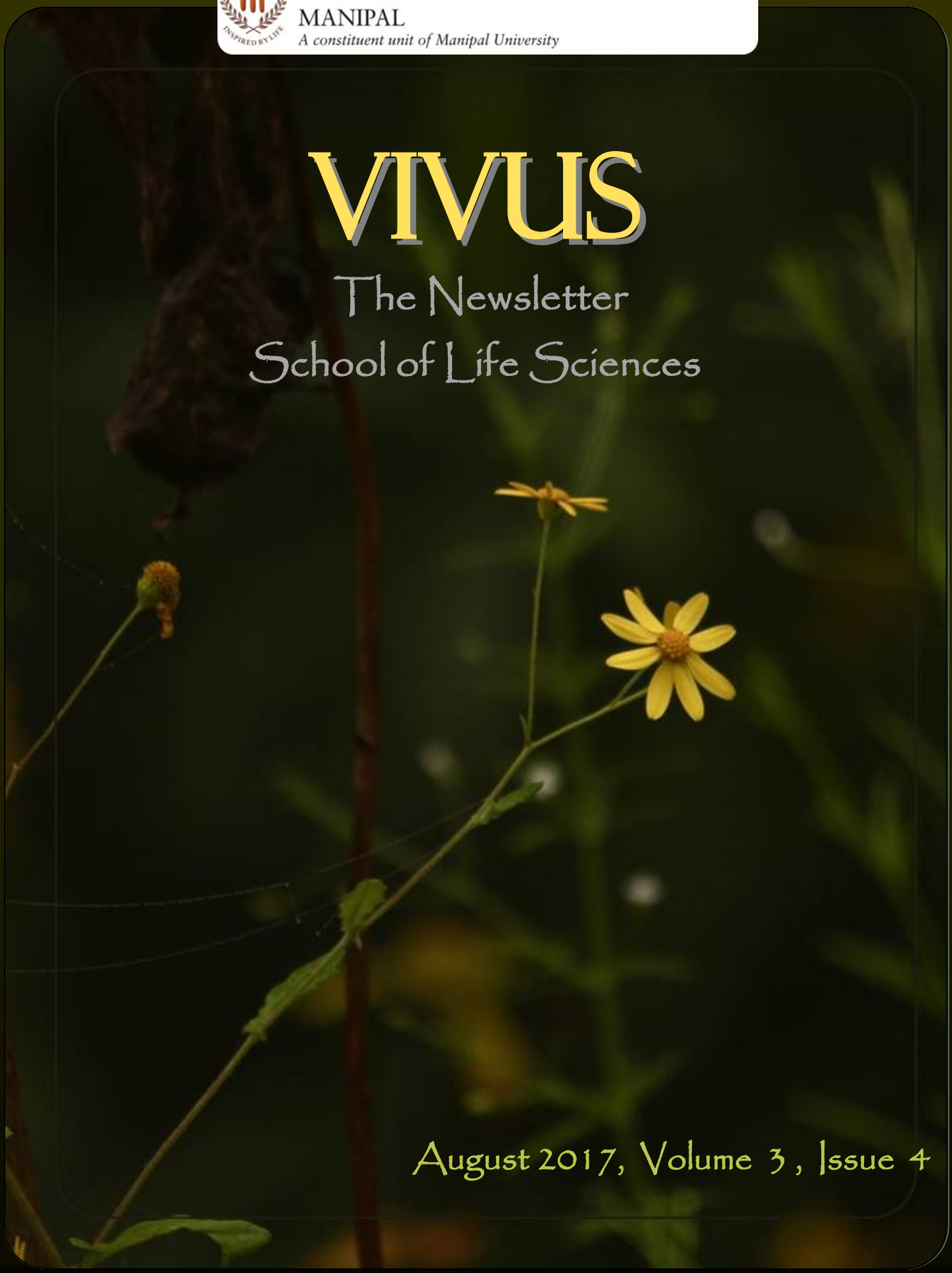
SCHOOL OF LIFE SCIENCES
MANIPAL
A constituent unit of Manipal University

VIVUS

The Newsletter
School of Life Sciences



August 2017, Volume 3 , Issue 4

A NOTE FROM THE EDITORS

DEAR READERS,

Greetings!

Probably having named the newsletter, or for some reasons undefined, we, the editors 2016-17, built some personal bonds over the year with Vivus. As editors, we are obliged to make every issue of Vivus a success and this was less an obligation by post and more a responsibility as folks of a research institution. As we signed up for the job, we wanted this to be a medium for knowledge and a platform for showcasing potentials. And over the four editions, we hope that both of our motives have been satisfactorily achieved.

However, Vivus has not been a work of anyone alone. There are innumerous people we oblige to thank for its success.

We extend our sincere gratitude to

- ⇒ **Dr K Satyamoorthy** for his encouragement and support has proved extremely vital to this edition of ***Vivus: The School of Life Science Newsletter,***
- ⇒ **The Student Council** of the School of Life Sciences (2016-2017) for their kind support,
- ⇒ **Dr TG Vasudevan**, **Dr Saadi Abdul Vahab** and **Dr Vidhu Sankar Babu** for their inevitable supervision and advice,
- ⇒ **Mr. Harsh Ranawat** (3rd year BSc Biotechnology) for contributing the photographed picture for the cover page,

And most importantly,

- ⇒ **You, our Readers** and everyone who has directly or indirectly contributed to the success of this issue.

***Find the names of Nobel Prize winners for various fields in this edition (Source: nobelprize.org)**

Thank you one and all!!

Signing off,
Bhargavi Karna and Russell Lorenzo Castelino
2nd Year BSc Biotechnology
Co-editors
Editorial Board
School of Life Sciences
2016-2017

FROM THE DIRECTOR'S PEN..

Dear all,

As we come to an end of successful third year of with the release of VIVUS – The Newsletter of School of Life Sciences, I could not stop thinking of creativity of the contributors that went into completing the current issue. Each release truly blended the various activities of our School, instilled a sense of pride in us and brought out hidden talents amongst you.

The efforts by editorial committee, ***Bhargavi Karna*** *and* ***Russell Lorenzo Castelino*** *backed by* ***Dr TG Vasudevan***, ***Dr Saadi Abdul Vahab*** *and* ***Dr Vidhu Sankar Babu*** *is much appreciated. As the baton is passed on to the new league of science writers and impressionists, we shall rejoice the achievements of the past, savor the present and imagine what's in store for the future!*

Wish you all the very best!

Dr. K. Satyamoorthy
Director
School of Life Sciences
Manipal University

For her, genomics isn't typical business

Bhargavi Karna, BSc Biotechnology, 2nd Year

Dr. Sudha Rao, a Cofounder and Executive Director of Genotypic Technology, and a founder of Dhiti Omics Technologies, Bengaluru, a company known for its cutting edge technologies, has successfully pioneered genomics as a service in India with the motto "Genomics simplified". Dr. Rao, a polyglot and a master in the business of genomics, has a doctoral degree in biotechnology from Madurai Kamaraj University, Tamil Nadu and was a postdoctoral fellow in Neurobiology at the Weil Medical School, New York. The Editorial Board of Students' Council had an opportunity to interview Dr. Rao during August 2017 and following are some excerpts.

So, how did it all begin?

As a child, getting to learn about the ability of male canaries to sing songs during the season to attract the females fascinated the young mind in Dr. Rao. As she discovered the relation between this inborn birdsong ability of canaries and the testosterone levels, its effect on various parts of the brain and neural activity, she was driven into science of life by curiosity.

"20 years ago, there were handful opportunities for a PhD degree and only about 30 jobs to aspire for. And if you choose the 31st one, you end up as a commoner", said Dr. Rao highlighting the struggles of her budding aspirations. The start was tough, as she was confused between subjects, unsure about a career but still inquisitive about science and passionate about exploration.

In 2005, there was a breakthrough in the field of technology as Agilent Technologies was established. This sequencing research facility, predominantly available in the West, was also an urgent need for Indian researchers as India had many resources and potential living treasures in hiding. That thought motivated Dr. Sudha Rao and her team to customize the technology for the Indian niche and make it available for Indian researchers. With a single-minded focus, and with international and local collaborations, they now have been credited with about 400 publications in their name and have succeeded in contributing the maximum technologies for sequencing in the country along with training facilities for the right manpower ecosystem.

Is sequencing a revolutionized concept?

"FitBit wasn't an imaginable invention but today people actually can track their physical activity through something that looks as ordinary as a wristwatch. It happened! Similarly, sequencing started with a few genes and we have ended up sequencing the entire genome of organisms including humans. From few bases at a time to third generation sequencer by PacBio that could sequence 10kb at a time, and MinION by Oxford Nanopore Technology that reads 1000kb-20Gb in real time, we've come a long way in this field. With Genotypic, we improvise and customize these sequencing technologies to best suit the requirement of researches in India like with Next Generation Sequencer."

Further referring to 'MinION', she said, "This technology requires no chemistry for tagging the bases and works completely with the principles of Physics; while native DNA sample passes through the pore, the difference in electro-conductivity is used to identify the bases within 10 minutes on a device as mobile as a phone with the relevant software. So much so, the device has reached (outer) space for exploration of life."

Basic Sciences or Applied Sciences?

"Basic Science (Research) and Applied Science (Technology) must go hand in hand. For an idea to be published or read about it has to be bought and to buy it, people have to be convinced of its usefulness in their lives. 'Selling yourself' in the right way, at the right time to the right people is the only way of survival."

When and how will India equal the West in this aspect?

"The scenario in India can be upgraded if like in the West (Europe and the USA), funding encourages methodological research with a multidisciplinary approach and a liberty to exposure."

Note to the students?

"There is no defined prospect. The best fit for you is what makes you less comfortable and yet most happy. To dabble a little is okay, to fix is not. Your path is what you define. Don't do a job, set yourself a task and complete it while you love what you're doing."

HANDS-ON WORKSHOP ON FLOW CYTOMETRY

Dr. KP Guruprasad, Associate Professor

A hands-on training on "Basics of Flow cytometry and its applications" was organized by School of Life Sciences, Manipal University, Manipal on 4th and 5th August 2017. A total of 42 participants attended the workshop. Dr. K.P. Guruprasad (Associate Professor, School of Life Sciences, Manipal University, Manipal) welcomed the participants. Dr. H. Krishnamurthy (Head, Central Imaging and Flow Cytometry Facility, National Centre for Biological Sciences, Bengaluru) was the resource expert of the workshop. Inaugurating the workshop, he emphasized on instrumentation and different components of flow cytometer. He also elaborated on the analysis of flow cytometry data.

Experiments such as immunophenotyping and cell cycle analysis were demonstrated by Dr. Guruprasad and Dr. Krishnamurthy with the help of technical assistants and research scholars. The participants were able to perform these experiments under the observation of the experts. The participants interacted with the mentors to understand the various clinical and research applications of the flow cytometry technique. In the valedictory session, participants received their certificates from the chief guest Dr. Poornima Baliga (Pro-Vice-Chancellor – Health Sciences, Manipal University, Manipal) and Dr. Krishnamurthy. The participants shared their views on the workshop. They opined that such workshops will be helpful to enhance their knowledge globally and more workshops of this kind need to be conducted to benefit the research and clinical community. Dr. Guruprasad thanked the dignitaries, members of School of Life Sciences and the participants.

Painting by: Sagnik Pal, MSc Medical Biotechnology(1st Year)

FAITH DRIVES SCIENCE TO FACTS?

Indo-Japan Dailab series of lectures

Dr. KP Guruprasad, Associate Professor

The DAILAB-CAFE (Classroom for Advanced and Frontier Education) Webinar Series-20 was organized on 3rd July 2017 under the aegis of our own MU-DAILAB. Dr. Manjunath B Joshi from School of Life Sciences, Manipal University, Manipal, India presented his work on "Extracellular traps: Potential armamentarium of neutrophils". The presentation highlighting the expelling of DNA out by neutrophils as extracellular traps and their association with diabetic condition was given (through Skype) to an audience of researchers from overseas institutions associated with the National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan.

The next DAILAB-CAFE Webinar Series-21 was presented on 1st August 2017 by Ms. Amrita Kumari, Regional Centre for Biotechnology, NCR Biotech Science Cluster, Faridabad, India. She presented her work on "Molecular basis of cargo switching in nanomotor dynein during mitosis", describing the role of distinct individual phosphorylation events at specific amino acid residues in dynein affecting discrete stages of early and late mitosis.

These webinars were arranged in the seminar room of School of Life Sciences, Manipal University, Manipal. Graduate and post-graduate students, research scholars and faculty members from School of Life Sciences, Manipal University and researchers from AIST, Japan; Peking Union Medical College (PMUC), Tsinghua University, China; Brawijaya University, Indonesia; Hanyang University, South Korea; University of Sri Jayewardenepura, Sri Lanka and Indian Institute of Technology, New Delhi participated in the webinar. Researchers and students interacted with the speakers.

SLS wins in Indo-Japan Dailab-cafe plus talk

Dr. KP Guruprasad, Associate Professor

The DAILAB-CAFE (Classroom for Advanced and Frontier Education) PLUS (Presentation Learning for Young Scholars) talk Series 2 Round 1 was held on 4th August 2017. It is a competition for young research scholars in the collaborating institutions to present their work and train them for 'clear/crisp/careful/concise/conclusive' presentations. The presentations are streamed live in all partner institutions. At the end of the presentations, the audience members select the best presentation. The first round was held during March 2017.

In this round of presentation three research scholars presented their work. Mr. Moolchand Sigar from Indian Institute of Technology, New Delhi presented his work on "Heterologous expression of GCSF protein in *Pichia pastoris*". Mr. Priyanshu Bhargava from School of Life and Environmental Science, University of Tsukuba, Ibaraki, Japan presented his work on "Mitochondrial chaperone Mortalin contribution in cancer cell stemness and drug resistance". Ms. Supriti Ghosh from School of Life Sciences, Manipal University, Manipal presented her work on "Cervical DNA viral infections in asymptomatic women of Udupi District of coastal Karnataka". Ms. Supriti Ghosh presented data on the prevalence of different DNA viral infections among tribal and non-tribal women of the Udupi district, Karnataka, India. She also highlighted the strong association of infection pattern with various socio-demographic and reproductive characteristics of the study participants. Ms. Supriti Ghosh was selected as the best presenter by the audience from all the overseas institutes.

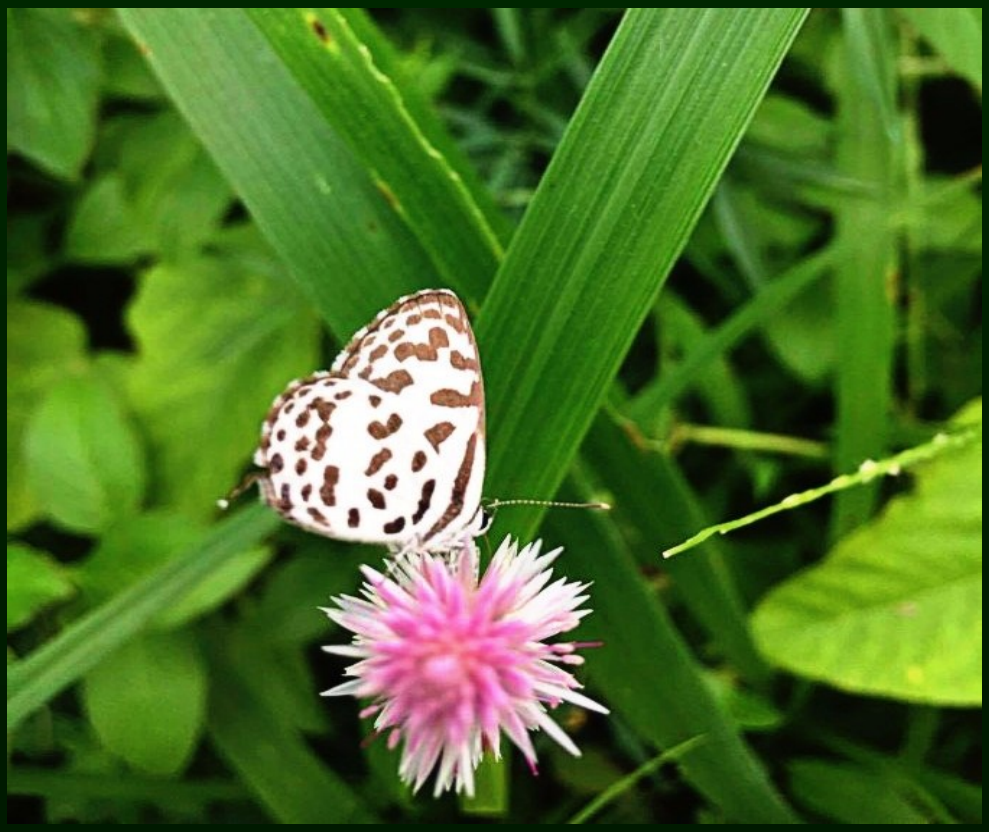
These webinars were arranged in the seminar room of School of Life Sciences, Manipal University, Manipal. Graduate and post-graduate students, research scholars and faculty members from School of Life Sciences, Manipal University and researchers from AIST, Japan; Peking Union Medical College (PMUC), Tsinghua University, China; Brawijaya University, Indonesia; Hanyang University, South Korea; University of Sri Jayewardenepura, Sri Lanka and Indian Institute of Technology, New Delhi participated in the webinar.

YOU OBSERVE A LOT JUST BY WATCHING

Harsh Ranawat, BSc Biotechnology (3rd Year)

Bhargavi Karna, BSc Biotechnology (2nd Year)

INTERDEPENDENCE IS OF HIGHER VALUE THAN INDEPENDENCE



Singing hOSAnnas

Tanaaz Khan and Bhargavi Karna, BSc Biotechnology, 2nd Year

In the month of July 2017, the Optical Society of America (OSA) Student Chapter of Manipal, at the School of Life Sciences, organized and participated in multiple events to reach out to young minds in every possible way.

One-Day Symposium

The Manipal Students Chapter of the Optical Society of America (OSA), established in August 2016, conducted a one day symposium on "Advances in Bio-Optics, Bio-Photonics and Optogenetics" at Manipal University, Manipal on July 29, 2017. The event was inaugurated by Dr. M.S. Valiathan (National Research Professor, Manipal University) in the presence of Dr. Poornima Baliga, (Pro-Vice Chancellor-Health Sciences, Manipal University), Dr. K. Satyamoorthy, (Director, School of Life Sciences (SLS), Manipal University) and Dr. K.K. Mahato (Head, Department of Biophysics, SLS, Manipal University). Mr. Harsh Ranawat (President, Manipal OSA Students Chapter, SLS, Manipal University) welcomed the dignitaries and the 100-odd delegates from different parts of the country. In his inaugural address, Dr. Valiathan stressed on the need for indigenous innovations, especially in biomedical instrumentation, to overcome the reliance on import of equipment. Dr. Baliga wished for more such events with multidisciplinary outlooks in Manipal.

The symposium was divided into three sessions and had several lectures by esteemed researchers in the field of optics, photonics and related subjects. Dr. Jayashree R (Head, Division of Biophotonics and Imaging, SCTCE, Trivandrum) spoke on 'Gold-nanostructures'; Dr. Vijendra Prabhu (Assistant Professor, Dept. of Biotechnology, MIT, Manipal University) gave a talk on 'Low Level Laser therapy'; Dr. Saikat Dutta (Assistant Professor, NITK, Surathkal) talked about 'Functional Organic crystals'; Dr. Vinod Jyothikumar (Independent Biosecurity Consultant, Mysuru) shared his views on 'Biosecurity and Food Security'; Dr. Angela Brand (Maastricht University, Netherlands & Adjunct Faculty, SLS, Manipal University) spoke on 'Medical devices for early detection of Alzheimer's disease'; Dr. K.K. Mahato on 'Photoacoustic Spectroscopy', Dr. Shama Prasad (Associate Professor, SLS, Manipal University) on 'Confocal Microscopy' and Dr. Nirmal Mazumder (Assistant Professor, SLS, Manipal University) on 'Advanced Optical Microscopy'. In addition to these interesting lectures, one of the student chapter members, Ms. Raashi Chauhan also spoke on 'Quantum dots and its applications', while Ms. Sravasti Mukherjee (Vice-President, Manipal OSA Students Chapter) talked about the genesis of the chapter, its recent achievements and future plans.

The Optical Society of America is an organization that networks people with mutual interests in Optics and Photonics. The Manipal OSA student chapter is an independent student body with about forty members at present. With the aim of research, learning and spreading knowledge, the chapter conducted outreach programs in schools in and around Manipal, attended conferences and symposiums within the country, organized competitions like photography and displayed various experiments to middle-school students on National Science Day 2017.

Reaching out...

The first of a kind outreach programme by the Manipal OSA Student Chapter to impart knowledge and awaken an interest for science in school children was conducted on July 22, 2017 at the Manchi School, Udupi. The target audience was a mix of students - while the younger students filled the day with nostalgia to the OSA members, the older ones showcased the right amount of enthusiasm.

The students in ninth grade were shown a number of experiments related to optics, photonics and science. Starting with a brush-up on the basics regarding the properties of light, opaque, transparent and translucent objects, convex and concave lenses and mirrors, OSA student chapter members Sourav Patagi, Greeshma and Shreya Gudi, all fluent speakers of the local language, demonstrated and explained the experiments along with Aarti Ramachandran. As the curiosity in the room built up, they demonstrated the 3D image formation using a hologram, change in emitted wavelength of light in certain solvents due to fluorescence, refraction of light through a glass slab and scattering of light through a prism.

The next day (July 23, 2017) the students participated in an outreach program at the 'Madhavnagar Government School, Manipal'. The main intention was once again to develop a fascination for science among the children, while trying to eliminate any possible dislike for the field through practical demonstration of some of the theoretical concepts that the students might have learnt. With the focus solely on optics and interaction with the students, Sourav Patagi, Greeshma Gopinath and Shreya Gudi (*again!*) intrigued the children with a show on exquisite laser pointers. They taught them about different kinds of lenses, the splitting of white light using a prism and introduced them to the term 'Fluorescence'.

Both these programmes helped in understanding the need for practical learning for the school students to better their understanding of theoretical concepts, while for the OSA student chapter members it was a welcome experience in teaching.

When Tumors act smart

Shreya Tapaswi, BSc Biotechnology, 2nd Year

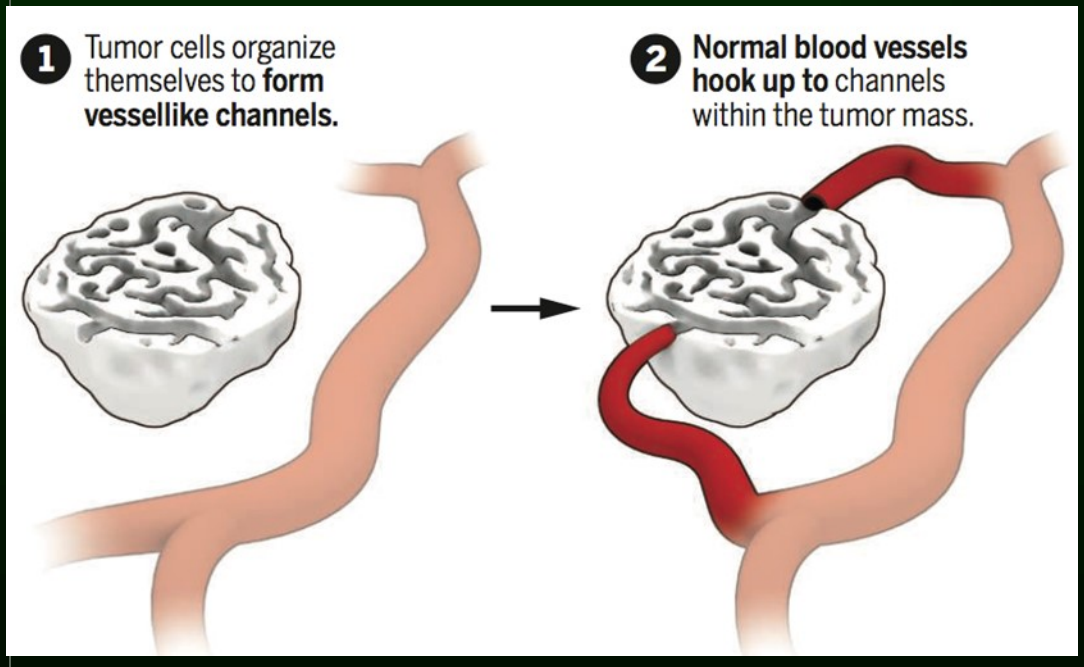
Just like all the other cells in our body, the tumor cells are also in great need of oxygen and nutrition for the sake of their growth and maintenance. For that, blood vessel formation is a '*must*'. Thus, angiogenesis takes place and involves the migration, growth and differentiation of endothelial cells to form the blood vessels in the tumor. These new blood vessels arise from pre-existing ones.

John Hunter, Scottish anatomist and surgeon, provided the first evidence of angiogenesis. His writings in *Treatise* strongly suggested that vascularity is proportional to metabolic requirements in both health and disease. The term angiogenesis was coined by Judah Folkman, whose hypothesis implied that tumor growth is angiogenesis-dependent. Discovery of angiogenesis stimulated extensive research in the field, making people believe that inhibiting the growth of these vessels would starve the cellular masses. By late 1990s, throngs of pharmaceutical companies were bustling to develop compounds that curb angiogenesis. Even James Watson announced that Folkman's approach would "cure cancer in 2 years".

Little did they know that the tumors had an alternative way to feed themselves and survive. When tumors are treated with angiogenesis inhibitors, the blood vessels get damaged and blood supply is of course halted. However, collectively, only a growth delay is reported as soon enough the blood supply is restored; this time not by angiogenesis, but by "Vasculogenic Mimicry".

Vasculogenic mimicry (VM) is one of the ways in which tumors develop a blood supply independently from classical angiogenesis.

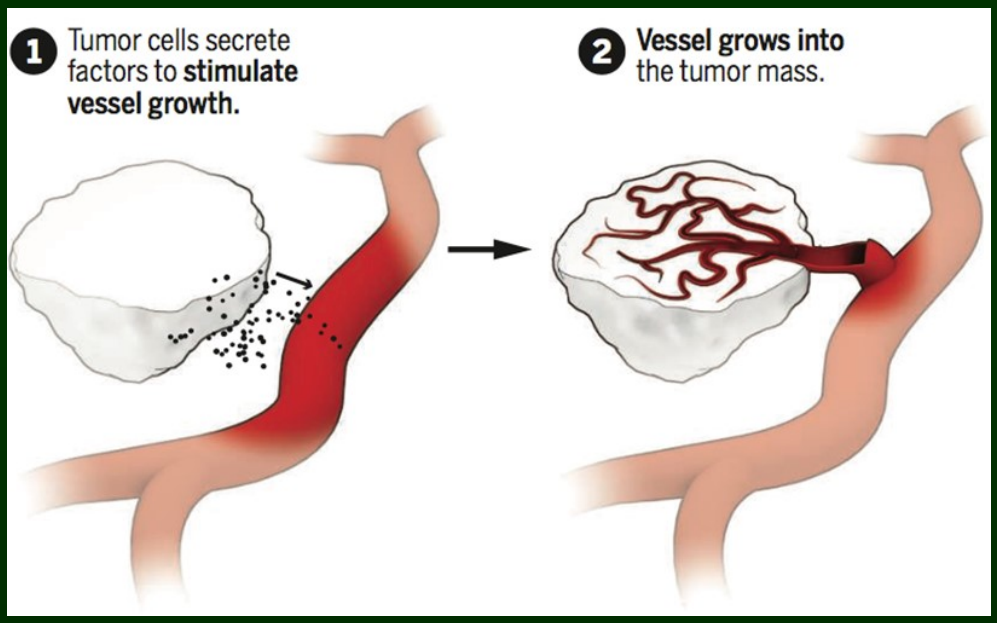
In 1999, Maniotis et al. presented that cancer cells line non-endothelial vascular channels that contain red blood cells. This *de novo* synthesis of vasculogenic channels was proved by making aggressive tumor cells migrate through a 3D matrix *in vitro*. The *in vitro* network of channels resembled the patterns seen in melanomas in patients' eyes.



Initially it was thought to be some tortuously growing blood vessel, but on a closer look they realized that the channels lacked endothelial cells, even though RBCs moved through those passages. Besides melanoma, VM is also observed in carcinomas of lung, prostate, bladder, kidney, ovary and breast, sarcomas and gliomas.

The characteristic pattern of VM networks show close resemblance with embryonic vasculogenesis pattern. This indicates that aggressive tumor cells undifferentiate to form cancer stem cells. The activity of *Nodal* gene drives the activity of VM. However, intricate molecular mechanisms governing VM are still ambiguous.

Endothelial cells express various members of the cadherin superfamily, in particular vascular endothelial (VE) cadherin, which is the main adhesion receptor of endothelial adherent junctions. The tumor cells which have become VM capable express VE-cadherin. Trans-differentiation leading to caricature of endothelial cells holds the hostile microenvironment at a bay. This keeps the tumor cells safe. Hence, neither there is shortage of oxygen nor nutrient.



VM increases the chances of metastasis manifold since the cancer cells are in direct contact with the blood. Blocking it could save lives.

Researchers have tested several standard angiogenesis inhibitors to inhibit vasculogenic mimicry, but they seem to promote it instead. By stalling the formation of normal blood vessels and hypoxic conditions, the drugs trigger cancer cells to build their own blood highways. CVM-1118, a derivative of a plant compound, is the first drug that targets VM and has reached clinical trials.

Only by knowing the detailed interactomics of the process will we be able to further develop drugs that will target different parts of the pathway. VM is surely not the only thing that drives cancer, but holds potential target of therapy. We can only look forward to an era with lowered cancer death when anti-VM therapies will be combined with other supplementary therapies.

References:

- Adair T.H., Montani J.P. (2010) *Angiogenesis,* Chapter 1, Overview of Angiogenesis, Morgan & Claypool Life Sciences
- https://www.cancer.gov/about-cancer/treatment/types/immunotherapy/angiogenesis-inhibitors-fact-sheet
- Leslie M., (2016) *Tumors' do-it-yourself blood vessels,* Science, **352,** 1381-1383
- Delgado-Bellido D., Serrano-Saenz S., Fernández-Cortés M., Oliver F.J. (2017) *Molecular Cancer* , **65**, doi: 10.1186/s12943-017-0631-x
- Maniatis, et al. (1999)

Organ Printing

Aron Mathias, MSc Bioinformatics, 2nd year

When Mr. Sandeep sir asked me what topic I would like to present for my Saturday seminar, I went back and checked for something different and one topic that caught my eye was 'Organ printing'. I went back and discussed it it further and got the approval. That is how I got to know more about this fascinating new(ish) technology.

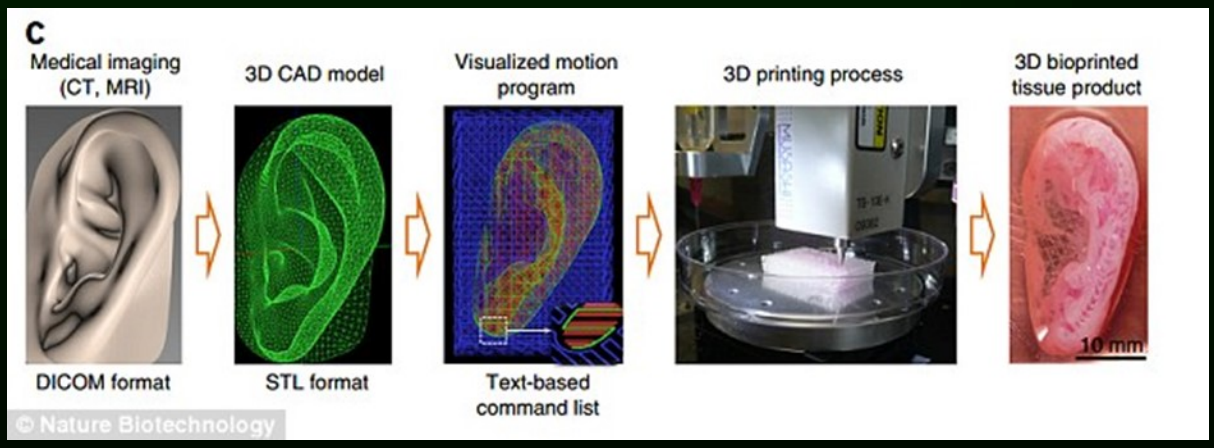
Before getting into organ printing, I would like to raise/refresh awareness about organ donation. An organ can be donated by a living or dead individual. It is because of the challenges faced during organ transplantation that organ printing came in to play. Organ transplants can be of three types. Autografting is wherein a tissue is transplanted from one part of the body to another for e.g. skin graft, bone graft. Allografting is wherein a tissue/organ is donated from a living or dead individual. Xenografting is tissue/organ taken from animal sources and transplanted in a human.

Fig. Three-dimensional bioprinter developed by 3D Bioprinting Solutions (Russia). Source-Wikipedia.

Organ Printing or 3D Bioprinting is a transforming technology. It is a biomedical application of rapid prototyping. Organ printing overcomes the biggest hurdle of organ rejection since the cells (stem cells) are taken from the patients themselves and the organ is grown *in vitro*.

The first organ was 3D printed at the Wake Forest Institute of Regenerative Medicine, USA. Atala *et al.* intended to reconstruct bladders using a scaffold-based technique. A biodegradable bladder shape scaffold, made of collagen and polyglycolic acid (PGA) was made using the biopsy result. The volume of the bladder construct was assessed by morphometric analysis. The patient's pelvic capacity and age were also considered. The bladder construct was implanted for reconstruction. A bladder, skin, blood vessels and vascular structures such as urine tubes have already been printed whereas an artificial heart and heart valves, kidney, and liver structures are still in the developmental stages.

BIOPRINTERS: Three types of 3D Bioprinters are mainly used in organ printing: Laser-based 3D bioprinting, Inkjet-based bioprinting and Extrusion-based bioprinting. Laser-based 3D bioprinting uses laser to transfer the bioink onto the scaffold. Inkjet-based bioprinting is a non-contact image reconstruction technology. This type of bioprinter has three nozzles: piezoelectric, thermal and acoustic conductivity nozzles. In extrusion-based 3D bioprinting, the materials are dispensed by force through a nozzle, syringe or orifice. These printers are similar in principle to the cartridge based printers; the major difference is that the ink is a bioink. Bioprinters are expensive and can cost anywhere between $10,000 and $200,000.



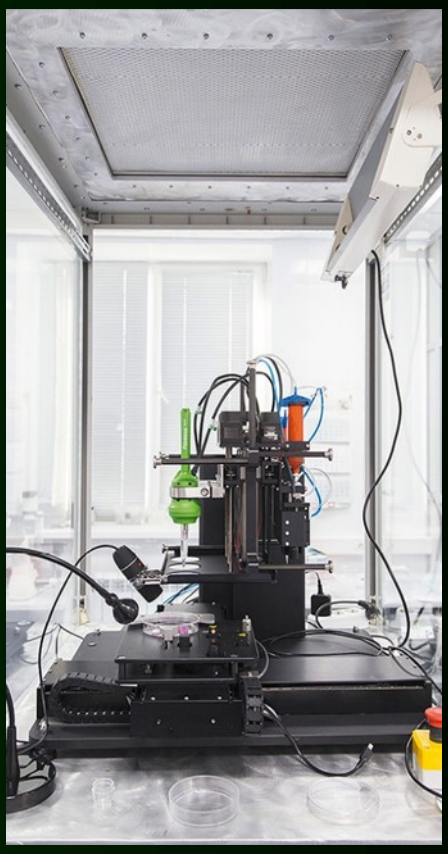
Source- https://blog.cirm.ca.gov/2016/02/18/meet-itop-a-one-stop-shop-for-3d-printing-body-parts/

ETHICAL ISSUES:

Organ printing has its own share of ethical issues involving various problems like the usage of stem cells, equitable access to health care wherein everyone is able to afford the treatment. Once the organ is printed it cannot be tested for safety and efficacy. It also cannot enhance the capacity of individuals beyond what is 'normal' for humans - a person with a printed heart may live for 5-10 years more than what is normal for him/her.

Considering these issues, organ printing is still in its developmental stages. It costs $40,000 to print a nose, while complex organs like heart or liver will be much more expensive. Organ printing is an expensive industry right from the printer to the development of bioinks and hence requires external funds were available.

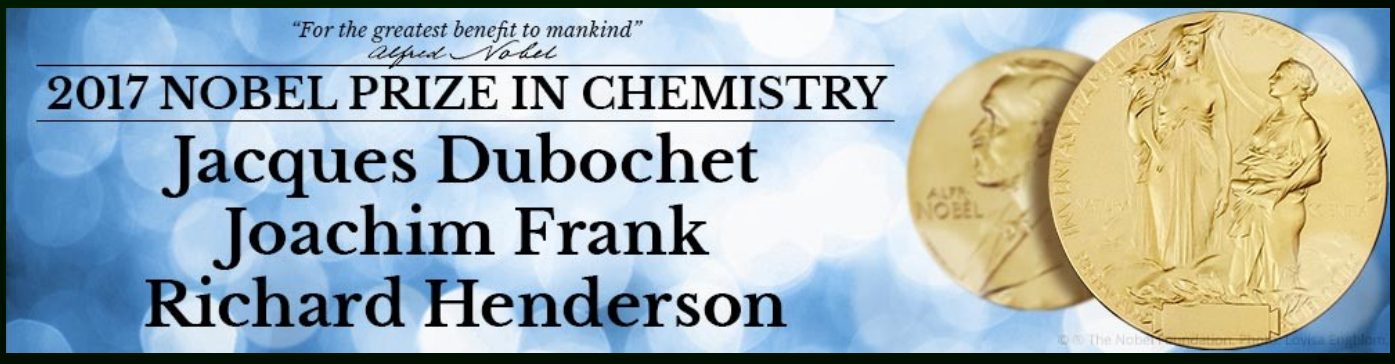
Nonetheless 3D bioprinting still has a huge way to go and can be vital in saving lives in the near future.



Three-dimensional bioprinter developed by the Russian company, 3D Bioprinting Solutions. (Source-Wikipedia)

References:

- Chua, C. K., & Yeong, W. Y. (2014). *Bioprinting: principles and applications* (Vol. 1). World Scientific Publishing Co Inc.
- Wang, X., Ao, Q., Tian, X., Fan, J., Wei, Y., Hou, W., ... & Bai, S. (2016). 3D bioprinting technologies for hard tissue and organ engineering. *Materials, 9*(10), 802.
- https://organovo.com accessed on 20-08-2017
- https://en.wikipedia.org/wiki/Bioinks accessed on 16-08-2017
- https://en.wikipedia.org/wiki/Organ_printing accessed on 16-08-2017



ABOVE THE SURFACE, CALM AND UNRUFFLED, BELOW THE SURFACE, PADDLE WITH ALL YOUR MIGHT

Shiksha Saraogi, BSc Biotechnology (1st Year)

Shiksha Saraogi, BSc Biotechnology (1st Year)

BREAKS ARE THE BEST PART OF WORKING

VISUAL PERCEPTIONS

Rajat Agarwal, BSc Biotechnology, 2nd Year

Vision is the most dominant of senses we have. Visual perception is the ability to interpret the surrounding environment using light in the visible spectrum reflected by the objects in the environment. Although vision seems as simple as projection of image on the retina to the conscious mind, it is far more complicated than that. Recent research has even questioned the different attributes we see and that is without even considering the 'unconscious' or 'subconscious' responses of the brain.

The act of seeing starts when the cornea and then the lens of the eye focuses light from the surroundings onto a light-sensitive membrane in the back of the eye, the retina. There are various mechanisms associated with the eye which ensures formation of an inverted and real image on the retina. These mechanisms work with complex feedback and feed-forward mechanisms.

The most important neurological question in the field of vision is how does the simple inverted image on retina leads to three-dimensional perception of vision?

Once the image is formed, certain nerve impulses are formed which are processed by the brain into conscious vision and unconscious responses. The most mysterious part of vision is the production of nerve impulse. Just like in protein formation, the theory of RNA codon explained the formation of protein from RNA, the field of vision needs a theory to explain formation of nerve impulses.

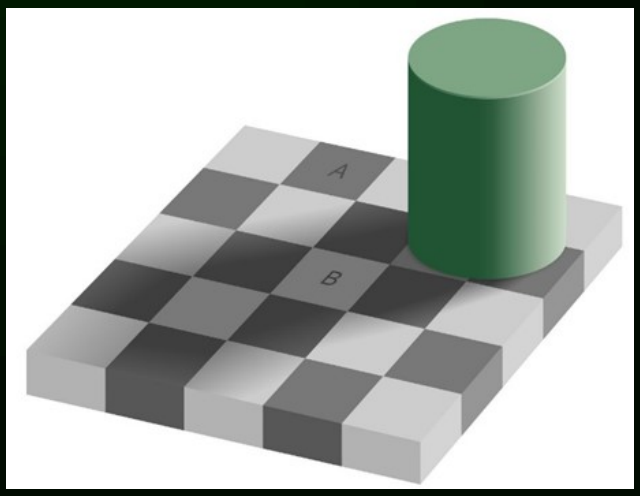
But act of perception is not as simple as that; since even after formation of nerve impulses, there is lot of processing to it, a lot of which have been hypothesized.

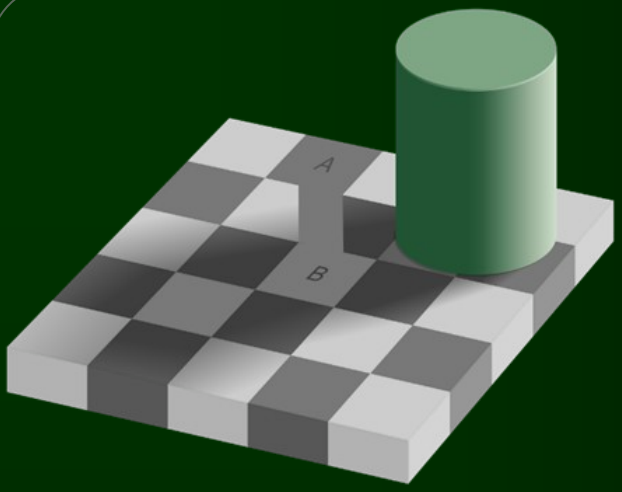
Consider this case study. Diane, a woman who had recently moved into a new city, was exposed to carbon monoxide poisoning. She luckily survived by getting help at the right time but prolonged exposure to carbon monoxide had caused brain tissue atrophy.

The result of this was that she became blind, but not in a conventional sense. In an interesting and yet peculiar case of blindness, she could not read the largest letters of the eye chart and also could not identify people (although she could recognize people by voice) or shapes, which is typical of traditional blindness; yet she could identify colors and gradients. What is even more interesting is that although she could not identify the object kept in front of her, she still had the ability to accurately grab on to without any error or difficulty and once she could feel the object, she could identify it.
This is one among many interesting and peculiar cases to have challenged the traditional notion that vision is a singular process primary linked to consciousness, from where the individual perceives the object.
The first and foremost thing to remember is perception is not absolute. Interception of vision different from simply replicating the image in retina to conscious mind, perception can change radically even when the image on the retina remains the same. A number of visual illusions illustrate this.

<u>Checker shadow illusion</u>

This optical illusion was published by Edward H. Adelson. Although the color of tiles A & B seem different (left side of the image), they are the same (right side). It can be confirmed using computerized methods. According to him, to determine the color of the tiles the brain just does not measure the light coming from a surface (the luminance) but it also considers the shadow cast by the object and compensates the color accordingly.





Every act of perception is more like an act of judgment by brain. Now, what determines the judgement?

During the lifespan of a human being, the brain learns certain things about the world around, things which never change. Based on those properties, the brain takes certain assumptions about the world. These assumptions are also partially shaped by evolution. These assumptions shape the perception of a person. For example, light comes from above, solid objects cast shadow etc. This phenomenon by which the human brain infers certain details of the vision is termed as 'unconscious inference'.

But does that imply there might be little bit of chance that things are not really as they appear to us humans? Maybe we see things the way we want to see them? Something to think about.
Despite the mystery around vision, the years of research have revealed and explained neurological pathways associated with vision.

Visual cortex region present at the back of the brain consists of a point-to-point map of the retina; any damage to this part of brain would cause bits and pieces missing from conscious vision.
Neural visual system has a simple organization overall, but the interesting aspect here is there are two distinct neural visual systems, one of which is exclusive to higher primates. Messages from the eye balls go through the optic nerve and immediately bifurcate along two pathways. One of the pathways is phylogenetically old while a second newer pathway is well developed in higher primates. The older pathway connects the eye to a structure called the superior colliculus in the brain stem, and from there it eventually gets to higher cortical area especially in the parietal lobes.

Now the question arises. Why two pathways? And how are the two pathways different from each other?

The present theory suggests that the phylogenetically older pathway is just associated with detection of the object not with the identification, like to tell where the object is, to move the eyes towards the object, a kind of a reflex. The newer pathway comes in and identifies the object and tells how one should respond to the object. The evidence for this theory comes from the phenomenon of blindsight. Blindsight in simplest terms can be defined as the ability to respond to a visual stimulus without consciously perceiving it. This phenomenon is usually observed in people with damage in primary visual cortex which makes them completely or partially blind depending upon the damage, at least consciously.

The experiments conducted with these people have shown astonishing results. These people, though unable to consciously perceive the visual stimuli, have the ability to rather guess the presence of the stimulus. The test subjects describe to having a likely feeling of something being there or being able to detect movement in the blind region. They were able to "guess" many properties of targets presented in that region, such as shape, specific location and other aspects one could know of only by seeing them.

In fact, some researchers and even experiments have concluded that blindsight is more sensitive than the conscious vision. There is a lot more to blindsight furthering complicated questions and brings in placebo effect. The most widely accepted theory of blindsight suggests that after damage to area V1, other branches of the optic nerve deliver visual information to the superior colliculus and several other areas, including parts of the cerebral cortex. In turn, these areas might then control the blindsight responses.
One more implication of this theory would be that the conscious perception is somehow exclusive to the phylogenetically newer pathway. This reconciles with the fact that consciousness is characteristic of higher animals.
The newer pathway travels from the eye to a cluster of cells called the lateral geniculate nucleus, which is a relay station en route to the primary visual cortex. From there, visual information is transmitted to the thirty or so other visual areas for further processing.

The two-stream hypothesis suggests that the newer pathway is again divided into two distinct streams. The ventral stream (or *what pathway*) is involved with object and visual identification and recognition. The dorsal stream (or *where pathway*) is involved with processing the object's spatial location relative to the viewer and with speech repetition.

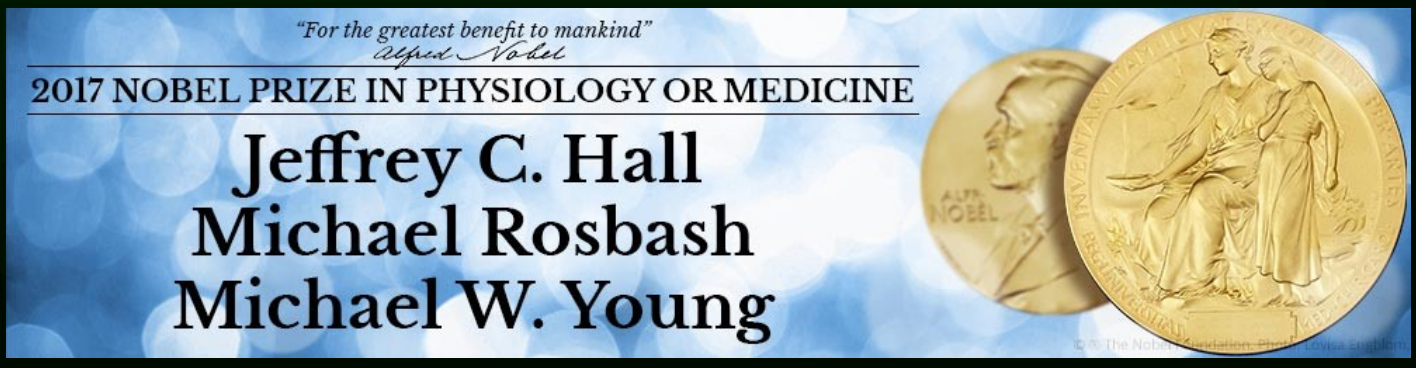
Coming back to Diane, in her case, the carbon monoxide poisoning had damaged the ventral or *what* visual pathway of her brain but the *where* pathway was intact. So, although she could not identify the objects in front of her, she could effortlessly grab at things in front of her. To a person who does not understand the visual pathways it would have almost seemed like the work of a zombie inside her.
The thirty visual areas associated with the newer pathway are highly specialized and help in extracting different attributes from the visual scenes. Damage to any one of these areas may bring about certain type of defects in vision.

Out of these functions of some of the areas are known, for example, the middle temporal area is responsible for "motion blindness" – people with damage in this part of the brain are unable to comprehend things in motion, instead they see static, strobe-like snapshots. And yet they had no trouble in identifying people, reading books. There is no reason to believe that other 29 areas would have any less significant function.
Though there is plenty of knowledge deciphered, vision is still a mysterious process. We still do not know how the inverted image on retina is converted into nerve impulses that could be processed by the brain. Basically, in the process of perception of the brain, the image formed on the retina is converted into nerve impulses and the different attributes are processed in different parts of the brain to bring in the conscious vision. Any damage to the visual part of the brain leads to vision disorder, meaning the person is unable to comprehend a certain aspect of the image. This basically implies that what we see is an image of what is shown to us by our brains; so is it possible that the object kept in front of me is different from what my brain shows me? Maybe it has an attribute which my brain cannot yet just process. Not having the part of the brain to process the attribute is just like having a damaged, non-functioning part. Or maybe my brain is showing me attribute which is not actually there. Are the attributes of the object just illusions by the brain? Does it matter? Maybe in future we will evolve to have even a superior vision. Just like how some lower animals cannot comprehend the third dimension, perhaps our brain cannot process the fourth! Maybe there are objects which just do not make sense to our five senses, which we cannot see, feel, hear or smell.

[Actually, we all have experienced something which we cannot see, touch, feel or smell, the air around us]
These are some questions which hopefully would answered in the future.

References

- "Phantoms in the brain" Sandra Blakeslee & V.S Ramachandran
- Cucinotta FA et al.(2000)
- https://blogs.scientificamerican.com/news-blog/blindsight-when-the-brain-sees-what/
- https://en.wikipedia.org/wiki/Visual_perception



Ram Sai, MSc Bioinformatics (2nd Year)

THE WILDERNESS HAS ANSWERS TO QUESTIONS WE HAVE NOT YET LEARNED TO ASK

ONE STEP AT A TIME

Sourav Patagi, BSc Biotechnology (2nd Year)

Exo-Biology

Amitha R., MSc Molecular Biology and Human Genetics , 2nd Year

Exo-biology or Space biology, in simple terms, is a branch of biology concerned with the effects of outer space on living organisms and the search for extraterrestrial life.

The Space Biology experiments of the National Aeronautics and Space Administration (NASA) in the USA aim to discover how spaceflight impacts microorganisms, plants and animals throughout their life cycle. Factors that have been shown to have an effect on biological systems in space flight include microgravity, radiation and magnetic fields, as well as the interactions and stresses among species in the unusual environments of space and spacecraft.

What science does NASA need to conduct?

The National Research Council (USA) outlined the scientific research recommendations in its publication, *Strategy for Space Biology and Medicine in the New Century* (1998), calling for NASA's space biology research to take "an integrated multidisciplinary approach that encompasses all levels of biological organization... from molecules to cells to tissues to organs to systems to whole organisms, and employ the full range of modern experimental approaches."

Space Life Science-1 (SLS-1), launched aboard Space Shuttle Orbiter *Columbia* (STS-40) on June 5, 1991 was the first Spacelab mission dedicated solely to life sciences research. The modular laboratory for conducting the research was carried in the cargo bay of *Columbia*. The purpose of the mission was (*i*) to study the mechanisms, magnitudes, and time courses of certain physiological changes that occur during space flight, (*ii*) to investigate the consequences of the body's adaptation to microgravity and readjustment to Earth's gravity, and (*iii*) to bring the benefits back home to Earth. The mission was designed to explore the responses of the heart, lungs, blood vessels, kidneys, and hormone-secreting glands, to examine the causes of space motion sickness, and study changes in the muscles, bones and cells. Many studies started during SLS-1 provided data that served as the foundation for investigations on the International Space Station.

Recent research conducted by Cucinotta et al. 2000 confirms that reliable projections for Central Nervous System risks from space radiation exposure cannot be made due to a paucity of data for particle types, doses and dose-rates, and lack of understanding on the extrapolation of experimental results with rodents to humans. The existing animal and cellular data suggest that space radiation can produce neurological and behavioral effects, and therefore the possibility exists for impacts for a Mars mission or other long duration deep space missions.

Ram Sai, MSc Bioinformatics
(2nd Year)

JUST LET GO AND FALL

Shiksha Saraogi, BSc Biotechnology
(1st Year)

WE RUN FROM THE RAIN TO ADMIRE THE DEW

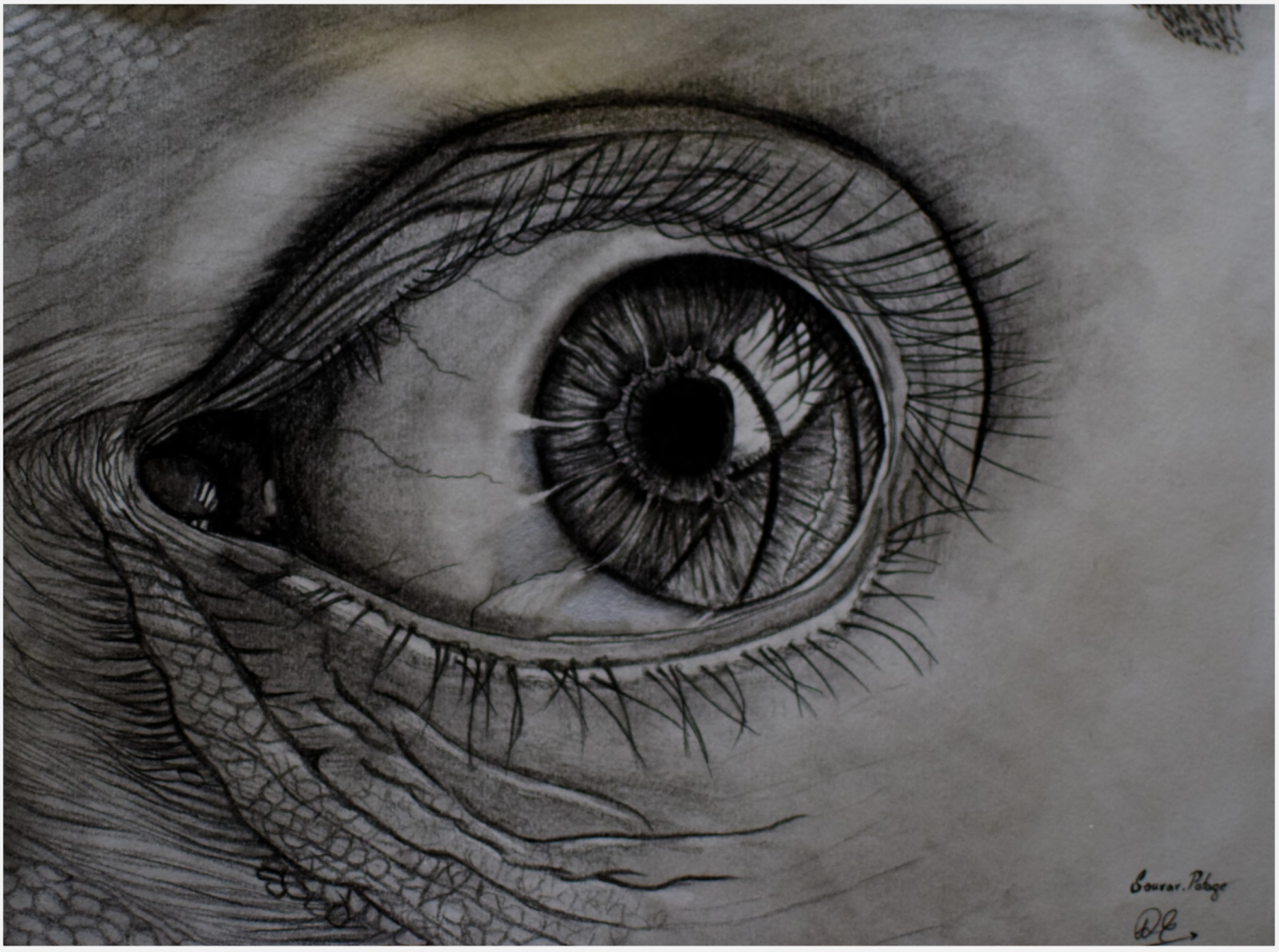
A grand Welcome to the Student Council 2017-18.

Student Council

President	Ramya Gupta
Vice-President	Namita
General Secretary	Vallabha Mohta
Treasurer	Niharika Jhawar
Joint Secretary 1	Sourav Patagi
Joint Secretary 2	Nidhi Singh

Student Committee

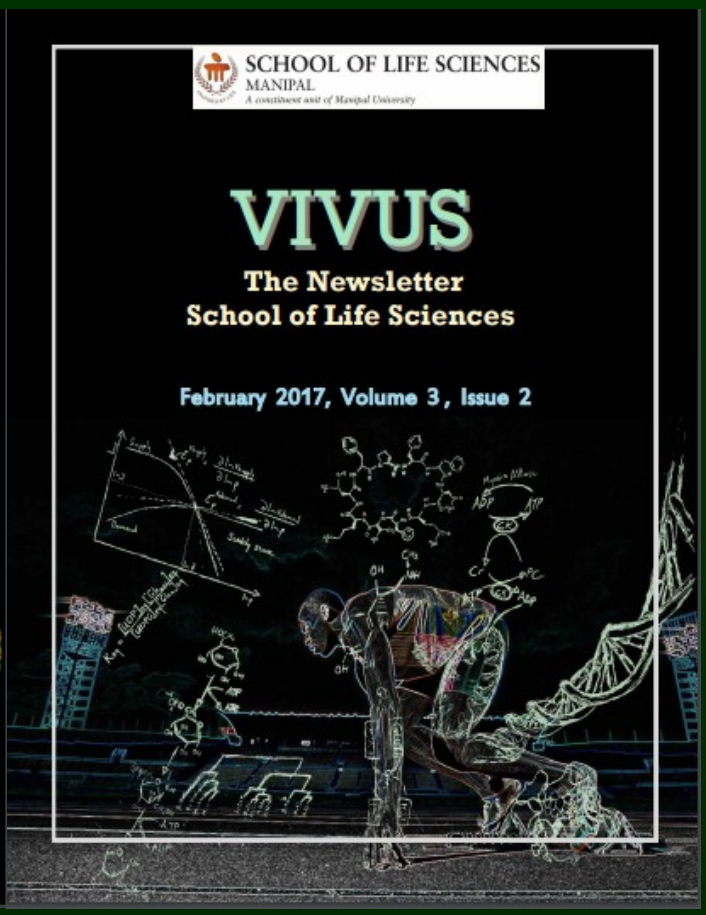
Cultural Committee	Kanaya Bhattacharya Nevin Kuriakose
Editorial Board	Harsh Ranawat Tanaaz M Khan
Sports Committee	Saswata Hore Nazhad Farook Rudranath Ghosh
Finance Heads	Rajat Agarwal Yesha Ramani
Social Committee	Syeda Inaas Bhargavi Karna
Photographers	Soumyabrata Harshit B Joshi Shiksha Saraogi
Student Research Forum	Sagnik Pal

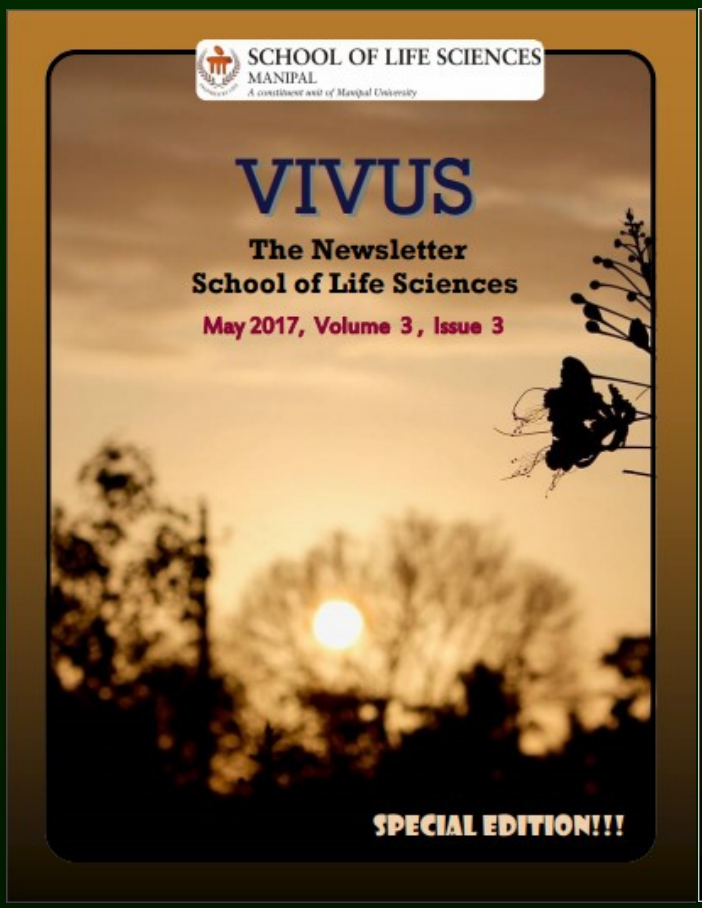


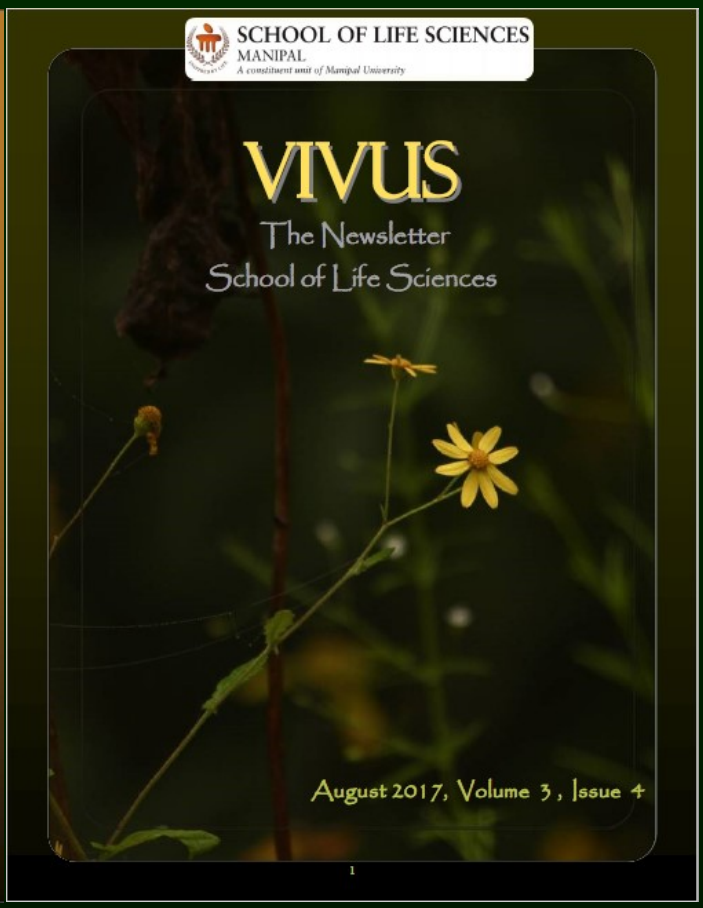
Sketch by: Sourav Patagi, BSc Biotechnology (2nd Year)

EYES ARE THE WINDOW OF THE SOUL


MANIPAL UNIVERSITY
VIVUS
The Newsletter
School of Life Sciences
November 2016
Volume 3 Issue 1
Moreno Gilli, Nikon Microscope View, Photography contest, UK


SCHOOL OF LIFE SCIENCES
MANIPAL
A constituent unit of Manipal University
VIVUS
The Newsletter
School of Life Sciences
February 2017, Volume 3, Issue 2


SCHOOL OF LIFE SCIENCES
MANIPAL
A constituent unit of Manipal University
VIVUS
The Newsletter
School of Life Sciences
May 2017, Volume 3, Issue 3
SPECIAL EDITION!!!


SCHOOL OF LIFE SCIENCES
MANIPAL
A constituent unit of Manipal University
VIVUS
The Newsletter
School of Life Sciences
August 2017, Volume 3, Issue 4
1