MANIPAL UNIVERSITY

VIVUS

The Newsletter
School of Life Sciences

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Moreno Gills, Nikon Microscope View, Photography contest, UK

FOREWORD

OLÀ DEAR READERS,

We are very happy to present our **quarterly** newsletter. As the **new editors**, while continuing the legacy put up by the previous editors, we've tried to put a new spin on the newsletter especially with the inclusion of a name for the newsletter, ***'VIVUS'*** which is *Latin for* ***living***.

There is no centralized theme for the newsletter this time, but rather we elected to go with an **umbrella of scientific topics** to increase the inclusivity of our reading audience and to do justice to the name '*Vivus*'.

It is inevitable to state that it would have not been possible to assemble this Newsletter without the help and guidance of the School of Life Sciences **family**.

We would like to extend our sincere gratitude towards **Dr K Satyamoorthy**. His permission and support has proved extremely vital to this edition of ***Vivus: The School of Life Science Newsletter.***

Furthermore, we are extremely grateful to **The Student Council** of the School of Life Sciences(2016-2017), especially **Ms. Aditi Kandlur**(1st year MSc), for the kind support.

We thank **Mr. Sourav Patagi** (1st year BSc Biotechnology) for designing the cover page for this issue.

Also, we would like to thank everyone (including our **readers**) who has directly or indirectly contributed to the success of this issue.

Thank you one and all!!

Lastly and most importantly, we would like to extend our heartfelt gratitude to our respected teachers **Dr TG Vasudevan**, **Dr Saadi Abdul Vahab**, and **Dr Vidhu Sankar Babu**. Their constant supervision and advice has helped us through our very first publication of the newsletter.
We are extremely thankful dear teachers!

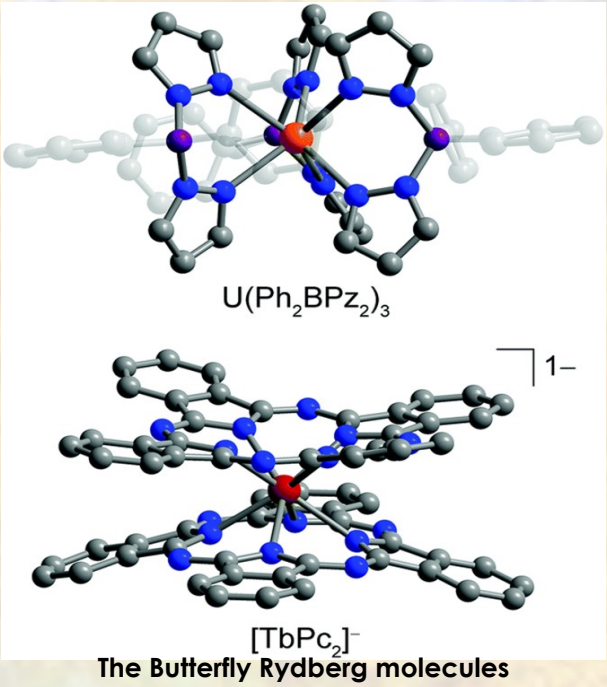
-Bhargavi Karna and Russell Lorenzo Castelino
1st Year B.Sc. Biotechnology
Co-editors
Editorial Board

The Butterfly Molecule

AKHILAJA PRATYUSHA , MSc Molecular Biology and Human Genetics (1st year)

First predicted in 2002, the butterfly or **Rydberg molecule**, named so for the shape of its electron cloud, has substantiated the existence of a new type of atomic bond. **Chris Greene**, a Purdue University physicist had stated 14 years ago that there exist Rydberg atoms that have electrons 100 or 1000 times farther from nucleus than the normal atoms, the electrons of which are 1 or 2 angstroms away from the nucleus. This property allows the formation of Rydberg molecules merely by a grab and trap mechanism elicited when a Rydberg atom moves past another atom, thereby attracting it toward a specific spot and eventually trapping it thereby forming a molecule. The researchers cooled **Rubidium gas** to 100 Nano-Kelvin and by means of a **laser** pushed an electron away from the nucleus. They then went on to adjust the laser frequency so that the atom could capture another atom placed at the right distance. Furthermore, these molecules are **larger** and require **less energy** to move owing to their **large electric dipole moments** that are **easy to manipulate**.

These properties put the Rydberg molecule up above the list of possible elements that can be utilized for the development of **molecular scale electronics** and can prove phenomenal in the field of **sensors**. The molecular butterfly can flap its "**wings**" and emit both blue and red light simultaneously in certain environments. This **dual emission** means it can create white light from a single molecule, something that usually takes several luminescent molecules to achieve.



The Butterfly Rydberg molecules
(From http://pubs.rsc.org/)

Also, it is extremely sensitive to temperature, which makes it a thermometer, registering temperature change by emission color. Scientists, thus, are on their way to creating **noninvasive thermometers** that can take better temperature readings on infants, and **nano-thermometers** for **intracellular temperature mapping** in biological systems. They are also trying to create **molecular machines** that are operated simply by sunlight. Tests to see if multiple atoms can be bound to the Rydberg molecule are underway and several other properties are yet to be discovered.

The team's research was supported by German funding sources and U.S. National Science Foundation, Purdue and the work has been published in Nature Communications.

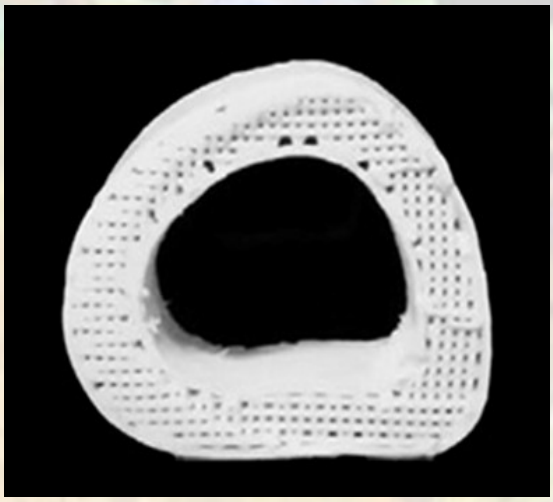
The Future of Bone Implants: 3-D Bio-Printing

TANAAZ M KHAN, B.Sc. Biotechnology (1st year)

3-D bio printing has become a very well-known and popular research topic in recent times pertaining to the subject of **engineering organs artificially**. Printing organs have been shown as a possibility with the first ever printing of a synthetic scaffold of a human urinary bladder. Now, scientists have made a breakthrough in the area of **reconstructive surgery**. Ramille Shah at Northwestern University, Illinois, USA and her colleagues has created an ink that produces synthetic bone implants.

The ink is made up of Hydroxyapatite, Polycaprolactone and a solvent - a combination collectively called **Hyperelastic Bone**.

Hydroxyapatite is a calcium mineral found naturally in our bones, and is a very brittle compound. So to compensate for that, Polycaprolactone, a biodegradable and biocompatible polymer was used by the researchers to give it the needed elasticity. The composition is **90% Hydroxyapatite and 10% Polycaprolactone**, with the solvent used between each printed layer (and evaporates after printing).
When stem cells are placed on the printed scaffold, they turn into bone cells purely due to the interaction between the cell and the mineral's bioactivity.



Picture: Cross section of a hyperplastic human femur (*more flexible and can be 3D-printed to make surgical implants tailored to the individual.)*

(From http://www.mccormick.northwestern.edu/)

One of the major advantages with this implant is that it can be **re-structured or re-modeled** during surgery to suit the patient's condition and requirement, as opposed to using auto-grafts which do not offer the same advantage. Hence, this printed bone can be used for a number of problems like broken jaws and skull repair. Another advantage this product offers is that there are much lesser chance of the body rejecting these implants as they made from the body's own cells.

The Hyperelastic Bone was first **tested in rats** to see whether they could **fuse spinal vertebrae**. Eight weeks after the procedure, formation of new blood vessels within the scaffold was observed. The formation of blood vessels is a crucial step as it encourages the growth of the cells, which in turn keeps the tissue alive. The combination mentioned above was more successful than any other method used. It was also used to test **a macaque's damaged skull**, which showed the formation of blood vessels and some calcified bone within four weeks of the procedure. No sign of any infection was observed either. The synthetic product can be altered to **contain antibiotics** as well to **avoid any rejection** or **development of infection** within the body as well.

Due to the promising results in other test subjects, the researchers are keen to take this forward in human trials, which would most likely occur in the next five years. If successful, it would be a great **boon** to patients around the globe as the product is **cheap**, **easy to produce**, **can be printed** within five to twenty four hours and is highly **beneficial** compared to the present methods being used.

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CIPA - Superpower or Kryptonite?

KANAYA BHATTACHARYA , B.Sc. Biotechnology (1st year)

Abstract - Congenital insensitivity to pain with anhidrosis, also known as CIPA, is a rare genetic disorder causing an individual to feel no pain or fluctuations in temperature. Such individuals have "anhidrosis" or inability to sweat. Usually **diagnosed at birth**, individuals with CIPA may **amputate or mutilate** their own body parts like the tongue, lips and inner parts of the buccal cavity due to failure to sense pressure. Patients with CIPA usually have **Osteomyelitis** or damaged joints as they do not perceive pain but unable determine the amount of pressure to put on a joint, destroying skeletal tissue and striated muscle fibres. They do not sweat and have **bouts of fever** due to **failure of osmoregulation**. Patients with CIPA generally **do not blink or cry**. Usual symptoms associated with CIPA are **hypotrichosis (**bald patches), inflamed joints and **hypotonia** (decreased muscle tone).
CIPA may seem like a blessing: "Inability to feel pain." To some it may even feel like a superpower, but in actuality, it is dangerous. Imagine *slamming the door shut on your hand, feeling no pressure, but knowing that you're hurt*. Or imagine *holding your arm over a burning stove, feeling no temperature, absolutely unaware that your hand is burning*. Horrifying, right?

What is CIPA?

CIPA is a disease which falls under the category of **hereditary sensory and autonomic neuropathy type IV**. It is caused by a **mutation in the *NTRK1*** gene and is inherited in an autosomal recessive manner. Approximately 70 mutations associated with CIPA have been reported so far from the studies on families with CIPA, including a double and triple mutations, the latter indeed, a rarity .The *NTRK1* gene synthesises protein NTRK1 which is actually a proteinaceous enzyme neurotrophic-receptor-tyrosine-kinase-1, which is essential for the proper development, growth and survival of neurons. NTRK1 lies on the surface of the neurons and helps in the transmission of signals between sensory neurons (neurons for pressure, pain and temperature). In the absence of NTRK1, these neurons degenerate and cause the condition known as CIPA.

CIPA causes a **lack of unmyelinated nerve fibres** as well as **short nerve fibres**. Lack of unmyelinated nerve fibres **blocks transmission of pain** and absence of short nerve fibres form the dorsal ganglion of the spine. The sweat glands do not get innervated causing **lack of perspiration**.

Symptoms

1. *Neurotrophic Keratitis* - decreases corneal sensitivity
2. *Hyperpyrexia* - high fever due to the inability to sweat
3. *Hyperthermia* - increase in body temperature
4. *Charcot joints* - inflamed, malformed joints due to excessive pressure on the joints
5. *Self-mutilation* - cuts or lesions due to inability to perceive pain during biting or chewing.
6. *Febrile seizures* - due to increase in body temperature.
7. *Irritability*
8. *Hyperactivity*
9. *Frequent mood swings*
10. *Ulcers and lesions* in buccal cavity.

Treatment

There is **no certain treatment** for CIPA, but with proper guidance from physicians, unnecessary injuries and lesions can be avoided. With **orthopedic assistance**, patients with CIPA make it into adulthood.

Diagnosis

- Genetic testing
- NTRK1 deficiency testing
- Invasive - Spinal Biopsy

Conclusion

Patients with CIPA are considered to be unfortunate medical marvels but questions remain. Is it a specialty? A life with no analgesics sounds like a relief, but it has its downsides too. Patients with multiple organ failure and CIPA would fail to know if they are in pain. Hypothetically, nerves from CIPA patients can be harvested and used for patients who require painless sensory structures. Ethical issues prohibit so. The question still remains - **Superpower or Kryptonite?**

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Nano Removal of Viruses

GREESHMA GOPINATH, B.Sc. Biotechnology (1st year)

The word 'virus' is a Latin derivative of *virulins*. These are pathogens that typically consist of a nucleic acid molecule in a protein coat. Viruses are the causative agent for many epidemic outbreaks which have led to severe consequences and to control them, early detection is important. However, viruses can begin to spread even before identification and grouping as they slip through the sight of a powerful microscope.

Taking this in account researcher, **Mauricio Terrones** (Professor of physics, chemistry and biomedical engineering at Penn State University) developed **Carbon nanotubes technology**. The device developed allows to selectively trap and concentrate viruses by their size – smaller than human cells and bacteria, but larger than most proteins and other macromolecules – in incredibly dilute samples. It further increases the **ability to detect small amounts of a virus** by more than a hundred times. Samples collected are passed through a filter to remove large particles such as bacteria and other contaminants, then through an array of carbon nanotubes on the device. Viruses get trapped and build up to usable concentrations within the forest of nanotubes, while other smaller particles pass through and are eliminated.

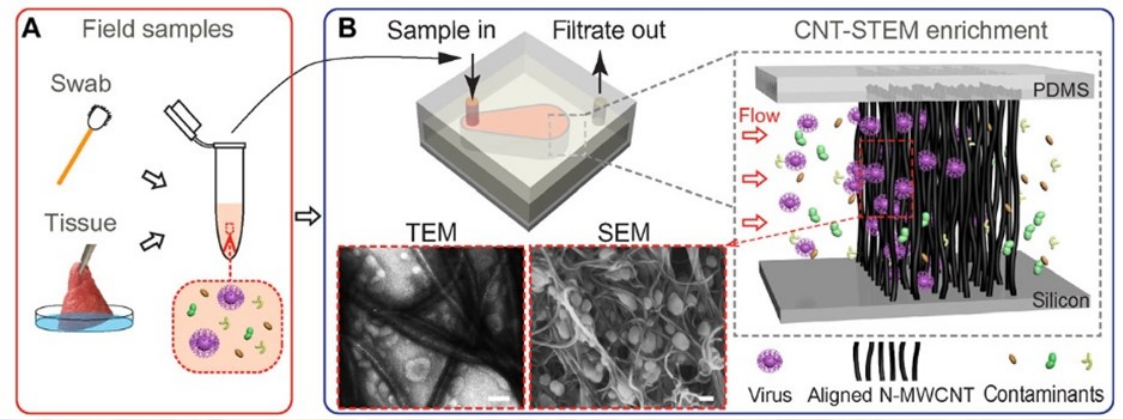

Fig. The working principle of virus enrichment and concentration from field samples. (From http://advances.sciencemag.org/)

The intertube distance can range from about 17 nanometers to over 300 nanometers to **selectively capture viruses**. The unique properties of the carbon-nanotube forest allows to integrate it into a **robust, scalable,** and **portable micro device** that can be adapted for use in the field without the need for bulky instruments and specialized storage of reagent. The concentrated virus captured in the device can then be put through a panel of tests to identify it, including **molecular diagnosis** by polymerase chain reaction (PCR), immunological methods, virus isolation, and genome sequencing.

Most lethal viral outbreaks in the past two decades were caused by newly emerging viruses such as influenza, HIV, Ebola. This **size-based virus-enrichment technology** can be particularly powerful in the identification of emerging viruses and discovery of new viruses that do not have antibodies and sequence information available.

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Can the baby cure the mother?

HUMAIRA SHAH, B.Sc. Biotechnology (1st year)

Cord blood banking basically involves "**collecting** blood left in a newborn's umbilical cord and placenta and **storing** it for future medical use. Cord blood contains potentially lifesaving cells called **stem cells**." (The stem cells in cord blood are different from embryonic stem cells.) Many research studies on how stem cell storage can be used for curing diseases have been going on, and cord blood banking alone claims to cure about 80 different diseases including cancers.

The interesting part about cord blood banking is that the stem cells from cord blood are more **adaptable** than bone marrow stem cells, which means that cord blood cells need not be an exact match as that of the donor. Doctors look for donors that match the stem cell of the patient just like how it works for a normal blood donation.

Another interesting fact is that the use of bone marrow stem cells for treating cancer has been replaced to an extent by cord blood stem cells, mainly for those who could not receive bone marrow transplant. What makes cord blood cells different from bone marrow cells is that the cord blood cells are **immature** and have not been **exposed to any disease** thus making them more adaptable (no resistance or rejection) to the patient's body. Also, it is more easily available and causes less pain to patients.

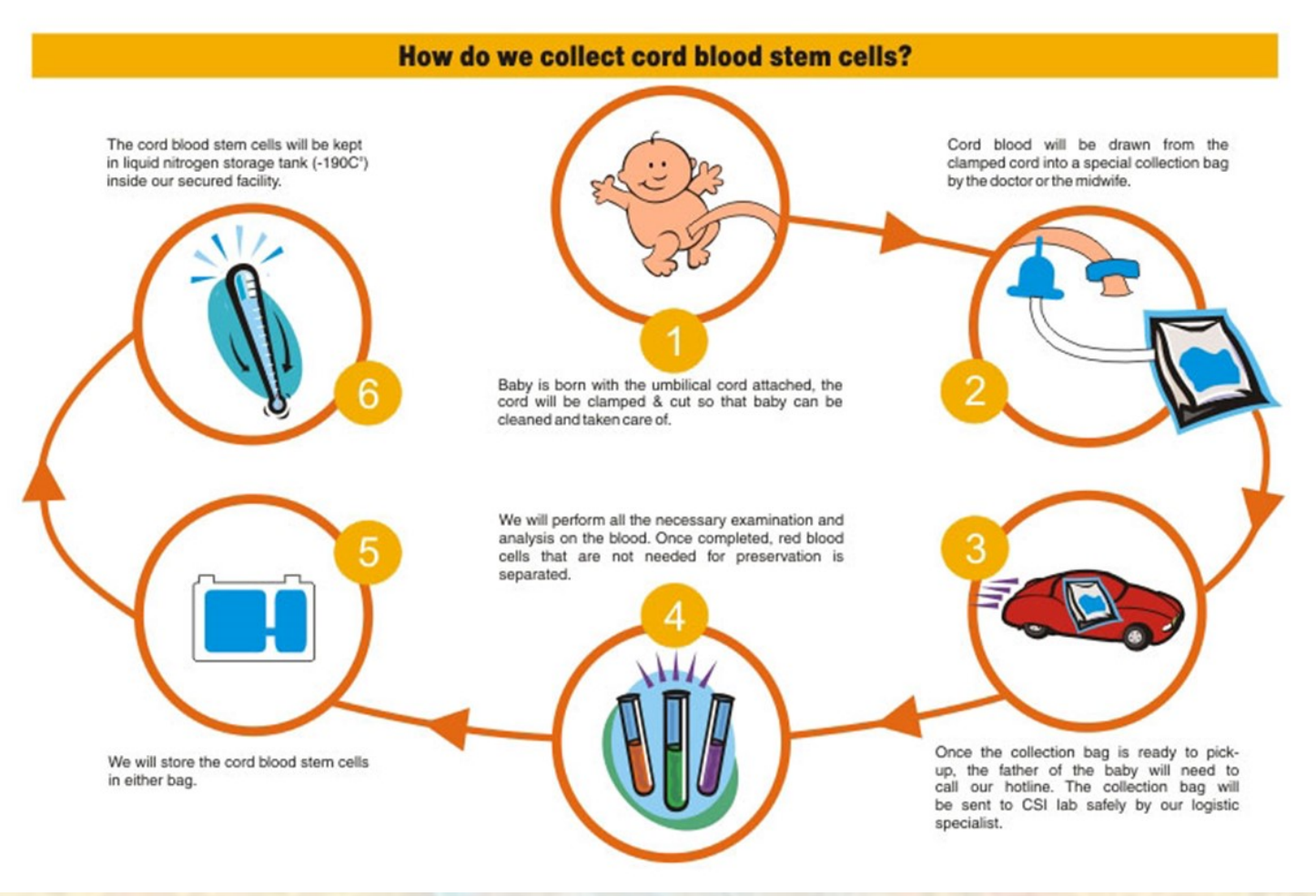
So, does storing cord blood take cells away from the baby? The answer is 'No'. Stem cells are collected after the umbilical cord is clamped. The baby does not experience anything different than she/he would in a normal birth procedure. Cells from the child's cord blood are removed in a completely different room such that the mother and child are not affected.

If cord blood banking really does help in curing diseases so efficiently, why is it not incorporated into many patients dying on a daily basis? That is the sad part of the issue. Cord blood banking is a very **expensive** treatment and is not really affordable. Roughly, $30,000 is needed for a patient using cord blood to treat a disease in a public bank while family banks typically charge about $1300 to $2200 for collection and processing, with an average of $125 in yearly storage fees.

Besides, privately banked cord blood has major **limitations** as a kind of health insurance policy. Even if the child does get sick, it may not be the right treatment for them. "If a child develops certain genetic diseases, his or her own frozen cord blood isn't going to help," says Arthur Caplan, PhD, a bioethicist and chairman of the Department of Medical Ethics at the University of Pennsylvania. "The cord blood will have the same genetic flaws that caused the disease in the first place, so it won't be a good treatment."

Due to the fascinating cure it provides, it has been used by many of the celebrities like Chrissie Swan, an Australian radio host and Big Brother winner, who shared her experience on how she decided to bank their child's cord blood. "Storing (your child's) cord blood is the **ultimate insurance policy** against the unthinkable," says Swan. An umbilical cord public stem cell bank, called LifeCell, was launched in India by Aishwariya Rai Bachchan recently. LifeCell aims to help patients in need of a lifesaving stem cell transplant to improve their odds of finding matching stem cells.

The potential of umbilical cord stem cells to renew the health and lives of people might be really debatable as well as controversial, but it is really exciting to come across such facts.



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Mouse Skin Cells Used to Create Eggs

SHAHINA MAZUMDAR, B.Sc. Biotechnology (1st year)

Stem cells have immense untapped potential as far as developmental biology is concerned. So far, stem cell therapy has been restricted to bone marrow transplants and umbilical cord blood transfusions, both leading to the restoration of healthy blood cells. However, research is going on to alter the source and developmental pathway of stem cells so as to exploit the **pleuripotency** of stem cells.

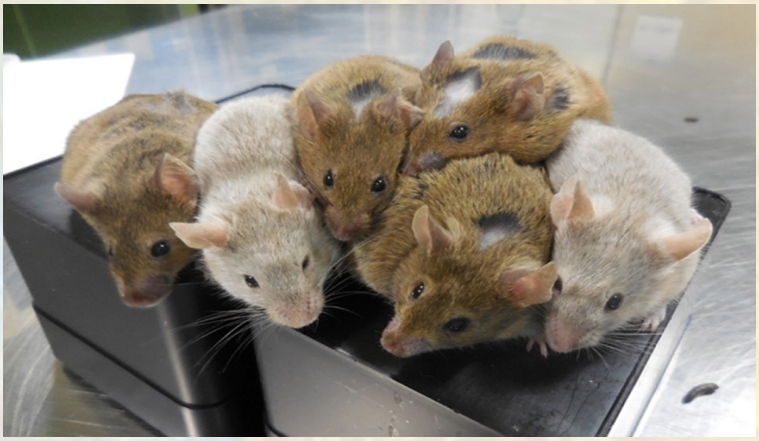
Pleuripotency occurs naturally in embryonic stem cells after the morula (16 celled) stage. Pleuripotent tissues can develop into any cells derived from the three germ layers, namely ectoderm, mesoderm and endoderm. Pleuripotency can also be **induced in somatic cells** by certain mechanisms. The ability to induce cells into a pleuripotent state was initially pioneered in 2006 using mouse fibroblasts and four transcription factors, Oct4, Sox2, Klf4 and c-Myc; this technique, called **reprogramming**, earned Shinya Yamanaka and John Gurdon the Nobel Prize in Physiology or Medicine 2012.

This time, reprogramming was carried out by scientists Hayashi (reproductive biologist, Kyushu University) and Saitou (stem cell biologist, Kyoto University) to reprogram **mouse skin cells** to pleuripotent **stem cells**, which were then converted to **primordial germ cells (PGCs)**. Primordial germ cells are the undifferentiated cells capable of giving rise to both spermatocytes and oocytes. Both the mouse skin cells and the induced stem cells have the same genetic complement; they only differ in their gene regulation and expression. This is why the PGC cells also retain the same genetic material and are capable of giving rise to eggs having haploid content of the somatic nuclei of the same organism.

The PGCs started developing into oocytes only when placed in the ovaries of live mice. Hayashi and Saitou then collaborated with Obata (Tokyo University of Agriculture) to grow the egg cells outside a live mouse, by using bits of mouse ovary cells in tissue culture. The eggs developed entirely **without the aid of a live mouse** or host. The eggs were then fertilized using in *in vitro* fertilization.

Using *in vitro* fertilization, 26 live pups were born, some of which have given birth to offspring.

The technique, though incredibly promising, needs to be perfected to increase the viability of egg cells developed using cell culture. Only 3.5% of the embryos created using this technique gave birth to surviving and healthy pups. After further development and refinement, there is the possibility of creating human egg cells from human somatic cells.



Live mice born from oocytes created out of mouse skin cells. (From http://www.nature.com/news/)

The breakthrough as reported in Nature on 17 October, 2016.

REPRODUCTIVE BIOLOGY

Mouse eggs made in the lab

First eggs created wholly in a dish raise call for debate over technology's use in humans.

BY DAVID CYRANOSKI

In a tour de force of reproductive biology, scientists in Japan have transformed mouse skin cells into eggs in a dish, and used those eggs to birth fertile pups. The report marks the first creation of mouse eggs entirely outside the animal. Researchers hope the process could be adapted to produce lab-grown human eggs too.

Katsuhiko Hayashi, a reproductive biologist at Kyushu University in Fukuoka, led the group that announced the breakthrough on 17 October in *Nature* (O. Hikabe *et al. Nature* http://doi.org/brxt; 2016). In 2012, when at the University of Kyoto, he and stem-cell biologist Mitinori Saitou reported taking skin cells down the pathway towards eggs: reprogramming them to embryonic-like stem cells and then into primordial germ cells (PGCs). These early cells emerge as an embryo develops, and later give rise to sperm or eggs. But to get the PGCs to form mature eggs, the researchers had to transfer them into the ovaries of living mice. The next advance came in July 2016, when a team led by Yayoi Obata at the Tokyo University of Agriculture reported transforming PGCs extracted from mouse fetuses into oocytes (egg cells) without using a live mammal. Working with Obata, Hayashi and Saitou have now completed the progression: from skin cells to functional eggs in a dish. With the use of *in vitro* fertilization techniques, 26 healthy pups were born, and some of them have given birth to offspring.

"This is truly amazing," says Jacob Hanna, a stem-cell biologist at the Weizmann Institute of Science in Rehovot, Israel. "To be able to make robust and functional mouse oocytes over and over again entirely in a dish, and see the entire process without the 'black box' of having to do any of the steps in host animals, is most exciting." The procedure is technically challenging, Hayashi says, but different groups in his lab have reproduced it. Although the team did not need to implant PGCs into living mice, they did have to add cells from ovaries of other mouse fetuses, effectively creating an ovary-like support in which the eggs could grow.

Hayashi says the work will help him to study egg development; he is not trying to make functional human eggs in the lab. But he suspects that others will try. "I do not think it is going to prove much more complex," says Hanna. Hayashi thinks that "oocyte-like" human eggs might be produced within ten years, but doubts that they will be of sufficient quality for fertility treatments. In his study, only 3.5% of the early embryos created from artificial eggs gave rise to pups, compared with 60% of eggs that were matured inside a mouse.

Debate over the ethics of the technology should begin now, says Azim Surani, a pioneer in the field at the University of Cambridge, UK. "This is the right time to involve the public in these discussions, long before the procedure becomes feasible in humans," he says. ■

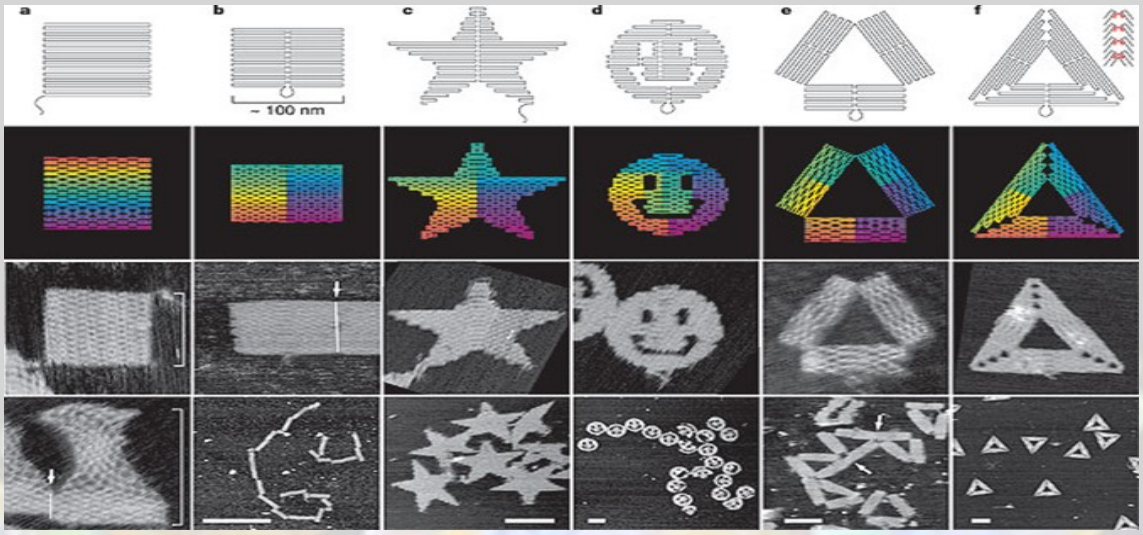
DNA Origami – A Place in New Age Artists' Repertoire

ADITI KANDLUR, MSc Molecular Biology and Human Genetics (1st year)

Origami is an art whose origin is traced to China in 105AD, though some suggest the Buddhist monks to have introduced the art form to Japan and parts of Korea. In Japan, this art form was unavailable to the general public due to paper being an expensive resource. It was often used in religious and formal ceremonies and now, this distinct concept of the art form has been extended to biological molecules!

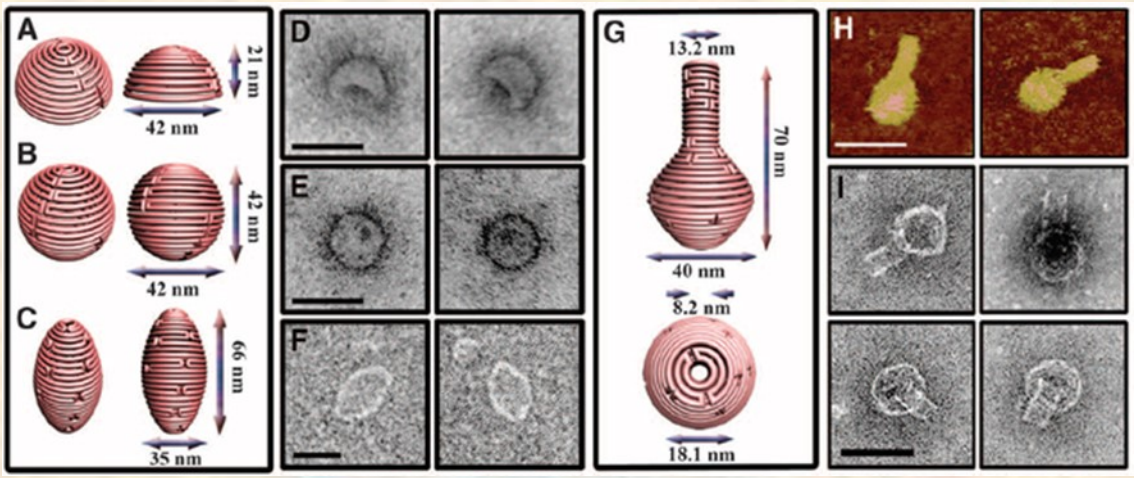
Origami has now progressed to an astonishing technique of creating **two-dimensional shapes** using a **raster fill technique** – **'scaffolded DNA origami'**. Before this was hyped, scientists over the world have been working with **self-assembling organic moieties** like porphyrins, short length peptides, proteins and even entire viral particles. However, they have been applied to construction and design of specific nano-sized structures such as nanotubes, semiconducting nanowires etc.

The biggest challenge that arises is to understand the attractive interactions in the basic units of the moieties being employed for the design, as they will be **highly specific**, which would mean no cross interactions and the resulting geometry of the complex structures/ design must have well defined features.



(Source: Rothemund, P. Folding DNA to Create Nanoscale Shapes and Patterns, Nature, 2006)

There are two well followed principles in this complex technique – **Hamming distance** [In information technology, it is a number that denotes the difference between two binary strings (sequence of 0s and 1s)] and **capability of DNA to form rigid non-linear helices**.
DNA origami is basically of two types: **(a) Single** strand and **(b) Scaffolded** strand (backbone) with single stranded helpers. The technique is dependent on the basic geometry involving the conventional Watson-Crick base pairing. Designs can be created using CAD software and other such tools.
DNA origami may find applications in **nano circuits**, **scaffolds** and many more. It all depends on how we as a science community helps it to progress and find diverse applications…
Here are the various shapes that have been designed so far !



(Source: Han, D. et al., DNA Origami with Complex Curvatures in Three-Dimensional Space, Science, 2011)

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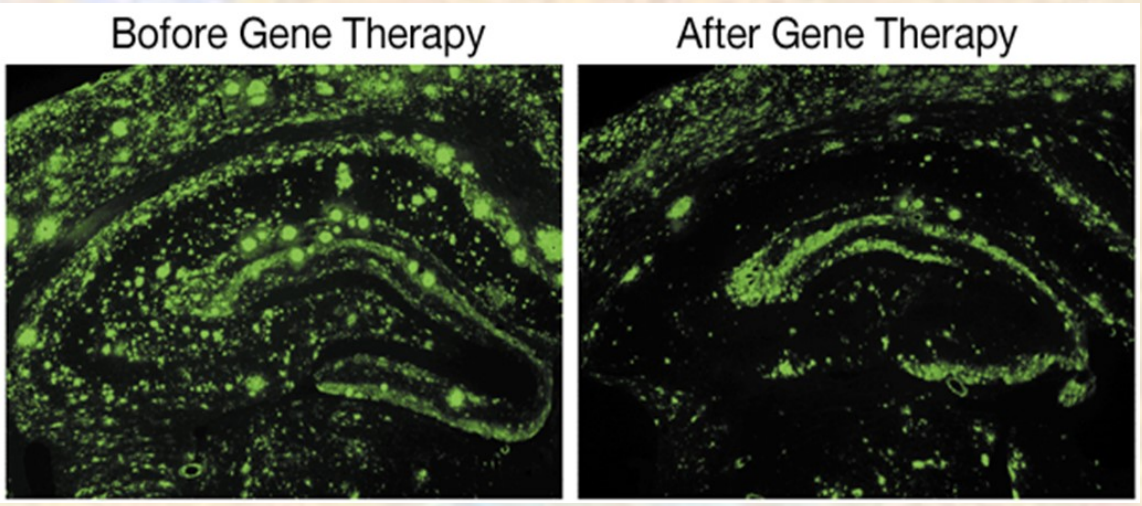
Gene Therapy for Alzheimer's disease

SYEDA INAAS, B.Sc. Biotechnology (1st year)

Alzheimer's disease is a chronic **neurodegenerative** disease that usually starts slowly and gets worse over time. It is the most common form of **dementia**. The major early symptom is difficulty in remembering recent events (short-term memory loss). As the disease advances, symptoms can include problems with language, mood swings, loss of motivation, not taking care of self and behavioral issues. The cause of Alzheimer's disease is poorly understood. About **70%** of the risk is believed to be genetic with many genes usually involved. There are no known cures for the disease, though symptoms can be treated. Several efforts are on towards finding a suitable therapy.

Mice do not develop Alzheimer's disease and scientists commonly use mice that have been genetically altered to develop the disease in their research. Recently researchers from Imperial College (London) have prevented the development of Alzheimer's disease in **mice** by using a modified **lentivirus vector**, generally used in gene therapies, to deliver a specific gene into the brain. The study results suggest that the expression of PGC1 – alpha gene (Peroxisome Proliferator-Activated Receptor-Gamma, Coactivator 1-alpha) may prevent the formation of a protein called amyloid-beta peptide in the brain cells of the affected individual. **Amyloid-beta peptide** is the main component of amyloid plaques, the sticky clumps of protein found in the brains of people with Alzheimer's disease. These plaques are thought to trigger the death of brain cells.



In the picture, the masses of green are the amyloid plaque depositions before (L) and after (R) gene therapy.

(From http://www.brain.riken.jp/bsi-news/)

Development of amyloid plaques occurs in the **hippocampus and cortex** regions of the brain. Short-term memory is affected in case of damage to the hippocampus while damage to the cortex affects the long-term memory. Hence, when these two areas were administered with the gene in mice, researchers found that the mice administered with the gene showed less amyloid plaques than those left untreated (the untreated mice showed multiple plaques). The technique comes with a disadvantage that the only way to deliver the gene is via an **injection** directly into the brain. The results are limited to mice as of now although extensive research in the future can improve the procedure for use in the treatment of patients.

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Great work, but Unheard

HARSH RANAWAT, B.Sc. Biotechnology (2nd year)

ROSALIND FRANKLIN

The structure of DNA was one of the most important scientific achievements in the last century, in human history in fact.

The famous double helix model is almost synonymous with **Watson and Crick** - the two scientists who won the Nobel Prize for figuring it out. But there is another name you might have heard: **Rosalind Franklin.** You may have also heard that her data supported Watson and Crick's brilliant idea or that she was a plain dressing belligerent scientist - which is how Watson actually describe her in **'The Double Helix'**.

But thanks to Rosalind's biographers who investigated her life and many people close to her, we now know that Watson's account was far from true and her achievements have been vastly underplayed.

Rosalind Elsie Franklin: The Unsung Mother of the Double Helix.

(From https://s-media-cache-ak0.pinimg.com/)

Here's the real story.
Rosalind Elsie Franklin was born in London in 1920. She wanted to be a scientist ever since she was a teenager, which was not an easy career path for girls at that time but she excelled at science anyway. She won a scholarship to **Cambridge** to study **chemistry**, where she got her PhD. She later conducted research on the **structure of coal** that lead to better **gas masks** for the British during World War II. In 1951, she joined Kings College to use X-ray techniques to study the structure of DNA - then one of the hottest topics in science.
The academic culture at the time was not very friendly to women and she was usually isolated from her colleagues.
She got to work and imparted **high energy X-Rays** on tiny white crystals of DNA. In 1952 she captured the most famous X-Ray image of DNA - Photo 51.

It took **100 hours** to capture the image and the time to analyze it would be a year. Meanwhile, the American biologist James Watson and the British physicist Francis Crick were also working on finding DNA structure.

Maurice Wilkins, her colleague, sent copies of **photo 51**, among other **crystallographic images** taken by Rosalind, to the duo. Francis Crick obtained her analysis methods from his thesis advisor - Max Perutz. All of this was happening without her knowledge, when she was busy analyzing her samples.

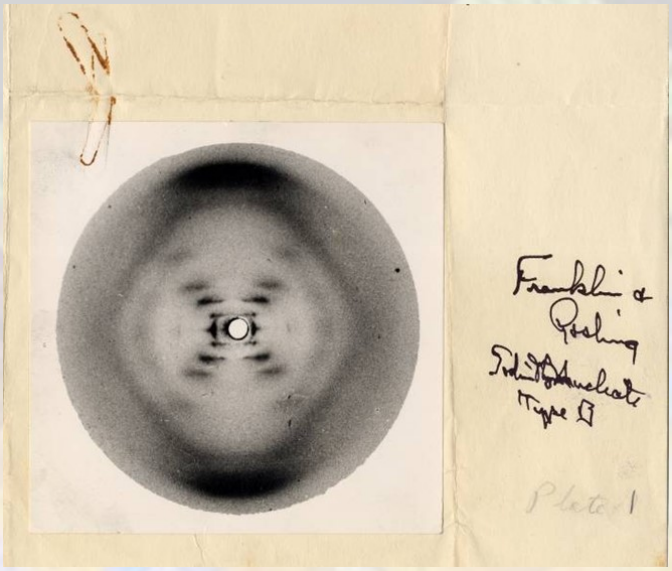

***Photo 51*, showing x-ray diffraction pattern of DNA**

(From https://askabiologist.asu.edu/Rosalind_Franklin-DNA)

Rosalind and Watson-Crick published their papers on the structure of DNA in the same edition of the journal **Nature in 1953**. Thanks to the deal between the directors of the two labs, Franklin's paper with X-Ray data was published in the latter half of the journal and with modified text, such that it only 'supported' the Watson-Crick model.
She continued her research, now on **RNA** and pioneered discoveries in the structure of **Tobacco Mosaic Virus.**

Rosalind died of **ovarian cancer** and **bronchopneumonia**, in 1958, at the age of **37**.
Watson, Crick and Wilkins received the Nobel Prize for the discovery of the DNA structure in 1962, 4 years after her death.
She fought **sexism in science** and revolutionized biology, agriculture and chemistry.

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EVENTS: IN AND AROUND

Swachh Pakhwada Phase I and II

HARSH RANAWAT, B.Sc. Biotechnology(2nd year)
KARTHIK NAIR, M.Sc. Bioinformatics(1st year)
BHARGAVI KARNA , B.Sc. Biotechnology (1st year)

On the **2nd of October, 2014**, Prime Minister Narendra Modi launched the **Swachh Bharat Abhiyan** as a mission of cleanliness across the Urban and Rural areas of the country.
The vision of this 'Abhiyan' is to attain a state of '**Clean India' by the 150th Birth Anniversary of Mahatma Gandhi in 2019**.

The School of Life Sciences, Manipal University has shown active participation in this campaign in a variety of activities.

The college organized a series of activities from the **1st to 15th of September, 2016** under **Swachh Pakhwada** including **sensitization programs** such as documentary, awareness banners and speech. There were essay and painting competitions held in relevance on the topic **"cleanliness".** Moreover, students of the college voluntarily participated in cleaning activities in and around the school. The college actively worked for weeding out and removal old and unused files and equipment.

To conclude the 15 days of Swachh Pakhwada campaign, on 15th of September, School of Life Sciences organized a **Swachh Diwas** with **Mr. Raghavendra B. S.** as the Chief guest.

Mr. Raghavendra, **Environmental Engineer** in Udupi district, enlightened us on the occasion about the ongoing in-site and off-site disposal and management of waste in the district and surrounding areas. He gave us an insight on the **5Rs of environment sustainability**: **Refuse, Reduce, Reuse, Recycle and Rot**. He emphasized how while the municipality would need help from each individual in enacting all the cleanliness policies they have made.

The event successfully concluded with a **mass pledge** taken by the staff as well as the students of School of Life Sciences promising to contribute minimally to pollution and maximum to cleanliness.

Following the first phase Swachh Bharat Pakhwada in September, the college soon held the **second phase** in November with a culminating event on **November 9, 2016**. This was one of the **1,200** such pakhwada events held in the country till that date.

The Chief Guest for the event was **Dr. Muralidhar V Pai** -Professor and Head of Department of Obstetrics and Gynaecology, KMC, Manipal. He is the National Corresponding Editor of Journal of OB/Gyn Of India and has received various novel awards like the Best Scientific Article Award, Journal of OB/Gyn of India, 2005.

Dr. Pai focused his talk on **hygiene, sanitation and sterilisation** methods and their importance. Though very common methods in principle, but if followed and done correctly, could have a profound positive impact - he emphasised. He presented statistics regarding **neonatal and maternal mortality** due to improper hygiene practices.
From the basic definitions of health to the various terms of disinfection, sanitation and sterilisation to the methodology of proper hand washing - Dr. Pai made sure he was clear and impactful in his ideas. He also gave a couple of his own experiences in regard to the topic for the day. He ended his talk with a small list of simple but important parameters we must make sure for healthier lives.

Enthusiastic students from MSc first year performed a short mime **act**, addressing everyday habits of the common man, which had to be changed for a cleaner nation. The act was without dialogues, but the message was loud and clear.

Lastly, the attendees took a pledge to devote time and effort in the process of making the country cleaner and to encourage others to do their bit in the 'Swachh Bharat Abhiyan'.
#MyCleanIndia

DAILAB Webinar on "Age related macular degeneration (AMD) in India: The missing links" - - Dr. Akshay Anand (28 September 2016)

ADITI KANDLUR, MSc Molecular Biology and Human Genetics(1st year)

Students and researchers from the School of Life Sciences, Manipal, joined their first webinar organised under the **Indo-Japan DAILAB** program along with other partner institutions in India, Korea, Japan, and Indonesia on **Wednesday, September 28, 2016**. This webinar had an audience comprising undergraduate, postgraduate students, research scholars along with the members of the faculty.

It was a part of the **CAFE (Classroom for Advanced and Frontier Education)** initiative undertaken by the **NIAT,** Japan and its partner organizations to reach out to the various parts of the world through the web.

The speaker of the webinar was **Dr. Akshay Anand** who is currently working in the Neuroscience Research Lab, Department of Neurology, Post Graduate Institute of Medical Education and Research (PGIMER), Chandigarh, India. The topic of the webinar was **"Age related macular degeneration (AMD) in India: The missing links".**

The talk was a brief description of the research that Dr. Anand has been doing on AMD with a trail of success following the findings of a specific **biomarker CCR3** which helps in the prediction and genetic testing for AMD.

Samples had been collected from **150 human subjects** from India as a part of the study. Cell lines as well as animal (mouse) model based studies were conducted. While the School had seen several eminent speakers giving lectures on their research activities and enriching our knowledge, in person, this webinar was a first of its kind and quite productive in its own way.

DAILAB Webinar on "Unique Gene Expression Strategy of Trypanosoma and its implication as drugs target" - Dr. Yuko Takagi (16 November 2016)

PRATEEKSHA, MSc Medical Biotechnology (1st year)

ADITI KANDLUR, MSc Molecular Biology and Human Genetics(1st year)

Students and researchers from the School of Life Sciences, Manipal University were part of the **DAILAB-CAFÉ webinar** on **16th November, 2016** that was also broadcast in many institutions in India, Sri Lanka, and Singapore.

The presenter, **Dr. Yuko Takagi** from AIST, Japan spoke on the prevalent neglected tropical diseases such as **Human African Trypanosomiasis**, **Chagas disease** caused by protozoans. The speaker introduced the audience to the characteristics of the **Kinetoplastid** order of parasites (*Trypanosoma brucei*, *T. cruzi* and *Leishmania spp*.) stating that they were also isolated from fossils recently and hence termed as **"Ancient Parasites"!**

The speaker then briefly mentioned the symptoms of African sleeping sickness and Chagas disease along with the vectors – the **Tsetse fly** and **Triatominae (Kissing bug)** respectively. She emphasized the critical fact that **7 million people** worldwide are affected by these diseases and that **no vaccines** have been developed so far against these diseases as they have continuously changing surface proteins.

She moved on to the molecular mechanisms of the parasite, especially the additional **mRNA capping enzyme Cap 4**, which is unique to **Kinetoplastids**. The kinetoplastids called **TriTryp**, can therefore be targeted by curbing their replication by controlling their RNA synthesis. She brought home the facts that the drugs currently being used (*Benznidazole and Nifurtimox*) have long treatment period (30-60 days), some show drug resistance and a lot of detrimental effects in the patient.

She mentioned that recent work in her lab indicated scope for **RNA interference** and **CRISPR/Cas9 genome editing** as prospective methods to target their replication and as potential treatment methods. She established the gap lying between the industrial clinical work and the academic research making the audience aware, for future aspects of the research field to offer better solutions to the problems in society.

Rock and Rains – High Voltage 2016

ANIRUDH GUPTA , BSc Biotechnology(3rd year)

The School of Life Sciences, Manipal University, conducted their **rock concert** event **"High Voltage"** for the second successive year on **Saturday, October 1, 2016**. Featuring **ten student bands** from in and around Manipal, the event highlighted the musical talent of the students of Manipal University and also the support and fan base within the Manipal community. About **nine hundred** people, including students and teachers turned up to provide vociferous support to the bands. "High Voltage 2016" featured crowd pullers and headliners such as **"Delirium"** and **"Under the Cross",** along with bands such as **"Metanoia"** and **"Army of Prawns",** who returned for the second year in a row.

A delayed start at the Amphitheatre at Manipal was soon forgotten as 'Delirium' took to stage and gave the sort of brilliant performance that they are known for, with the **crowd cheering loud**. This was followed by a succession of high voltage rock music that kept the **music flowing**, and the **crowd humming**.

However, the rain decided to play spoilsport with **heavy showers** midway through forcing the organizers to prematurely conclude the event, rendering some of the bands unable to play. But that was not before 'Under the Cross' have been able to **enthrall the audience** yet again.

This year, 'High Voltage' had partnered with **"Under 25 Club"**, an organization devoted to **"engage with entrepreneurs, creators, innovators, and doers under the age of 25".** Mr. Shouvik Roy, a member of the organizing team from School of Life Sciences spoke of the efforts that went on towards auditioning of the bands and the rest of the arrangements for the event, which was handled by a team of students for months in advance. In the end, though the rain did shorten the time, the great music and the vibe lifted the spirits of the audience. In accomplishing that, **the bar for conducting rock fests in Manipal has also been raised.**

Sports Week 2016

ATHIRA, BSc Biotechnology(3rd year)

Filled with loads of enthusiasm and sportsmanship, the **last week of October 2016** was a blast for students and faculty alike, with the start of the sports-related activities for the year, with a **'Sports Week'**. Events such as **six-a-side cricket league matches**, **throwball** and **volleyball** were held with active participation from BSc, MSc students, research scholars, and faculty and staff members.

Everyone gathered at the **Sharada court** from 5 pm onwards to support their fellow classmates and colleagues in some friendly intra-college competitions. The **cricket** finals were held on **Oct 25, 2016** and the winners were a team of BSc (2nd year) students. The **throwball** games were held on **Oct 26, 2016** with a team from BSc (2nd year) emerging the winners. A team of faculty and staff members won the **volleyball** competition on **Oct 27, 2016**. More games and athletic events are to follow in the coming months.

How we realized Diwali = Sharing joy!

HUMAIRA SHAH, BHARGAVI KARNA, BSc Biotechnology (1st year)

On the auspicious occasion of **Diwali** this year **(30th October 2016)**, the **Social Committee of the Students Council (SLS)** along with a few members of the school visited **Shri Krishna Balaniketan** - a nobly run orphanage in Udupi.

The Balaniketan family was Kannada lingual and we barely knew the language but Love and Happiness are languages with no barriers. The joy on their faces when they **danced** with us and the **satisfaction** in our hearts as we left the place was all that needed to be communicated.

The committee had beautifully packaged **presents** for the kids in the house: a clear-bag, a notepad, a pack of sticky notes, fruits and chocolates. Also, there were beautiful **handmade Diwali cards** for the children from the people who came along and those who couldn't.

An hour of interaction with the kids seemed to be a very short duration of fun we had with them while they played games, sang and danced with us.
It was, all together, the most **well spent** Diwali even though we were away from home.

Rashtriya Ekta Diwas (National Unity Day)

RAM SAI, MSc Bioinformatics(1st year)

ADITI KANDLUR, MSc Molecular Biology and Human Genetics(1st year)

October 31 every year is celebrated as **Rashtriya Ekta Diwas (National Unity Day)** after the Government of India introduced it in **2014**. The day is celebrated to commemorate the birth anniversary of **Sardar Vallabhbhai Patel**, known as the **'Iron Man of India'**, who is one of the founding leaders of the Republic of India, having been instrumental in keeping the union together soon after the country's independence.

To pay tribute to Shri. Patel, the School of life Sciences, Manipal organized events dedicated to the appreciation of his contribution to this nation, on **31 October, 2016**. The students, researchers, and employees in the gathering commemorated the messenger of unity with a song of national importance, a **talk** on the history of the Republic of India and how Sardar Patel played a role in the unity of India. The event culminated with a **pledge for national unity and integrity**.

The Chief Guest for the day was **Dr. Aravind Kumar**, Professor and Head of the Department of Geopolitics & International Relations at Manipal University, Manipal. He gave a clear insight on how Sardar Patel was an activist for justice since he was a school kid, how selflessly he participated in the country's struggle for independence and guided its integration into a **united, independent nation**.

Dr. Kumar highlighted how this persistent unifier of India is affectionately remembered as the "Patron saint of India's civil servants" for having established the modern all-India services system. His contributions to the **Satyagraha Movement**, **Quit India Campaign**, and the **unification** works after independence were also described, which served to increase the respect for Sardar Vallabhbhai Patel. The event helped the current generation to appreciate the struggle during the independence movement and be grateful for the **'unity in diversity'** motto practiced by the Sardar.

Halloween Night

RAMYA GUPTA, BSc Biotechnology(3rd year)

School of Life Sciences, Manipal University celebrated Halloween with an (albeit, delayed) event organized on the evening of **4th November 2016**. The cultural committee and student council, with a team of student volunteers, unleashed their creative talent to **decorate** the college and set up a spooky photo booth. The organisers screened the movie **"Lights Out"** for an audience of students, teachers and research scholars. **Lively music** and **food stalls** were the center of attraction during the interval of the movie. On the menu were home-made popcorn, chocolate cookies (with sprinkles!) and an ominous-looking red drink whose contents were not revealed. However, students were assured that it was perfectly safe for consumption and no adverse effects were reported in the aftermath.

All in all, in keeping with the tradition of Halloween at SLS, it was an **enjoyable** night that saw active participation from staff as well as students of all batches.

An interview with Dr. Vito Ferro

SUDIPTA PATHAK, ADITI KANDLUR, KARTHIK NAIR, SRITAMA PRAMANIK MSc (1st year and 2nd year)

Dr. Vito Ferro is the Director, Doctor of Biotechnology Program, School of Chemistry and Molecular Sciences, University of Queensland. He was on a visit to School of Life Sciences and Manipal University recently to explore various collaborative opportunities. He presented his work to the students, researchers and faculty members of the School. His main research focus is on the synthesis of compounds to **probe** and/or inhibit carbohydrate-protein interactions involved in disease process. His particular interest is in **Heparan Sulfate (HS)** and the development of **HS mimetics** as potential drug for cancer and other diseases. His team's previous work in this area has resulted in the discovery of **PG545**, a potential inhibitor of **angiogenesis** and **metastasis** of cancer. PG545 is currently in Phase I clinical trials in cancer affected individuals.

After the talk, and in spite of his hectic schedule (*and a jet lag*), he kindly consented to interact with the Students Council when we approached him. Here are some **excerpts**, and interesting thoughts, from his interaction with us:

When asked what motivated him to choose research, he recalled that after dropping out from school, he worked in a bank. During this period, he decided to complete his education and went on to study chemistry which was his interest back then (and still is today!), he went on to do an Honors degree in the subject **Organic Chemistry**. After completing his PhD at the University of Western Australia, he availed and worked on two postdoctoral fellowships at the Carlsberg Laboratory in Denmark and the University of British Columbia in Canada. He spent 12 years in the biotechnology industry sector with Progen Pharmaceuticals Ltd as the Director of Drug Discovery. In 2008, he joined QUT as a Principal Research Fellow and Deputy Program Leader in the CRC for Polymers before joining The University of Queensland in 2010.

He encouraged students to explore the various M.Sc. and PhD programs available in the **University of Queensland** for Indian Students and also highlighted that various scholarships are available for Indian students and International students in general. He also emphasized that the University also has M.Sc. Biotechnology program with business management as a subject, which creates a better platform for recruitment by industries and understanding marketing strategies apart from the science part of it.

When asked for a message to students and youngsters, he said that it is important to be patient and at times better to go with the flow… On his first ever visit to Manipal he found the School of Life Sciences "**impressive and to be well equipped for research**" after visiting the various labs.

Constitution Day (26 November, 2016)

ADITI KANDLUR, MSc Molecular Biology and Human Genetics(1st year)

KARTHIK NAIR, MSc Bioinformatics (1st Year)

The School of Life Sciences celebrated 'Constitution Day' on **26 November, 2016** by conducting an **awareness session** on the **Fundamental Rights and Duties**, which was attended by faculty, staff, research scholars and students.

The speaker of the day was **Shri. Prakash Kanive**, Principal of Vaikunta Baliga College of Law, Udupi. He began his talk by recalling the history of the constitution. He described the events as the first draft of the Indian Constitution was completed under the coordination of the President of Constituent Assembly, Dr. Rajendra Prasad and the Chairman of Drafting Committee, Dr. BR Ambedkar on 26th November 1949. Since 1979, the day has been celebrated as **'Law Day'** based on the orders of the Supreme Court Bar Association. However, in 2015 the Government of India declared it as **'Constitution Day'**. The speaker then explained the various fundamental rights that have been conferred by the constitution and the amendments that have been brought about in the Supreme Court during the past few years. He also mentioned the various cases that were the reason behind the multidimensional approach that the Court observes, such as Subhash Kumar vs. State of Bihar and Virender Gaur vs. State of Haryana, which led to expansion of Article 21 as Right to get unpolluted air or water.

He emphasized that ***fundamental rights*** *are* ***not absolute*** *and that* ***duties*** *are as* ***important*** *as the rights*. He stated that Article 14 on Intergenerational Equity finds its roots in the Atharva Veda, which states that man is permitted to take from nature only up to the extent he could contribute back to the future generations. This talk and the interactions helped in gaining further insights into the fundamental rights and duties as citizens of this country.

Be the DESIGNER!!

Wouldn't it be nice to have a T-Shirt of our college? Just imagine wearing around a T-shirt that speaks enough of our identity?

Well, the School of Life Sciences plans to have T-shirts of their own and believes that our readers would have ideas unmatched for the same.

We ,thus, invite you to send out your ideas to us.

Remember, if your design is approved, there'll be people wearing YOUR DESIGN everywhere they go!

GRAB THE OPPORTUNITY!!

Contact: Aditi Kandlur, council.students1617@gmail.com

Guest Lecture- Proteomics to Understand Cancer Biology

SHRUPTHA KUMARI, ADITI KANDLUR AND SANIKA AMONKAR, MSc Molecular Biology and Human Genetics

Dr. Akhilesh Pandey, Founder & Director, Institute of Bioinformatics, Bangalore, was invited for a guest lecture on a very much upcoming field- proteomics, at the School of Life Sciences, Manipal on **December 6, 2016**. This was attended by faculty members, research scholars and students. He was introduced to the audience by Dr. T.S. Murali, School of Life Sciences, Manipal.

The speaker began his talk by informing the audience regarding few of the ongoing projects at their institute. He covered topics such as **therapeutic targets** in triple negative breast cancer, tamoxifen resistant breast cancer as well as tobacco and oral cancer.

The speaker stated that **triple negative breast cancer (TNBC)** is highly invasive and they have done vast amount of diversified research approaches to figure out a target protein in TNBC such as targeting *AXL* and *TNK2* via antibodies and shRNA have been applied. He emphasized that lower *AXL* levels correlated with decreased **mortality**.

He then went on to talk about **the tamoxifen resistance** in breast cancer, wherein the *FAK2* increases along with the resistance characteristics in the cancer cells, relating to poor prognosis in cancer affected individuals. He then spoke on his colleague's work regarding tobacco and its slow but definite impact to cause **tumorigenesis** on long term exposure and how they are coming up with a translational procedure of using salivary biomarkers in oral cancer such as *SPOCK1* and also *DYRK1A* in head and neck cancer.

The talk concluded with him encouraging the young aspiring researchers to look up the signaling pathways as targets, informing the audience regarding the opportunities offered in proteomics for **oncogenetic mechanism** discoveries. He also encouraged future collaborations with the host institute stating it would open new aspects in research and also insisted on students looking up their institute in Bangalore.

The session concluded with Dr. Gopalkrishna Bhat, School of Life Sciences handing over a memento to the speaker as a token of appreciation.

EXPERIENCE FROM ALUMNI

From "Mr." to "Dr."

AMITH MAROLI, Alumnus- BSc & MSc (2005-2010)

After graduating from **MLSC** (pardon for not referring to as SOLS, we were known as MLSC during my time and somehow feel a personal **nostalgia** with the acronym), I took up a voluntary research position at the Dept. of Microbiology, KMC-Manipal. Over there I worked on a research involving the **molecular characterization of MRSA** in the school children in Udupi while simultaneously preparing for CSIR and GRE exams. Once I got CSIR-JRF fellowship, I yearned to be close to my home so I joined for an integrated MPhil-PhD program in Genomic Science at Central University of Kerala.

As part of my MPhil degree, I worked on annotating the recently **sequenced genome** of an agricultural pest *Hessian fly* (*Maytieola* destructor) in collaboration with faculties at Kansas State University, KS, USA. Towards the end of my MPhil program, I started developing an interest in plant science. Though initially I was skeptical of switching my field from human biology to plant biology, I decided to take the plunge with the single goal of enriching myself with the knowledge of both realms of the living kingdom.

Dr. Maroli working in the MUAL lab on UPLC-MS|MS

Though my passion lies in understanding the intricacies of cancer development, I realized that in order to impart wider impact on the society, it is necessary to get improve the knowledge on **drugs available to treat cancer** (rather than finding a cure) and alleviate the pain due to the multiple chemo sessions and the large dependence on expensive drugs. This compelled me to devout my attention to **nutraceutical research** and natural product derived medicines which has less side effects than chemical drugs. Thus I decided on developing my knowledge on plant medicinal chemistry and analytical chemistry.

An interesting development, I owe to my time at MLSC, is the fact that during my early education, I was neither fond of chemistry nor botany. However, after my MSc work under the tutelage of Dr Roopa and a brief research work with Dr Vidhu brought me to like chemistry and botany to the extent that I was planning to do a PhD majoring in plant science with a focus on analytical chemistry

After relentless applications and numerous rejections and dejections, I was finally received acceptance letters from 3 universities with wide program focus-PhD in Neuroscience at McGill Univ, Canada; PhD in Molecular Pathology at UPitt, PA, USA and PhD in Plant and Env Science at Clemson University. It was tough decision to choose from. Being raised in the deserts of Kingdom of Bahrain and sweating in the heat of Manipal, I decided to forgo the coldness of Canada with a heavy heart.

Based on the assistantship offered and the savings I would have at the end of the program, the scales tipped in favor of **Clemson**. The lab I was accepted to was doing research on Metabolomics and was also a Core Facility on **Multi-User Analytical Chemistry and Metabolomics**- this piqued my interest. One of my responsibilities was to develop analytical methods on mass spectrometer (LC | MS and GC | MS) to separate, characterize, identify and quantitate various small molecule compounds.

In my stride towards conversion from **Mr to Dr.**, the initial months at Clemson was bit of a struggle and was in a constant fight with myself to stop myself from quitting and return back. I discussed my research plan with my advisor and my MLSC teachers Dr Vasu and Dr Vidhu, who helped me tune my way. After numerous rounds of discussion and disagreements, I was finally able to formulate my research plan.

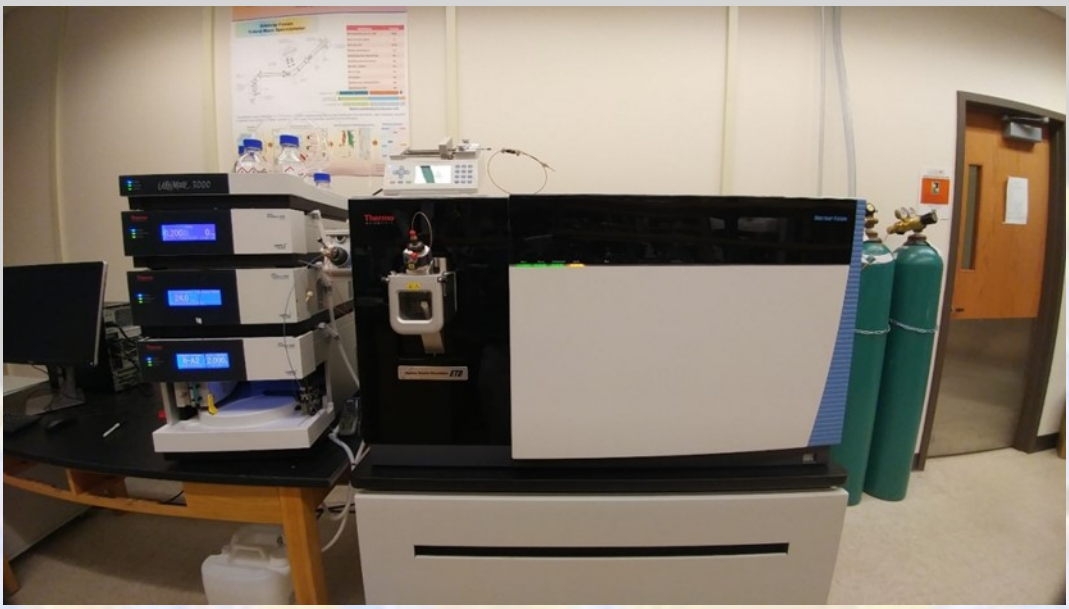
I titled my plan as **"Application of Metabolome Profiling to Elucidate Physiology of Herbicide (Glyphosate) Resistance and Tolerance Mechanisms in Weeds".** Briefly, my research aims to look at how weeds are able to evolve resistance to herbicides that are sprayed to control them.

Being based in South Carolina, the predominant weed over here is *Amaranthus palmeri* **(Pigweed)**. This weed is unique such that it alone has evolved resistance to almost all the herbicides. Sometimes, a single weed is resistant to multiple herbicides. This weed is considered as a **"Superweed"** similar to the Super bugs that are resistant to multiple antibiotics. Our work attributed the resistance to an elevated anti-oxidant machinery functioning in the resistant biotypes compare to the sensitive biotypes. This work was published in the **Journal of Agriculture and Food Chemistry (JAFC; 63(41), 9199-9209)** and was widely applauded when the findings were presented at national and international conferences. From the findings of this study we progressed to the next study to study the implications of our findings on weed physiology using a new technique called Stable Isotope Resolved Metabolomics (SIRM). The findings from this study complemented our earlier results as well led to the understanding the despite being under stress, sensitive plants devout resources to synthesize new amino acids which require less energy while salvaging energy intense amino acids by proteolysis. In comparison, the resistant biotypes are able to actively synthesize new amino acids efficiently in the presence of chemical stress thus able to mitigate the toxicity. This work resulted in my second paper, also published in JAFC (JAFC; 64 (37), 7040-7048). However, the method and analytical technique we adopted to come to our conclusions was unique such that the paper was selected as **ACS Editors Choice**.

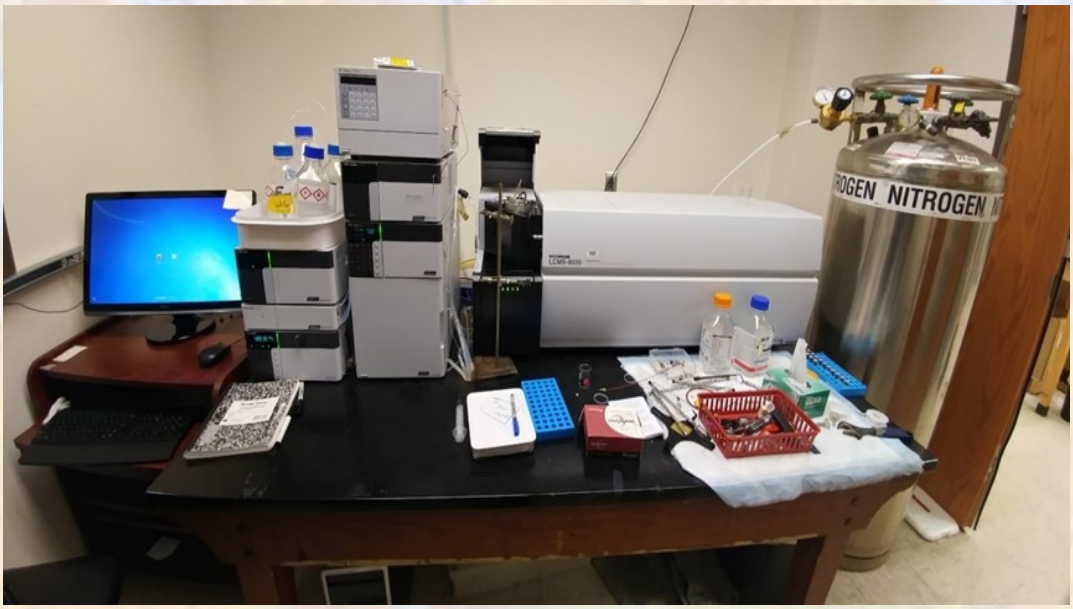
This is very special because the selection of articles that are bestowed this honor is based on recommendations by the scientific editors of all the **ACS (American Chemical Society) journals** from around the world and is made freely available so that it will have wide readership due to its potential to advance scientific knowledge.

My ongoing research is on **proteomic investigation of resistance mechanisms**.

Some of the instruments in my lab that I have expertise in:



A Thermo Fusion Tribrid Orbitrap Mass Spectrometer



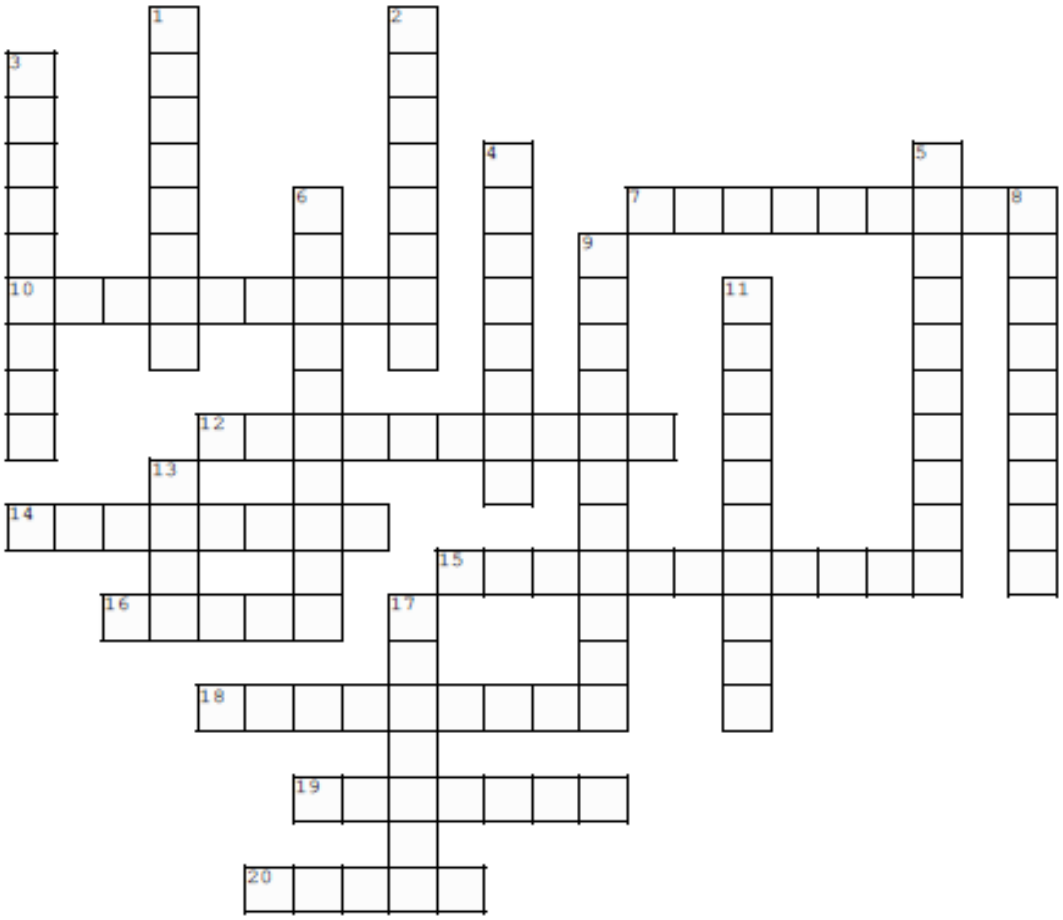
A Shimadzu HPLC-Triple Quadrupole Tandem Mass Spectrometer

Science is vastly more stimulating to the imagination than the classics.

-J. B. S. HALDANE, 1892 TO 1964 (Biologist)

KNOW YOUR BASICS!!!

Complete the crossword below



Down

1. Produced by ruminant animals in the lining of the stomach.
2. A particle that travels at speed close to the speed of light and are created as a result of radioactive decay.
3. Glycolysis takes place in the _____
4. A special organ of attachment composed of non-vascular tissue, developed by many marine algæ.
5. A protein first recognized in animals for its action in inhibiting viral replication and inducing resistance in host cells.
6. The person who coined the term 'Biotechnology'.
8. A multinucleate cell which can result from multiple nuclear divisions without their accompanying cytokinesis.
9. The study of heritable changes caused by the activation and deactivation of genes without any change in DNA sequence.
11. Cells in organisms which contain more than 2 paired(homologous) sets of chromosomes.
13. Location in a genome where a short nucleotide sequence is organized as a tandem repeat.
17. A tiny opening or pore that is used for gas exchange.

Across

7. Refers to genetically engineered organs that have been grown within and animal of another species.
10. A chemical substance present in the cells of bioluminescent organisms.
12. Chemicals capable of acting outside the body of one animal, to impact the behavior of another animal of the same species.
14. A thick-walled dormant cell derived from the enlargement of a vegetative cell.
15. The protein which help clot blood.
16. Many scalar variables in PERL create an _____.
18. Study that combines information from genomics and proteomics with molecular relationships of cell components.
19. Dinoflagellates feed on _____
20. An investigative procedure for qualitatively assessing or quantitatively measuring the amount of analyte.

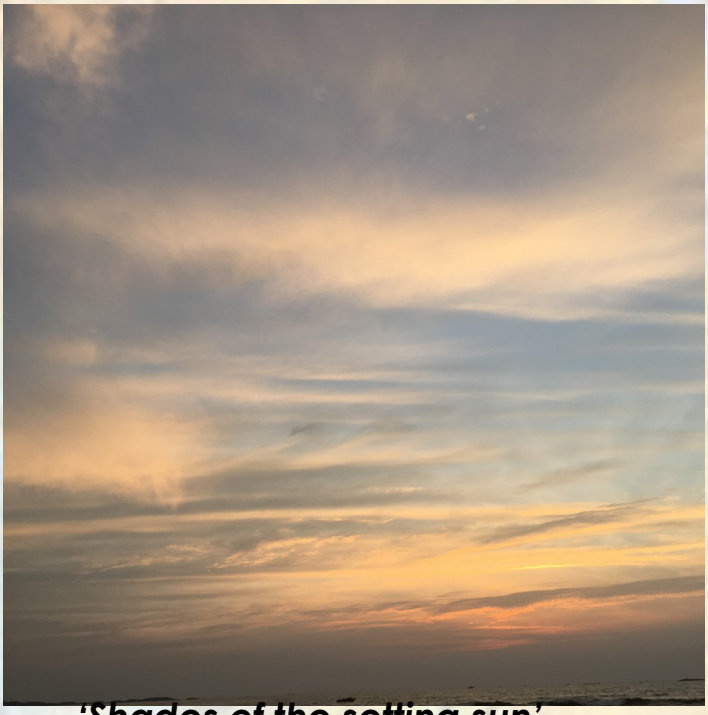
AARTI RAMCHANDRAN, SHREYA GUDI, MALAVIKA MELOTH

B.Sc. Biotechnology (1st year)

NEW VISION, NEW PERSPECTIVE

'The race demands too many legs'
-Aarti Ramchandran
(1st Year BSc Biotechnology)

'The yellow friends'
-Bhargavi Karna
(1st Year BSc Biotechnology)



'Shades of the setting sun'
-Greeshma Gopinath
(1st Year BSc Biotechnology)

'Fusion'

-Sourav Patagi (1st Year BSc. Biotechnology)

'Colourless is colourful'

-Thyagarajan

(1st Year BSc. Biotechnology)

'***What is your defense?'***

-Harsh Ranawat

(2nd Year BSc. Biotechnology)