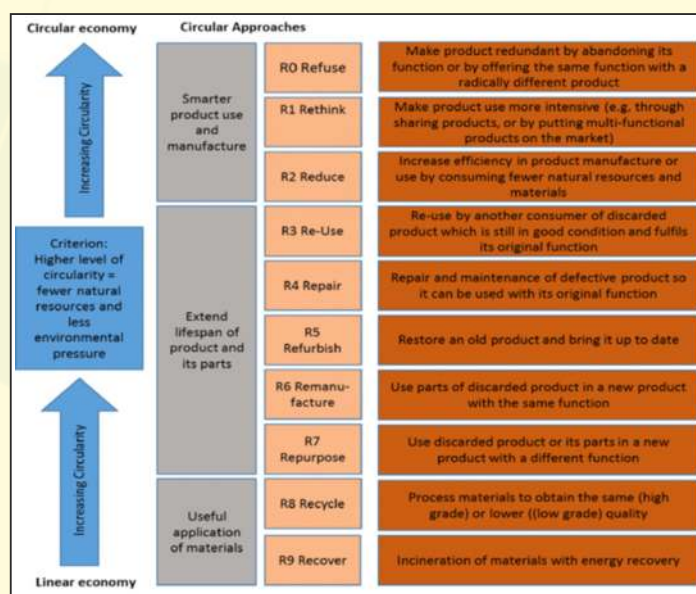
Ultimately, one of the purposes of the circular economy is to optimize resource yields by circulating products, components, and the materials in use at the highest utility at all times in both technical and biological cycles.

What Are The Benefits Of The Circular Economy Model?

Since the industrial revolution, humankind has been following a linear model of production and consumption. Raw materials have been transformed into goods that are afterward sold, used and turned into waste that has been many times unconsciously discarded and managed.

On the opposite, the circular economy is an industrial model that is regenerative by intention and design and aims to improve resources' performance and fight the volatility that climate change might bring to businesses. It has benefits that are operational as well as strategic and brings together a huge potential for value creation within the economical, business, environmental and societal spheres.

One of the goals of the circular economy is to have a positive effect on the planet's ecosystems and to fight the excessive exploitation of natural resources. The circular economy has the potential to reduce greenhouse gas emissions and the use of raw materials, optimize



agricultural productivity and decrease the negative externalities brought by the linear model. When it comes to reducing greenhouse gases, a circular economy can be helpful:

- Because it uses renewable energy that in the long run is less polluting than fossil fuels.
- Thanks to reusing and dematerializing, fewer materials and production processes are needed to provide good and functional products.
- Because residues are seen as valuable and they are absorbed as much as possible in order to be reused in the process.
- Since the preferred choices will be energy-efficient and non-toxic materials and manufacturing and recycling processes will be selected.

The principles of the circular economy on the farming system ensure that important nutrients are returned to the soil through anaerobic processes or composting, which softens the exploitation of land and natural ecosystems. In this way, as "waste" is returned to the soil, besides having fewer residues to deal with, the soil gets healthier and more resilient, allowing a greater balance in the ecosystems that surround it.

Economic Benefits of the Circular Economy:

1. Increased Potential For Economic Growth–

It is important to decouple economic growth from resource consumption. The increase in revenues from new circular activities, together with a cheaper production by getting products and materials more functional and easily disassembled and reused, has the power to increase GDP and therefore economic growth.

2. More Resources Saved

When compared with the raw material extraction that's common on the linear approach, the circular economy model has the potential to lead to a bigger (up to 70%) amount of material savings. Considering that the total demand for materials will increase due the growth of the world population and middle classes, a circular economy leads to

lower material needs, as it skips landfills and avoids recycling, focusing on making materials' cycles last longer. On the environmental side, it also avoids bigger pollution that extracting new materials would represent.

3. Employment Growth

According to the 'world economic forum', the development of a circular economy model, together with a new regulation (including taxation) and organization of the labor markets, can bring greater local employment in entry-level and semi-skilled jobs.

The study says that these new jobs will be created through increases in:

- Recycling and repairing practices, where one could add new designers and mechanical engineers to make lasting and easily disassembled products and materials at the transformation/production stages;
- An increase in new businesses (and niches) due to innovation processes and new business models;
- An increase in consumption and spending by lower prices.

4. New Profit Opportunities

Lower input costs and in some cases create entirely new profit streams that can be achieved by businesses that move to the circular economy model. In this circular sphere, profit opportunities may come from playing in new markets, cutting costs off with waste and energy reductions and the assurance of continuity of supply.

Barriers To The Implementation of a Circular Economy Model:

Implementing a circular economic model would have several benefits for the environment, economy and businesses, as we've discussed above. Nevertheless, there are some reasons that explain why this model has been growing slowly.

A. Economic Barriers To A Circular Economy Model

In our current economic system, there are some barriers to the implementation of a

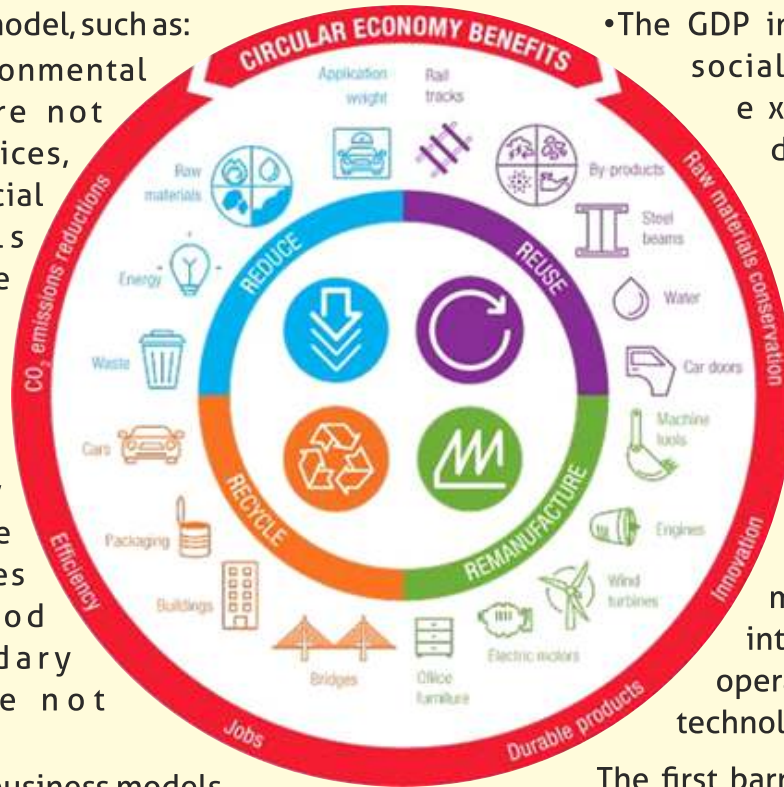
circular economy model, such as:

- Social and environmental externalities are not considered in prices, privileging financial market signals instead of people and nature when economic decisions are made;
- Prices of raw materials are fickle and at low prices alternative, good quality secondary resources are not competitive;
- Circular economy business models are harder to develop, as most investors are still working under a linear economy logic and sometimes upfront investments are required;
- The demand for circular products and alternatives is still small,
- There aren't still many qualified professionals with technical or 'information and communication technology' (ICT) knowledge.

B. Institutional Barriers To A Circular Economy Model

When it comes to implementing and developing the circular economy, many different barriers might need to be overcome, such as:

- The fact that our current economic system is geared towards the demand of the linear economy and are not yet prepared to deal with circular economy entrepreneurs;
- New business models may be challenging to implement and develop because of laws and regulations that aren't prepared for this kind of innovations;
- Plenty of businesses rely on old and/or strong alliances, making it harder to create new alliances and therefore to close loops;
- Many companies still have goals and appraisal systems that focus on short-term value creation, whereas the circular economy model is a long-term value creation model;



- The GDP index doesn't consider social and environmental externalities, discouraging the creation of value in both these areas;

A Broad Perspective On The Barriers To A Circular Economy Model:

The main barriers to moving towards the circular economy model can be divided into financial, structural, operational, attitudinal and technological.

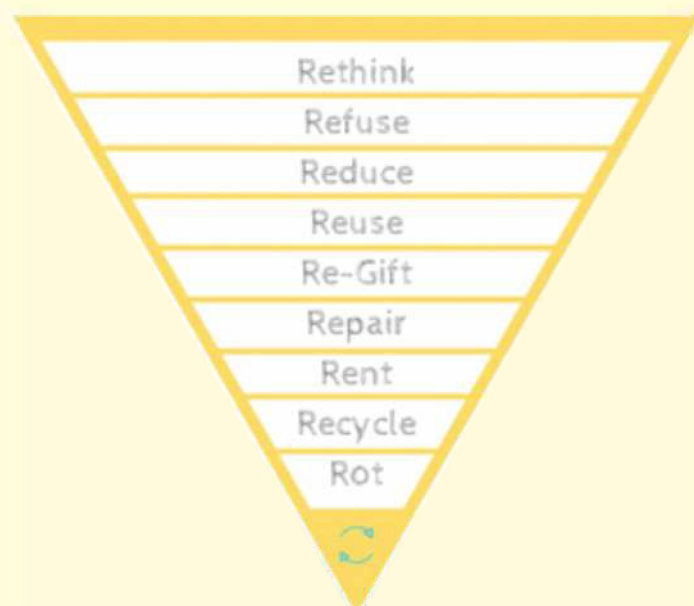
The first barrier has to do with the challenge of measuring the financial benefits of CE and its profitability. The 'structural' barrier that follows has to do with being unclear of gets responsible for CE within companies. By their turn, 'operational' challenges represent the difficulty of dealing and staying in control of processes within the value chain. The fourth barrier, 'attitudinal', has mostly demonstrated the lack of knowledge about sustainability issues and also a big risk aversion – it shows that disruptive changes aren't the best way to develop circular strategies.

The last barrier to a circular has a technological origin and it has to do with the need for changing and re-designing products and production/ take-back systems. These needs end up creating concerns about the ability to do this and still being competitive and having quality products.

Individual Social Responsibilities to achieve A Circular Economy Model through following "The 9 R's of Sustainability"

The principals embodied are "The 9 R's of Sustainability." They are not needed to be memorized but as a means to reflect and move forward to the future in sustaining individual lives and our most precious environment. Even science has demonstrated that they are intelligent principals by design embodied in nature and nature's laws by creative works.

R	Approach
Rethink	Your Choices
Refuse	Single Use Materials
Reduce	Consumption
Reuse	Everything
Re-Gift	Old Stuff
Repair	Before you replace
Rent/ Repurpose	Be creative
Recycle	Last Option
Rot	Natural decomposition



Dr. Vrajesh Parikh is the founder of VOICE OF THE EARTH and luminary leader of Harvard extension students environment club

Teaching during COVID times

We have all seen photographs of university campuses across India during the COVID-19 pandemic lockdown looking desolate and empty. After all, what is a university without its students, without the hustle and bustle of classes, labs and lectures? It is an empty space, waiting for the return of interaction and education.

At Ahmedabad University, however, we closed down classes in March as the lockdown began, and moved immediately to online teaching. This was easier than I had expected. Along with the Vice Chancellor and the Dean of Engineering, we began teaching a course using Zoom called 'Archiving the Times'. As a historian, I asked my students to examine the 1896 plague epidemic in Bombay and Ahmedabad, and the 1918-19

'Spanish Flu' pandemic in western India from a historical perspective. They then used this approach to the past to try to chronicle the impact of what was happening around them in the present. Out of this, the students put together a website, Archiving Covid-19.

It was a small-class teaching method, where the students were able to access digital online archival resources such as the Gokhale Institute of Politics and Economics 'DSpace' collection of reports, and digital newspaper cuttings. Sharing our work and images daily on screen, it was possible to teach, learn and absorb information in a way that was a testament to the power of online learning. Although the participants were in locations including Ahmedabad, Delhi, Surat, Lucknow and Wapi, it was possible to collaborate effectively.

My expectation is that in the future, this sort of distance learning will remain an option for humanities and social sciences teaching, even after the coronavirus pandemic is at an end. Engagement with many students may become a problem in large classes, but most of the time it is possible to keep the dialogue moving, and to call on students for responses.

The same is the case for theory classes in the sciences and engineering. Our faculty in biological and life sciences, physics and psychology at the School of Arts and Sciences were able to use a combination of Zoom and Google Hangouts for classes. Where a student had poor connectivity, it was possible to record and replay classes using chunks of short video recordings. The biggest obstacle to this kind of teaching is helping those who do not have appropriate computer equipment, and this is a challenge that may only be solved by cheaper hardware. If a family does not have a computer, or has a single shared one that others need to access, university learning is difficult.

If teaching online was effective in theory classes and in humanities and social sciences, it remains difficult to run a lab course online. As an intermediate solution, video of experiments can be shown, and one of the things we are considering now as our biology labs are partially reopen, is installing movement-

tracking video cameras in some labs and classrooms. With social distancing, half the usual number of students can be present, and the other half can watch online. The following week, they rotate. Assignments, projects and collaborations also help. Miro and Jamboard are useful platforms, and can be used for brainstorming, design, visualisations and

discussions in real time.

Online teaching is a challenge, but my fellow professors at Ahmedabad University have made a remarkable transition into the virtual world. I believe this kind of new teaching is here to stay.

Professor Patrick French is the Dean of the School of Arts and Sciences at Ahmedabad University

Awards and Fellowships of GSA



Name of the Award	Subject Area	Eligibility Criteria	Submission Deadline
Prof. S. C. Pandeya Memorial Gold Medal	Biodiversity and Ecology	To recognize and reward outstanding research contributions to Biodiversity and Ecology to a scientist below the age of 45 years.	December 1 st week

Name of the Award	Subject Area	Eligibility Criteria	Submission Deadline
GSA – Prof. P. A. Pandya School Science and Mathematics Teacher Awards	Physics Chemistry Biology Mathematics Science	School Teachers of Gujarati, Hindi or English Medium Schools: Cat-1 (Std. 1 to 8) Cat-2 (Std. 9 to 12)	December 1 st week
GSA- Dr. A. K. Shah Best Research Paper Award in Sciences	Science	Under-graduate Teachers & Post-graduate Teachers	January 1 st week
GSA – INSA COMPETITION on Scientific Presentations on the NOBEL PRIZES	Physics, Chemistry & Medicines	For students: Cat.-1 (Class 9-12) Cat-2 (Undergraduate) Cat-3 (Postgraduate /MPhil) [Gujarati, Hindi or English Medium]	January 2 nd week
GSA-CHARUSAT Best Ph.D. Thesis Award in Sciences	Chemical Sciences Life Sciences Mathematical Sciences Physical Sciences Pharmaceutical & Medical Sciences	Ph. D.	January 1 st week
GSA-Prof. M. P. Patel Best Ph.D. Thesis Award in Geology	Geology	Ph.D.	January 1 st week
GSA-GYAN SHIKSHA TRUST Best Ph.D. Thesis Award in Space Sciences	Space Sciences	Ph.D.	January 1 st week

Name of the Award	Subject Area	Eligibility Criteria	Submission Deadline
Buti Foundation – GSA Award for Science Communication	Science Popularization	Publication of Popular Science books, articles, video presentation/ popular lecture and interactive science activities	December 1 st week
Dr Achal Mal Singhvi, Professor C.J. Pandya and L.J. Group of institutions' Science Teacher Awards	Science Teaching	For teaching at undergraduate level	December 1st Week
L.J. Group of Institutions Post Graduate Science Teachers Awards	Science Teaching	For teaching at postgraduate level	December 1st Week
Minaxi-Lalit Science Quiz	Science Quiz	Undergraduate and postgraduate students	Annual event

Youth Corner

How quantum mechanics keep trees alive ?

Quantum mechanics is a branch of physics that has extended our understanding of nature to a different dimension. In quantum mechanics, there are several events that seem almost impossible, or which seem quite unrealistic and magical. For example, subatomic particles can be at more than one place at a time, and particles like electrons, protons, etc. can act as both particles and waves. But this is the very basic level introduction of quantum mechanics! Now biology is a branch of science in which living things or organisms are studied. The basic constituent of every organism is the cell. These cells are made up of different molecules and these molecules are made up of different atoms.

The molecular assembly is due to interactions of these atoms through van der waal forces and other bonds as well as hydrophobic interactions between them and biological. The biological order is achieved following energy flow and the law of thermodynamics, to maintain redox potential. Furthermore, these atoms are made up of different subatomic particles, such as electrons, protons, quarks, etc., which obey the rules of quantum mechanics. Now it is natural to ask whether the phenomenon of quantum mechanics can affect the function of a cell or the function of an organism. Well, the answer is "yes". Quantum mechanics has, in fact, shown an impact in biological processes. Because of this, a new branch of science has been developed called "Quantum Biology". Quantum Biology has been in existence since the 1930s, but the clear evidence of its existence has begun to emerge since the last couple of decades.

To understand what trees have to do with quantum mechanics, we must first understand a phenomenon of quantum mechanics -- "Quantum Coherence". Very loosely speaking, quantum coherence is a phenomenon, according to which a single particle can be at more than one places at a time. E.g. let's suppose that humans can perform quantum coherence, then you could simultaneously be present in the main hall of your home and in your bedroom with the help of quantum coherence (as long as there is quantum coherence). Now let us try to understand this wonderful phenomenon of the quantum world more easily. Again, let's suppose you could do or perform quantum coherence just like any subatomic particle (electrons, protons, etc. ...). Now suppose you want to go for shopping. There are three ways to get to the shop where you want to purchase the stuff you need. Generally, you choose one of these three paths but now we have the ability to perform quantum coherence, by which you can be at more than one place at a time (at the exact same moment of time). Now you can go through all the three paths simultaneously using quantum coherence. In general, in the first case you can choose only one way out of the total possible three paths. With the help of quantum coherence you can travel all the possible paths at once, all at the same time. It may seem impossible to us but this phenomenon is very common for subatomic particles (electrons etc.). The main cause behind quantum coherence is the wave nature of particles such as electrons, etc. Particles like Electrons can behave as waves. Any particle-like object on the beach such as a stone can only be in one place at a time but ocean waves in the ocean exist throughout the coast at once, they are everywhere at the same time, at the coast. Similarly, because of their wave nature, electrons can reside in more than one place at a time, similar to these ocean waves. It is because of such strange phenomena that quantum mechanics is considered to be one of the most strange and weird sciences. Now, let us move to the answer of the question of how quantum mechanics keeps the trees alive. The food, to keep the tree alive, is made through photosynthesis in the leaves of the tree but the photosynthesis process is so efficient that

almost negligible amount of energy is wasted when the chemical energy is generated from the light energy? The scientists questioned why the photosynthesis was so efficient because the theories that were given by biology and biochemistry failed to explain this thing. So, there was something mysterious happening in the leaves during photosynthesis. Let us now understand how quantum mechanics has answered this question.



Image credit: <https://freedesignfile.com/303797-green-plant-sprouts-hd-picture/>

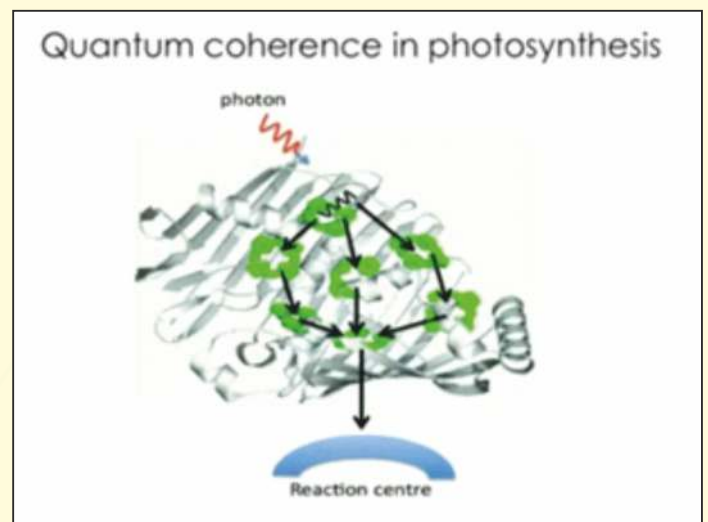


Image credit: <https://medium.com/a-spoonful-of-sugar/quantum-biology-6b8ea6284786>

When a photon of light falls on a leaf, it collides with the chlorophyll (consisting porphyrin ring, coordinated to a central atom Mg) and in the chloroplast of the leaf and forms a particle called exciton (a special type of electron). Now when this exciton reaches the reaction center in the cell, chemical energy is finally produced. Now during the reaction the exciton has to go through a lot of chlorophyll atoms (like a forest of chlorophyll molecules). Now due to the random motion of exciton and collisions with chlorophyll

molecules some amount of its energy (not so small) must be dissipated as heat until it reaches the reaction center. This is the reason, according to scientists, why some wasted energy must be generated in photosynthesis. But photosynthesis is in fact very efficient and some negligible amount of energy is wasted during the process. There was something going on in this trip of Exciton because of which the wasted energy was so small. According to quantum mechanics, exciton was not going to the Reaction Center by taking only one path at a time but it was passing through all the possible routes to the reaction center, simultaneously. Because of passing through all possible routes simultaneously through the quantum coherence, the exciton was soon reaching the reaction center and was losing a very small amount of energy.

Photosynthesis is not the only phenomenon in which quantum effects plays a part. In addition to this, there are many other cases where quantum effects are observed. For example, our nose can distinguish between hundreds and thousands of aromas and odors. Scientists previously believed that the aroma of an object depends on the shape of the constituent molecules of that substance, this theory was called "Shape Model of Olfaction", but there are some problems with this theory as it is unable to explain the cause of aromas of certain substances. E.g. Despite both benzaldehyde and cyanide chemicals having the same aroma, there is a huge difference in the shapes of these both. So that's why using the quantum mechanics a new theory "Vibration Model of Olfaction" has been developed which says that not only shape but the vibration frequency of the atoms are also the reason behind the different aromas felt by us. For both benzaldehyde and cyanide, the vibrational frequency is the same, thus both have the same aroma. The "Vibration Model of Olfaction" theory is still in doubt. Thus, quantum mechanics actually affects the life of different organisms in so many unexpected, different and unknown ways.

Kishan Malaviya is a B.Sc, Physics student at St.Xavier's College (Autonomous), Ahmedabad.

He also would like to acknowledge Dr. Tushar Pandya, St Xavier's College, Ahmedabad and Dr. Nayan K. Jain, Gujarat University for providing valuable inputs while reviewing the article

Pollution



Drishya Dilip Gala is a BBA student at the Amrut Mody School of Management, Ahmedabad University, Ahmedabad

"Ravigrahan 2.0" Live Streaming Solar eclipse



The solar eclipse is a stunning celestial event where a portion of the Earth is engulfed in the shadow cast by the Moon which blocks sunlight falling on the Earth.

On June 21, 2020, Sunday the solar eclipse started a little after 9:00 AM as the sun, the moon, and the earth came in a straight row.

The solar eclipse that took place on 21st June was an annular solar eclipse, the Moon was unable to cover the entire Sun, leaving a small surface exposed which is called "Ring of fire".

However, it was a partial solar eclipse in Gujarat.

ASTRONOMICA (Astronomy club of St. Xavier's College, Ahmedabad) organized an event named **"Ravigrahan 2.0"- live streaming and sessions on solar eclipse** for observing the solar eclipse on 21st June in collaboration with **Universe Science Forum** and **Stargazing India**. ASTRONOMICA used a Celestron power seeker refractor telescope of 60 mm focal length. They prepared the whole apparatus to take the projection of eclipse on a white screen which was being telecasted live on their YouTube channel. The club not only arranged the live stream of the solar eclipse but also organized PowerPoint presentations on the solar eclipse by students along with the stream. During the live stream and student presentations, a live quiz was also arranged for all the viewers. In the end, winners of the live stream were also appreciated. The team of ASTRONOMICA captured different phases of the eclipse from different cities using a DSLR camera from their home.

This excellent event was held under the guidance of Dr. Tushar C. Pandya. 2 teams conducted this program.

1. Coordinating team:- Mr. Jahaan Thakkar, Mr. Kishan Malaviya, Mr. Suresh Parekh, Mr. Vaibhav Trivedi, Mr. Bhavya Thacker, Mr. Mishil Patel, Mr. Yash Chauhan
2. Volunteer team:- Ms. Riya Rathi, Mr. Mustafa Dosani, Ms. Zubiya Moriswala, Ms. Zeel Thakar, Ms. Preeti Kachhia, Mr. Akshat Sharma, Mr. Divya Kotia, Mr. Arnav Chaturvedi, Mr. Kerman Zaveri, Mr. Ashutosh Agrawal

Near about 2900+ people witnessed the event live on youtube with several comments and

appreciations. The whole team of ASTRONOMICA worked day and night to make this grand event successful.

Interesting read

1. Fang, L., Karakiulakis, G., & Roth, M. (2020). Are patients with hypertension and diabetes mellitus at increased risk for COVID-19 infection?. *The Lancet. Respiratory Medicine*, 8(4), e21.
2. Minhas, S. (2020). Could India be the origin of next COVID-19 like epidemic?. *Science of The Total Environment*, 138918.
3. Singal, T. & Singal A.K. (2020). Determining planetary positions in the sky for ± 50 years to an accuracy of $< 1^\circ$ with a calculator. *Journal of Physics Education*. DOI: arXiv:0910.2778

Annual Event of GSA

Gujarat Science Congress

Gujarat Science Congress is the largest annual science event of the state and its participation routinely exceeds 500-600. Science Congresses are two day events comprising futuristic talks on Science, Technology and Innovation by eminent scientists / science managers, endowment lectures, talks by the fellows and Best Thesis Awardees, a public lecture, Poster presentations, a science forum and awards Ceremony (S.R.Thakore Lecture Award, Dr. Ajay Divatia Lecture Award, Planetary Science & Exploration Societies' Endowment Lecture Award, Prof. A.K. Shah Lecture Award, Gujarat University- GSA Oration Award) for selected teacher and researcher awardees. Normally the first weekend of February is marked for the Gujarat Science Congress. The first Gujarat Science Congress was held at Ahmedabad during 25-27 December 1984. GSA has since organized 32 Science Congresses without a break. Most recent congresses were held at Changa (2013), Patan (2014), Ahmedabad (2015), Kachchh (2016) Gandhinagar (2017), and the XXXII Gujarat Science Congress was held at Bhavnagar during 4-5 February, 2018. The XXXIIIrd Science Congress in 2019 was held at L.J. Group of Institutions at Ahmedabad. The XXXIVth Science Congress in 2020 was held at Ganpat University at Mehsana, Gujarat.



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Scientists, Teachers or Technologists with an exceptional track record of research, innovation or leadership in science. Currently GSA has 220 fellows and it adds 2-3 fellows every year based on suitable nomination and academic scrutiny. A one-time fee of Rs. 5000/- is payable on election.

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Scientists, Teachers or Technologists with potential for leadership in Research/ Academic Innovation/Education in Science and Technology. Currently the number of Associate Fellows is 64. At present a fee of Rs. 3000 is payable on election and after 3 years, Associate Fellows with good professional record and active

participation in the activities of GSA become eligible to be considered for designation as Fellows. In such cases a one-time fee of Rs. 2000 is payable on election.

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Students at any level. Fee per year is Rs.300.

To download the membership form please click the following link:

<https://drive.google.com/file/d/1kvDtJoEotOfKnErZ8-sVhE6nbFY2Kqp/view?usp=sharing>

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Jointly with Institutional Members (ImS), GSA develops programmes and holds Science Congresses on an annual basis. Regular consultation with IMs help develop new initiatives for future research, education and entrepreneurship in the areas of Science and Technology in Gujarat. Current adherence fee is Rs. 1 lakh. GSA offers several benefits to its members, ranging from free registration of two nominees at the annual Gujarat Science Congress, complimentary copies of publication

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