

May 2021. E-Issue

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# EDITORIAL

**“Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less.”**

**-Marie Curie**

**Dear Readers,**

**2021 has already proven to be a whirlwind of a year. The second wave of Covid-19 has impacted our close ones and left us feeling like we are fighting a losing battle. Amidst all this chaos, science feels like a ray of hope; hope that medical advances will help improve the situation around us and hope that the vaccine will curb the disease.**

**The Delphic aims to provide young readers with a platform to share their knowledge and subsequently encourage more people to find what piques their interest. When most of us hear the word science, we picture a mountain of books slowly suffocating us while a bunch of Greek symbols float around in the air. But what science truly is is an amalgamation of observations, reasoning and logic. It is the wonder that makes the universe. It provides order in a world full of turmoil and chaos. I encourage you to use your curiosity. Question anything and everything around you till you realize that knowledge is infinite. The deeper you dig, the more you will uncover.**

**This issue of the Delphic tries to cover a vast array of topics. From quantum mechanics to freaky genetics, each page will surely have something for everyone. While compiling this issue, I was amazed by the knowledge and interest harboured by every individual who wrote for this edition. The edition would have not been possible without the work put in by the editors and Mrs Pant. I hope that after reading this, you are left with a hunger for more.**

**Most of all stay safe and positive. Wear a mask at all times and sanitize. Follow all the precautions necessary to prevent the spread of the coronavirus.**

**Happy reading!**

**-Diya Dhyani**

# Bangaram Beach – A Bioluminescent Wonder

The city skyline in the evening looks spectacular, nature has something else as well, that can easily allure you: bioluminescent or, as commonly known as '*glow in the dark*' beaches.

One of the most famous bioluminescent beaches in India is the Bangaram beach. Bangaram is an uninhabited island part of the Lakshadweep archipelago in the Arabian Sea. Its tear drop shape, dense and white halo of sand and the luxurious coconut trees surrounding its shores, is what attracts tourists to such a quaint environment. However, its most unique feature is that it glows at night, with a dark bluish tinge in its waters due to the prominent presence of *algae* and *dinoflagellates*; a type of phytoplankton.

The reason for the beach's glow is ***Bioluminescence***; a natural phenomenon in which a living organism produces and emits light due to chemical reactions occurring in its body. The two essential chemicals for these reactions are - ***Luciferin*** and ***Luciferase***; the enzyme which interacts with oxidized ***luciferin*** to produce light.

The bioluminescent color is the result of the unique arrangement of the ***Luciferin*** molecules. While there are numerous mechanisms through which bioluminescent organisms obtain ***Luciferin***, *dinoflagellates* can synthesize ***Luciferin*** within their bodies hence, producing light.

However, marine experts believe that this phenomenon is an ecological indicator of climate change and degraded water quality. The phytoplankton appears when the seawater has low levels of dissolved oxygen and high levels of nitrogen and phosphorus - an unfavourable situation for large marine food chains. Despite this, many tourists still visit this exquisite beach - a bioluminescent wonder of an unexpected origin.

Jeeval Choudhary

Class Ten



# The science of being blue

All major components of the world including our sky and water bodies are blue in colour, but even after this blue is one of the rarest colours found on earth. This is due to the lack of its natural pigmentation. The ocean looks blue because red, orange and yellow are absorbed more easily by water than blue is, so when light from the sun enters the ocean, it is mostly the blue that gets reflected back. When it comes to food, it is the least common and according to research can exert signs of danger. The colour blue in design, pottery and cutlery first appeared in China in blue-white pottery and since has been used in many decorative items. Very rarely do we see plants and animals of the colour blue. Even a blue whale is not totally blue in colour. In plants, this blue colour comes from a red pigment called anthocyanin. Plants mix it with other pigments to produce blue. Many pigments in animals come from the food they eat. For example, flamingos are not born pink but get the colour by eating food like shrimp. But how often do we come across food that is blue in colour? In butterflies, the colour blue is not present as pigmentation but is absorbed by the structure inside their wings which is arranged like Christmas trees, making them look blue. An exception to this is the *Obrina Olivewing* butterfly, which is the only known animal to produce a true blue pigment.

Saamya Malhotra

Class Eleven



# CRISPR/Cas9

On 7th October 2020, the Royal Swedish Academy announced Emmanuelle Charpentier and Jeniffer A. Doudna as the recipients of the Nobel Prize for Chemistry for their discovery of a method of genome editing. Described as a "tool for rewriting the code of life", the CRISPR/Cas9 genetic scissors discovered by the duo has proven beneficial to further scientific development. The announcement also mentioned that this genome editing technology is contributing towards cancer therapies and may even lead to cures for genetic disorders in a few years.

Imagine a foreign body entering a human cell and as a defence, a pair of scissors cut the DNA of the foreign body at a precise location to prevent the foreign invasion. Luckily, we do not have to imagine as this is (to put it in simple words) exactly what the CRISPR/Cas 9 technology does. CRISPR, clustered regularly interspaced short palindromic repeats, are specialised regions of DNA that include spacers and repeats. The next component of this 'biological software' is the guide RNA which when it binds to the Cas 9 protein, recognises the DNA sequence of the foreign body. Then the RNA 'guides' the Cas9 enzyme, our third vital component, to cut the DNA at the target location recognised. Scientists have used this technology and modified it continuously to treat diseases like cancer, cystic fibrosis etc. Another fascinating application of this technology is the creation of gene drives. Gene drives are genetic systems that increase the probability of inheritance of a particular gene.

The Nobel laureate duo did not identify CRISPR, instead, they developed a highly efficient and accurate technology using CRISPR. Charpentier, an RNA molecule that is involved in recognizing phage sequences, in the bacterium *Streptococcus pyogenes*, which can cause disease in humans. After this, Doudna joined her. Together, they used their existing knowledge of CRISPR and the RNA molecule to isolate the components of the CRISPR/Cas 9 system. In a test tube, they showed how the RNA and CRISPR could alter the genetic sequence at specific sites. However, these two are not the only pioneers of this technology. Francisco Mojica was the first to identify and give this system its name. Feng Zhang is another name that often accompanies Doudna and Charpentier, for his contribution to the research of this technology, so much so that many in the scientific community were surprised that his name was not listed for the Nobel Prize.

What is most fascinating is that it was barely fifty years ago that scientists had, for the first time, manage to manipulate DNA in a test tube. Now, with the CRISPR/Cas 9 technology, we have the ability to prevent or cure diseases by editing the genome inside our body cells. Compared to other scientific discoveries, the speed and accuracy with which genome editing has developed is truly an unimaginable feat.

Krishna Khanna  
Class Twelve



# The Mystery of the Glass Phase

While you drink your favourite drink from a clean glass, you may need to rethink its significance. Glass may look like a solid, but it is an odd one. It is amorphous because it lacks the ordered molecular structure of true solids, and yet its irregular structure is too rigid for it to qualify as a liquid, making it neither a solid nor a liquid. When a material changes from liquid phase to solid phase, the molecules of the matter form a crystal pattern, while the molecules of glass do not form any. Scientists hold a sense of fascination for the transitioning of glass because the new state of matter exhibits behaviour at the microscopic level that has not been seen before. Matthias Fuchs and Andreas Zumbusch used tailor-made ellipsoidal colloids in their experiment that revealed that liquid glass is formed because the particles can move but are unable to rotate - which results in local particle clusters that obstruct each other and thus prevent an ordered state of matter from forming. There are more baffling questions waiting to be answered. How can the structure of glass phase remain the same during the transition from a liquid to an amorphous solid while the viscosity increases by 15 orders of magnitude? Although what is more bizarre is that the prediction of liquid glass had remained a theoretical conjecture for twenty long years. As scientists continue to observe liquid glass, it may become as established a state of matter as its cousins.

Heet Dhawale  
Class Eleven

## Where did Covid-19 come from?

As you may well know, SARS-CoV-2 (or, more popularly, the coronavirus) has been assumed to have originated in a bat. However, few people bother to find out how the World Health Organization reached this conclusion. Here is a quick overview of their report on this virus' origin.

A cross-species transmission event is called a "spillover". Understanding the process of a spillover requires deep knowledge of the virus diversity and its evolution in animals. An understanding of animal interaction with their environment and humans is also necessary. SARS-CoV-2 has caused a global pandemic, so naturally, it must be highly adaptive to human environments. Such adaptation may be gained suddenly or may have been evolving through multiple steps.

Most emerging viruses originate in animals. Nearly three-quarters of infectious diseases have originated either in wildlife or in domesticated animals. Similarly, SARS-CoV-2 is thought to have had a zoonotic origin. It has been found through genome analysis that bats may be the source of this virus. However, its specific route of transmission from animals to humans is still not clear. It is possible that an intermediate host was involved, like in the case of MERS-CoV. Candidate intermediate host species may include mink, pangolins, rabbits, raccoon dogs and domesticated cats that can be infected by SARS-CoV-2. Spillover of viruses from animals to humans can occur through direct contact with infected animals, indirectly through animal products or excreta, or via intermediate hosts.

Howsoever this virus may have reached us, what's important is that we continue to fight it. Following precautions against it is the only way you can keep yourself and your family safe. This virus has already taken too many lives, don't let it take more.

Ananya Makker  
Class Eleven

# The Perseverance Rover

"Touchdown confirmed, we are safe on Mars....."

On 18th February 2021, NASA's perseverance rover landed on the Red planet after a 7-months long journey. The largest and most advanced, this rover marks the first step to collect samples from Mars and send them to Earth. Not only has it got lasers, radars, and x-ray capabilities, but also 19 cameras and a nuclear-powered battery system for energy. It converts heat from the radioactive decay of plutonium into electricity, which gives it the potential to perform its functions.

The key objective of Perseverance's mission is astrobiology and the search for signs of microbial life that existed during the primitive years of the universe. The rover will characterize the planet's geology and past climate, paving the way for human exploration of the Red Planet and will be the first mission to collect and cache Martian rock.

It has a drill to dig out a chunk of rock, the size of chalk. These rocks will then be packed and left behind with 43 samples for future missions to collect and get back to Earth. This way we can study the signs of past life on Mars through instruments, we can never fit on a rover. Furthermore, the rover carries a device called 'moxie' (Mars Oxygen In-Situ Resource Utilization Experiment) which will test the production of oxygen from carbon dioxide. In other words, it is a man-made tree. While this technology is just a start, it could pave the way for science fiction to become science fact - isolating and storing oxygen on Mars to help power rockets that could lift astronauts off the planet's surface.

Moreover, once the rover reaches a suitable "helipad" location, it will release a drone named ingenuity, which will be man's first powered flight on another planet. The main reason for the presence of the drone is to test out a future system of transportation, through continuous tests of flight and landing, which might help in getting samples from far away locations or scout out our terrains.

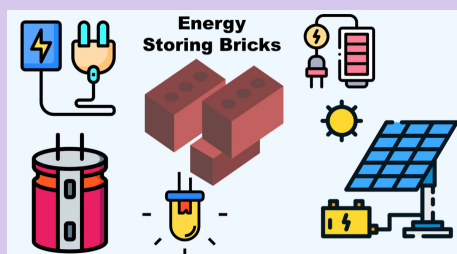
Enabled with groundbreaking technology, this rover is nothing but the reflection of our future on Mars. Though mankind's first step on the red planet is far away from the Rover, Perseverance only brings us closer to it.

Bhavya Sangal  
Class Ten

## Turning Bricks into Batteries

Red bricks — some of the world's most commonly used building materials — can be converted into energy storage units that store electricity, like a battery. Scientists have developed PEDOT - a coating made up of nanofibers that infiltrates the porous structure of the bricks. It taps into the red pigments' energy-storage potential and turns the brick into "an ion sponge" that conducts and stores energy. PEDOT-coated bricks are ideal building blocks that can provide power for emergency lighting for up to 5 hours when connected to solar cells. The breakthrough development could potentially convert buildings into giant supercapacitors that can store more energy and be charged more quickly than batteries. Advantageously, a brick wall serving as a supercapacitor can be recharged hundreds of thousands of times within an hour. However, the technology is still far from commercialization as it is very costly. If the team can find a way to make 'smart bricks' cheaper, they could be an ideal building material as one brick would have more energy than an AA battery and it would also reduce the amount of wiring required.

Vidhita Mittal  
Class Eleven



# The Significance of Red

English poet Leigh Hunt once said, "Colors are the smile of nature". Colours indeed signify not only the pigments present in the anatomy of the animal but also their general behaviour in a favourable or hostile environment. Red colour has been characterized as one of the most powerful and striking shades in the animal kingdom. Every living being has an innate sense of survival, therefore the colour red is most advantageous to creatures for camouflaging, blending into the environment either to protect from predators or attack prey without suspicion. It is seen that the red skin gives them an edge over other animals by making them appear more ferocious and attractive. Hence, red is also the colour of dominance in the wildlife. Organisms also use this colour for various purposes like protection against a predator, aggression, attracting a mate or finding a prey. Vibrant hues like crimson, vermilion and scarlet showcase the daring nature of the animal, they signify power and valour. Organisms like the velvet ant, red eft, red spider, strawberry poison-dart frog and Siamese fighting are the most deadly and poisonous crimson coloured creatures found all over the globe. They behave peculiarly by aposemating. Aposematism is a biological mechanism by which a dangerous organism displays its danger to a potential predator. Having seen the organism as an unfavourable prey, the predator refrains from attacking it. This is a warning activity done to prevent the risk of likely injury even in a successfully repelled attack by a predator. The most effective way is to have bright, striking colours and patterns on the outer layer of the body. All in all red and its shades have predominantly affected the environment and behaviour of animals and has given them not only an amazing appearance but also a great benefit of protection!

Devika Agarwal  
Class 11

## The Eco-friendly drive to an Eco-friendly future

The efficiency of modern technology has made us blind to the other 10 million species we share our planet with. These species are disintegrating at a rate between 100 and 10000 times faster than the arrival of our own species. Hence it is high time that before the world moves towards its desired destination, it actually moves towards renewable energy. These words describe the importance of electronic vehicles, the next disruptive force for transportation and technology. Not only are these vehicles one hundred percent eco-friendly and sustainable but also are seventy-five percent efficient in turning input energy into kinetic energy while the gas-powered vehicles are only twenty-five percent efficient.

Within the coming decade, the prices of batteries are expected to fall down by 73% and are expected to be as cheap as fuel-powered cars. The companies too are making an effort to improve the present-day model of electronic vehicle to a better and more efficient machine. The power stations are increasing in number and it is estimated that there will be 70 million cars on the road by 2025 and countries around the world are waking up to the potential of e-mobility. Besides saving the environment an electric car can rocket up to 60mph in a period of just 2.4 seconds just as much as of Bugatti or Lamborghini.

Let me ask you a question, if driving electric cars makes the earth a better place, reduces carbon emissions, controls global warming, has the potential to improve public health, helps in the growth of the economy, is energy efficient and significantly cleaner and safer for the environment, then WHY NOT? Why not? introduce it in the world and see the rise in society. It is now time to embrace the change and rewrite our future to what represents, a cleaner and greener world.

Kritika Gupta  
Class ten

**The term “evolution” dates from the Latin evolutionem, meaning “unrolling” or “an opening of what was rolled up.”**

**A descended larynx, which allows humans to speak, evolved roughly 350,000 year ago.**

**Scientists believe that the nictitating membrane (the small pink tissue in the corner of a human eye) is a remnant of a third eyelid, similar to the semitransparent eyelid used by birds, reptiles, fish, and other mammals.**







**Humans share about  
31% of their genes  
with yeast**

**Hiccups may date back  
to humans' watery  
ancestors. Wiring in the  
brain that pushes water  
over fish gills and  
makes amphibians gulp  
air has been imperfectly  
rewired in mammals. It  
can make the  
diaphragm go into  
spasms, which causes  
hiccups.**

# A quantum experiment suggests there's no such thing as objective reality

A quantum experiment suggests that there is no such thing as objective reality

In 1961, the Nobel Prize-winning physicist Eugene Wigner laid out a study that demonstrated one of the lesser-known paradoxes of quantum mechanics. The test shows how the bizarre nature of the universe permits two observers—say, Wigner and Wigner's friend—to encounter different realities.

Physicists have used the "Wigner's Friend" psychological test to investigate the idea of measurement and to argue whether objective facts can exist. That is significant as researchers perform experiments for the very purpose of establishing objective facts. Yet, on the off chance that they do experience different realities, how can they agree to what these facts may be?

Recently physicists realized that new advances in quantum technology have made it conceivable to recreate the Wigner's Friend test in a genuine experiment. Hence, it should be feasible to create different realities and compare them in the lab to see if they can be reconciled. Now, Massimiliano Proietti at Heriot-Watt University in Edinburgh and a few colleagues say they have performed this experiment for the first time: they have created different realities and compared them. They conclude that Wigner was correct—these realities are irreconcilable so that it is impossible to agree on objective facts about an experiment.

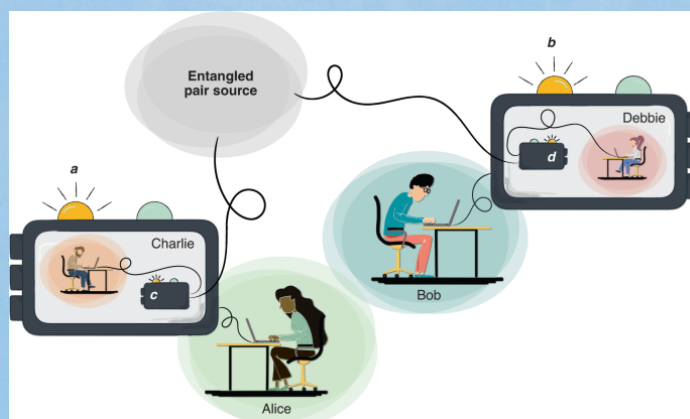
Wigner's unique study is straightforward on the fundamental level. It starts with a single polarized photon that can have either a horizontal polarization or a vertical polarization. Yet, before the measurement as indicated by the laws of quantum mechanics, the photon exists in both polarization states simultaneously—in a so-called superposition. Wigner imagined a friend in another lab estimating the condition of this photon and recording the outcome, while Wigner saw from afar. Wigner had no data about his friend's estimation and is, therefore, compelled to expect that the photon and its measurement are in a superposition of all potential results of the test. Wigner can perform an experiment to confirm if this superposition exists.

From Wigner's perspective, the "reality" is that the superposition exists. Also, this reality suggests that a measurement cannot have occurred. However, this is different from the perspective of the friend, who has estimated the photon's polarization and recorded it. So the two realities for different observers are at odds with each other.

However a few years ago, Caslav Brukner, at the University of Vienna in Austria, came up with a different approach to re-make the Wigner's Friend explore in the lab through methods including the ensnarement of numerous particles simultaneously. They use six tangled photons to make two alternate realities—one addressing Wigner and one addressing Wigner's friend. Wigner's friend estimates the polarization of a photon and stores the outcome while Wigner performs an interference measurement to decide whether the estimation and the photon are in a superposition. The experiment creates an unambiguous outcome. The conclusion turns out that two different realities can exist together even though they produce irreconcilable results, as Wigner anticipated.

This brings up some captivating questions that are compelling physicists to rethink the idea of the real world but Wigner, and his friend, would surely not be surprised.

Reva Agrawal  
Class Twelve



# CAN LIFE EXIST ONLY ON EARTH?

When we talk about the enormity of the cosmos, it is easy to toss out big numbers, but far more difficult to wrap our minds around just how large, how far and how numerous celestial bodies really are. To get a better sense, for instance, of the true distances to exoplanets (planets around other stars), we might start with the theatre in which we find them, the Milky Way Galaxy. The fact that the earth is brimming with life and facing overpopulation as one the major ultimatums it makes one look for the probability of life outside earth. Out of the three hundred million potentially habitable exoplanets discovered in our Milky Way, NASA's Kepler Telescope has chosen twenty-four 'superhabitable' or 'Better than Earth' planets in 2014. In theory, with the advent of a new generation of complex technology, the colonization of such planets can be seen as a near possibility.

The term 'superhabitable' describes an exomoon or exoplanet which may be better suited than earth in the case of evolution. There are multiple factors responsible in shaping such planets that may be more habitable than the earth itself. They should have a stronger gravitational force and must be at least 1.3 times the size of the earth, allowing a thicker and warmer atmosphere for a significant heterogeneity of species. The planet's surface temperature must be 4.5°C (8°F) higher than that of the earth and a satisfactory presence of water ensuring commendatory biodiversity conditions. The closest possibility to a new liveable planet is Proxima Centauri-B, a celestial body about 4.2 light years away from earth. Proxima Centauri an exoplanet with potential existence of water due to its rocky surface and warm atmosphere like that of earth.

Later, NASA announced its major discovery of the Trappist-1 planet system in 2017, which is about 40 light years away from the earth, surrounding an ultra-cool dwarf star in the Aquarius Constellation. It consists of seven planets, all earth-sized and habitable. It has been declared as the most similar planet system to our own. Trappist 1e is the most liveable planet out of the seven. Now the big question: is it possible to colonize these planets and call it our home, and an even bigger question: how we are supposed to reach there. The scientists today have found theoretical solutions by creating the 'Alcubierre Warp Drive', a spacecraft designed to manipulate time and thus travel ten times faster than light. Though a conjecture this may become the very future of existence.

Pakhi Pragya Sinha  
Class Ten

## Gamma Ray Bursts

There exists a space phenomenon so powerful and catastrophic that it may have restricted the ability for most of the early galaxies from being able to form life. This phenomenon is known as Gamma Rays Bursts. Gamma-ray bursts are the strongest and brightest explosions in the universe, known to be generated during the amalgamation of two black holes or a black hole with a neutron star. These are also caused when the large stars collapse in on themselves and explode as their fuel sources run out, another phenomenon known as supernova. The amount of energy that a gamma-ray burst generates is tremendous, lasting anywhere from a few milliseconds to several minutes, Gamma -ray bursts shine hundreds of times brighter than a typical supernova and about a million trillion times as bright as the Sun. When a Gamma Ray Burst erupts, it is briefly the brightest source of cosmic gamma-ray photons in the observable Universe. The amount of energy that a gamma-ray burst generates in last mere seconds (approximately 10 seconds) is more than the Sun will emit in its entire 10-billion-year existence. This mysterious spectacle was first seen in 1967 by a U.S. Air Force satellite, which was designed to keep watch for secret Soviet nuclear testing, but it ended up spotting dazzling gamma-rays — the most powerful electromagnetic radiation — coming from beyond the solar system, according to NASA. It wasn't until 1991 that astronomers launched the Compton Gamma Ray Observatory with the Burst and Transient Source Experiment (BATSE), which discovered roughly one new gamma-ray burst per day. Interestingly, the bursts are distributed evenly throughout the universe from Earth. The highest energy GRB ever detected was captured on April 27, 2013. It had 94 million times the energy of visible light and had a lasted for several hours. Gamma Ray Burst detected in 2009, is currently the most distant object identified in the universe. It is estimated to have originated from approximately 13 billion light years away nearly the age of the universe!

Chaitanya Modi  
Class Twelve

# Explosion-prone stars

Tiny crystals of uranium could set off massive explosions within a dead star, physicists propose, making for a cosmic version of a thermonuclear bomb. Expired stars called white dwarfs slowly cool as they age. In this process, heavy elements like uranium begin to crystallise, forming "snowflakes" in the stars' cores. If enough uranium clumps together about the mass of a grain of sand, it could initiate a chain of nuclear fission reactions, or the splitting of atomic nuclei.

Those reactions could raise temperatures within the star, setting off nuclear fusion — the merging of atomic nuclei — and generating an enormous explosion that destroys the star. Whereas this scenario is still hypothetical, more research is needed to determine if uranium snowflakes could really spur a stellar detonation.

White dwarfs are already known to be explosion-prone: They're the source of blasts called type 1A supernovas. Typically, these explosions happen when a white dwarf pulls matter off a companion star. The researchers' uranium snowflake proposal is an entirely new mechanism that might explain a small fraction of type 1a supernovas, without the need for another star.

Arshiya Sharma  
Class Ten



# Quest-The Future of Quantum Communication

The research on Quantum Communication had begun back in 2017 with the project - Quantum Experiments Using Satellite Technology (QuEST). The aim was to achieve satellite - based long - distance quantum communications.

On Friday, 19th March, the Indian Space Research Organisation (ISRO) announced that it has successfully demonstrated free - space Quantum Communication over a distance of 300 meters. This has proven to be a historic milestone in the field of quantum technologies. Unconditionally secured satellite data communication can now be carried out using these technologies. With this breakthrough, India joins a handful of other nations such as the United States, the United Kingdom, Canada, China and Japan who have made significant contributions in the field of quantum communication.

ISRO demonstrated their quantum capabilities by a live video conference where they used quantum- key-encrypted signals. The free-space Quantum Key Distribution (QKD) was demonstrated at the Space Applications Centre (SAC) in Ahmedabad, between two line - of - sight buildings within the campus. To ensure that there was no interference of direct sunlight, the experiment was performed at night. Most of the mission's critical technologies used in the experiments were built by ISRO in - house, which includes the Navigation Indian Constellation (NAVIC) receiver for time synchronization between the transmitter and receiver modules, and gimbal mechanism systems instead of bulky large - aperture telescopes for optical alignment.

Quantum Key Distribution allows to generate and distribute a secret key which can be used to encrypt or decrypt information. The presence of a third party between a sender and receiver can easily be identified by phenomenon like quantum entanglement, hence securing the data transmission. Through phenomenon like quantum entanglement, a third party between the sender and receiver is identified and this ensures the accuracy of the data transmitted.

"The Quantum Key Distribution (QKD) technology underpins Quantum Communication technology that ensures unconditional data security by virtue of the principles of quantum physics, which is not possible with the conventional encryption systems. The conventional cryptosystems used for data-encryption rely on the complexity of mathematical algorithms, whereas the security offered by quantum communication is based on the laws of physics. Therefore, quantum cryptography is considered as 'future - proof', since no future advancements in the computational power can break quantum-cryptosystems," said ISRO.

The success of this experiment has paved the way for highly secured satellite-based quantum communication as ISRO gears up to establish contact between two Indian ground stations as part of their next experiment. The experiment has been a crucial step towards ISRO's goal of demonstrating Satellite Based Quantum Communication (SBQC).

Kudrat Brar  
Class Twelve

# Evo-Devo

Evolutionary developmental biology or Evo-Devo is a new science that looks deep into our genes to understand how they give instructions to make various parts of our bodies. And as the name suggests, it gives us some leads into the nature and mechanisms behind evolution. One important thing it shows us is that animals are way more similar than we ever imagined. It is easy to imagine how humans and chimpanzees have 95 per cent of the same genes. But what about animals like mice? Humans and mice are 85 per cent genetically identical. So why then are mice and humans so different? It is all because of remarkable genes called developmental regulatory genes.

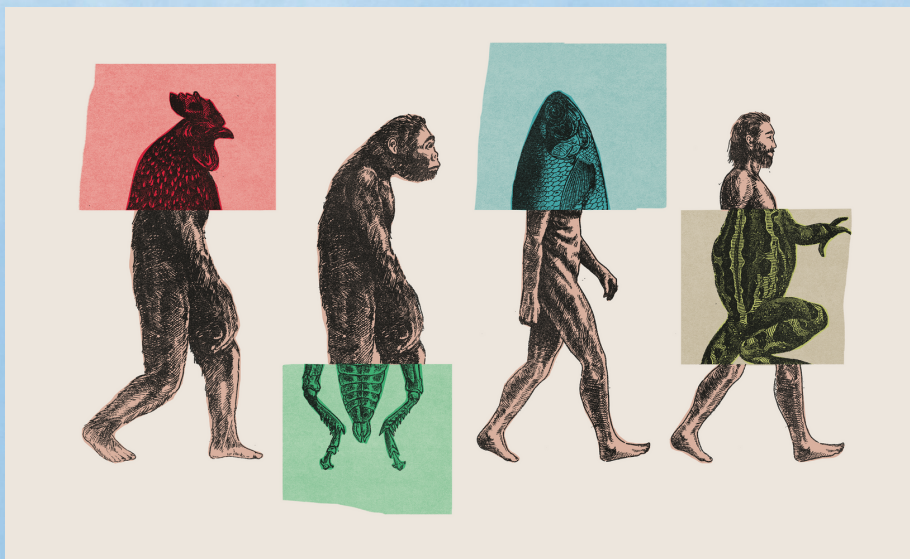
When we think of genes, we think of the nucleic acids that code for an enzyme or protein. But those genes don't just come on and off randomly. They have to be turned on and off. That is what these developmental regulatory genes do. They activate the genes that assemble our body parts. They do not tell them how to do it; they tell them when or if it's time to get to work. These genes start working pretty early on in the stages of embryonic development. For example, a regulatory gene called Gap gene is responsible for telling the blastula where to make the mouth and where to make the anus. The most perplexing kind of regulatory genes are the Homeobox genes or Hox genes, which kick into gear after the embryo is further developed. Hox genes control the identity of body parts, setting up how an organism's body is organized. If a Hox gene tells its subordinate genes to make a body part in a particular place, those subordinate genes will give more specific instructions to other genes to form body parts. This chain of regulatory genes sends instructions down the chain of command, adding more specific instructions as they go.

Even though most regulatory genes are inherited normally, each individual within a species tends to have the same DNA sequence in those genes. This makes sense since all individuals of a species should be built from the same basic blueprint. Hox genes and other regulatory genes that are at the highest tier are the same not just within a species, but also across different animal groups. The differences between a human's regulatory genes and a mouse's regulatory genes are in the low-tier genes, where the instructions are the most specific. And that's why 85 per cent of humans' genetic makeup is the same as mice.

In 1995, a team of researchers in Switzerland took a Hox gene from a mouse embryo, one that gave the instruction for the placement of the eyeball and inserted it into the DNA of a developing fruit fly embryo. They placed the mouse eye gene in a region of the fly that would become the fly's back leg. The fruit fly did not grow a mouse eyeball next to its back leg, but a fruit fly eye next to its back leg. This is because the gene did not code for how to make an eyeball, it just gave the instruction to make an eye. If it had coded for how to make an eye, a mouse eye would have been formed near the fly's leg.

This kind of experiment is where Evo-Devo has begun to revolutionize our understanding of evolution. We know that evolution can take place over long periods of time, but we have not been able to tell how it sometimes happens really quickly. Traditionally one of the main ways that scientists have explained evolution is through genetic mutations. But an organism would have to do a lot of mutating to evolve from say a dinosaur into a bird. But it turns out that a small chain in a regulatory gene at the higher tier can have a large effect on how an organism is assembled.

Diya Dhyani  
Class Twelve



# Caution- Red Ahead!

What is common between a traffic light, an Airtel advertisement board and a "WARNING! Road Under Construction" sign? If you are thinking of the colour red, you're right. The fastest colour on the visible spectrum, red boasts of a capacity to catch anyone's attention even from miles away.

The physics behind its universal usage is quite simple. Red light has a large wavelength of 620 to 750 nm. This means that it travels a longer distance in one second than its violet, indigo, blue, green, yellow or orange counterparts. According to the rule of Rayleigh scattering, effect of scattering is inversely proportional to the fourth power of wavelength. When red light travels from a sign board to the viewer's eye, the air molecules in between can't scatter much of it, and it penetrates sharply through the air forming a clearer picture in the observer's eye than any other colour in its place could've made. Red light is capable of piercing through fog, mist and rain. It also stands out most vividly against a green background.

In addition, humans are genetically engineered to associate red with danger. Therefore, it is safe to say that this simple application of physics has helped handle busy roads, saved countless people from falling into holes and ditches, enabled top-notch advertisements which earned capitalists millions of dollars. It has also prevented all of us from parking in the wrong place and ensured that we exit from the correct door.

Himanshi Gupta  
Class Eleven

# Could Plastic eating bacteria save the planet?

We have plastic drifting in our seas, accumulating on our land and polluting our air. Scientists predict that by 2050 there will be more plastic in the ocean than sea life. Plastic is in the food we eat and the water we drink. The cost of global plastics and the cost of recycling is rising, making our future bleak. But, the recently discovered plastic-eating bacteria has given scientists hope to decontaminate our planet and make cleaner products for the future.

In 2016, a team of Japanese scientists found a bacteria that would eat PET plastics and help do the recycling. They found that the bacteria living off the plastic bottles in a recycling facility in Japan. They took that back to the lab and were able to culture it by feeding it only PET plastic (the plastic used in bottles and clothing - a common plastic). After eating the plastic, the bacteria would secrete certain enzymes which could break apart the polymer chains in plastic. Now, several groups of scientists all over the world are studying the potential of this plastic-eating bacteria.

How it works:

PET plastics are made of two building blocks - Terephthalic Acid and Ethylene Glycol - held together by ester bonds in long chains. The enzymes split these bonds like a pair of 'molecular scissors' and separate the plastic into its two constituent building blocks again. The bacteria and its enzymes can now be reproduced in labs through DNA coding.

Scientists then put together two separate enzymes (PETase and esterase) and physically linked them together to create an enzyme six times faster than the original natural enzyme. They took their learnings from nature to the lab to make a faster and economically more viable solution for recycling.

The dream is to produce industrial quantities of the enzyme which can be freeze-dried and turned into a powder to pour over landfills. This would help break down the product, leaving just a clear solution of monomers behind. These monomers can then be reused to make new plastic products (in the form of polymers), thus creating an infinite cycle of plastic regeneration and recycling. Currently, the enzymes are too slow to be economically viable and only deal with PET plastic - which is only 20% of the plastic in the environment.

The problem of plastic waste is now mainstream and has support all over the world. But our planet is at a critical moment, as the use of plastic continues to grow. Therefore, innovations like enzymes from plastic-eating bacteria, though not fool-proof, could help reimagine the entire system.

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# Searle's Thought Experiment

The Chinese Room Argument, one of the best-known arguments in recent philosophy, was first published in a 1980 article by American philosopher John Searle. Searle's thought experiment goes like this:

A closed room has a non-Chinese speaker with a list of Mandarin characters and an instruction book. This book explains the rules according to which the Chinese words may be formed — but without giving the meaning of the characters. Suppose now that we pass to this man a sequence of Mandarin characters which he is to complete by following the instructions he has been given. We may call the sequence passed to him from the outside a "question" and the completion an "answer." Now, this non-Chinese speaker masters this sequencing game so much that even a native Chinese person outside the enclosed room will not be able to spot any difference in the answers given by this man and a native Chinese speaker. But the fact remains that not only is he not Chinese, but he also does not even understand Chinese, and far less think in it. The Chinese room argument holds that a program cannot give a computer a "mind", "understanding" or "consciousness" regardless of how human-like the program may make the computer behave. It argues that a machine is just like this man, in that it does nothing more than follow the rules given in an instruction book (the program). It does not understand the meaning of the questions given to it nor its answers, and thus cannot be said to be thinking. "A human mind has meaningful thoughts, feelings, and mental contents generally. Formal symbols by themselves can never be enough for mental contents, because the symbols, by definition, have no meaning," said Searle when questioned about his argument. The Strong AI Hypothesis is the claim that a computer that behaves as intelligently as a person must also necessarily have a mind and consciousness. Therefore, by this thought experiment, Searle concludes that the "strong AI" hypothesis is false. AI today is advancing at a speed faster than ever, with developers coming up with AI models that are said to imitate human behaviour. However, we must ponder that no matter how intelligent a computer may seem, will it ever be able to think without instructions from strings of code.

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