VIVUS

Vol. 5 Issue 4

BLACK HOLES AND BEYOND!

They've eluded scientists' for decades... Cosmic vacuum cleaners or more?

GENE NOMENCLATURE

Ever wondered why the protein is called 'hedgehog'? Find out more about biologists' humour skills!

MANIPAL SCHOOL OF LIFE SCIENCES
MANIPAL
(A constituent unit of MAHE, Manipal)

Dear Readers,

All things come to an end and so does our tenure as the Editorial Board. This is our fourth and last issue as a new Student Council takes over. Meet them all in the "What's up MSLS?" section.

This time in "Get Scientified!" we bring to you biologists' sense of humour in **naming genes**. Some of those names, our writer agrees, are quite *'punny'*. Delve into the micron-scale to read on about **antibody engineering** and then explore the galaxies to **black holes and beyond**! And then catch up with **Dr. R.S. Jayasree** on her work in nanotechnology for medical applications in the section "Words of Wisdom". Finally, take a break and head on to the creativity section where our in-house comic continues his story from issue 2.

Front and back cover photographs credits to Shiksha Saraogi, III B.Sc.

We thank our Director, **Dr. K. Satyamoorthy** for all his support. We are also grateful to our faculty advisors **Dr. T.G. Vasudevan, Dr. Vidhu Sankar Babu** and **Dr. Saadi Abdul Vahab** for their guidance. We would also like to acknowledge all the support from the Student Council 2018-'19 and the various committees. But the biggest thank you is for all of you who made the effort to contribute to us in writing. And to all of you who take the time out to read Vivus and let us know how you like it, a huge shoutout!

Signing off,
Mayukha Bathini, Swetha Stanley and Nicole Mary Swer
Editorial Board 2018-'19
Manipal School of Life Sciences
MAHE, Manipal

In This Issue

What's up
MSLS?

STUDENT COUNCIL ELECTIONS

For the academic year 2019-2020

Elections for the new Student Council of MSLS were held on August 19, 2019 at the auditorium, MSLS annex. Students from all the B.Sc. and M.Sc. batches took part as candidates as well as voted. The posts for Treasurer and General Secretary were uncontested and hence elected without any votes. For the other posts, the contesting candidates gave a short speech to introduce themselves to the gathering, which was followed by voting for the posts of President, Vice-President, Joint Secretary II and Joint Secretary I while the Treasurer and General Secretary were unanimously elected.

Following their investiture into office, the Council held interviews to select the heads of the various committees functioning under them.

Student Council		
Anaswara Sugathan	I M.Sc. MBHG	President
Shruti Thergaonkar	I M.Sc. MBHG	Vice President
Snigdha Chatterjee	II B.Sc.	Treasurer
Dinika Gowda	II B.Sc.	Joint Secretary I
Ummuabiha Karim	I B.Sc.	Joint Secretary II
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Mehak Jain	II B.Sc.	
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Sarah Joseph	II B.Sc.	Social committee
Ankshita Dasgupta	I B.Sc.	
Neha Chaudhary	I M.Sc. MBT	Finance
Ovee Kalyankar	II B.Sc.	Social media

MSLS Student Council 2019-'20

Left to right: Osborne Pereira, Shruti Thergaonkar, Snigdha Chatterjee, Dinika Gowda, Anaswara Sugathan, Ummuabiha Karim

Get Scientified!

BLACK HOLES AND BEYOND

Of all the objects in the cosmos, none are as intriguing, strange and mysterious as black holes. For quite a long time, many pre-eminent astrophysicists and scientists like Einstein and Eddington did not believe that these invisible stellar corpses with immense power even existed. It remained a mathematical enigma for a very long time. But what exactly are they? What would happen if one were to 'visit' a black hole? How did they get there? Even as scientists try to solve each piece of this jigsaw puzzle, questions still remain.

It was Karl Schwarzschild, who first made the correlation between gravity and black holes in 1915, while serving in the German Army. Since then, several scientists and astronomers have left their fingerprints on the study of these mysterious abysses, but it was much later in 1969 that the American scientist John Wheeler coined the term 'black hole'. It was very recently in 2019 that the Event Horizon Telescope Collaboration succeeded in releasing the first real image of the supermassive M87, larger than the size of our entire solar system, with a mass 6.5 billion times that of the sun.

Black holes are often described as apocalyptic objects in the universe, engines of destruction, that are billion times the mass of the sun, having infinite density. Unlike what many think, black holes aren't black objects but voids in the fabric of space and time. It appears black because it reflects no light and has a distinct edge called the event horizon. In simple terms, black holes are the consequences of the death of a massively huge star. When stars come to the end of the fuel that keeps them shining, it triggers a luminous explosion called the Supernova, collapsing the star profoundly into an infinitesimally small point. Now imagine the grandeur of such an entity, a core containing the entire mass of an enormous star surrounded by gravitational pull so strong, that even light can't escape!

The notion of a gigantic star shrinking into zero size may seem beyond the bounds of possibility but turns out it is possible, according to modern physics.

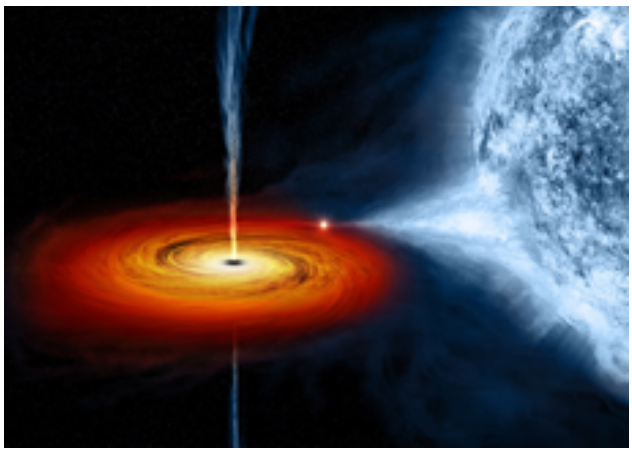

Image source: https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-a-black-hole-k4.html

To truly understand what one can expect while watching a star collapse to form a black hole, one has to remember that there is no absolute time in the theory of relativity. Time is only relative, its pace affected by gravity. As explained by Stephen Hawking in his book "The Theory of Everything", suppose a very adventurous astronaut decided to venture about the surface of a collapsing star and sent a signal every second to his fellow astronaut on a space ship farther away. From the perspective of the fearless astronaut, signal is being sent every second. However, the duration between the receipt of each signal to his colleague keeps prolonging as the star collapses progressively and eventually shrinks below the critical radius, beyond which the spaceship receives no more signals. What happens here is that the light waves emitted from surface of the star gets dissipated over an infinite period of time, as seen from the spaceship. The fate of our very fearless astronaut who succumbed to the black hole might be quite unfortunate as he might never see light again. Falling through a hole does not always end you up in a wonderland with peculiar creatures! According to scientists' speculation, the considerable difference in the gravitational pull at their feet and head would cause a person falling into a black hole to be squeezed and 'spaghetti-fied', ultimately disintegrating them into their fundamental particles before being crushed into a single point!

A fathomless single point, that defy the laws of physics, a singularity where everything that we know about space and time breaks down. This is rather like the big bang at the beginning of time, only that it would be the end of time for the collapsing star and the astronaut.

There is a lot more to unravel as so much about black holes are irretrievably out of our reach and we will never know about their history or what's inside. What we do know is that black holes are powerful enough to gobble up anything that comes in their path. It's like cosmic vacuum cleaner. So how worried should we be of a black hole engulfing earth on a Sunday afternoon while we're netflixing and chilling? I'll leave you to that!

Image source: https://eandt.theiet.org/content/articles/2019/04/high-life-in-a-black-hole/

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2. Ghosh, P. (2019, April 10). First ever black hole image released. Retrieved from https://www.bbc.com/news/science-environment-47873592

- Sonam Fathima Mehak, II M.Sc. MBHG

Gene nomenclature : what's the culture like?

If you are a fly biologist, it's punnier for you.

It all started with "sonic hedgehog", not the anthropomorphic blue hedgehog with the supersonic speed in the 2000's platform game by Nintendo but the protein 'hedgehog' I was taught in my Master's to be a ligand in the hedgehog pathway that makes an essential contribution during embryonic development. But 'hedgehog' was a funny name for a protein and the gene encoding it. Curiosity-driven, I wanted to understand fly geneticists' humour.

source : https://www.sonicthehedgehog.com/en-gb/

A British scientist by the name of Robert Riddle proposed this name from a comic book that his daughter brought. Some members of the Human Genome Organisation's Nomenclature Committee put 'Sonic' on their list of gene names they wanted to change. It was Riddle's day and today we have comical gene names reigning fly gene nomenclature.

Fly not beneath the radar.

In humans there is a family of three hedgehog proteins - sonic, desert, and Indian. The name 'hedgehog' comes from the original discovery of the gene in Drosophila – flies that carry a mutated form of the hedgehog gene will develop to have spiky denticles along their anteroposterior axis resembling spines of a hedgehog.

If I only had a heart…

Tinman who was earlier Tin Woodman from the Wizard of Oz, had a tin body and no heart. Inspired from this character is the homeobox-containing gene tinman in Drosophila that is expressed in the mesoderm primordium. The function of tinman is required for visceral muscle and heart development. Embryos that are mutant for the tinman gene lack the appearance of visceral mesoderm and heart primordia.

Source : https://tvtropes.org/pmwiki/pmwiki.php/Main/TinMan

> **"If I only had a heart, for brains do not make one happy and happiness is the best thing in the world"**
>
> -Tinman

On the other hand, the zebrafish can be all heart plus two when it develops a mutation in the gene - casanova (cas). Cas mutants lack endoderm, which is necessary for proper migration of the heart precursors and for formation of the actual heart. Due to this deficiency, when the heart precursors do not migrate, the cas mutants develop cardia bifida; (the formation of bilateral hearts). These mutants

also lack a gut tube and do not express any molecular markers of endoderm differentiation.

Zebrafish biologists would have had a strong fanbase for one of the most popular classic English rock band, the Rolling Stones or they would not have a gene named after it. The band's lucky to be having a scientific legacy behind them. Here, I introduce another gene associated with the rolling stones (rst), by the name of einstein (eis). These two proteins are required for otolith tethering in the zebrafish ear. The senses of hearing and balance depend on otoliths, often called ear stones in fish. Otoliths consist of a proteinaceous core that is biomineralised by calcium carbonate in the adult fish ear that help to control equilibrium. Only a single otolith forms in each of the ears of the zebrafish einstein mutant when there should normally be two. Einstein is German for 'one stone', so that explains it. The rst mutant has otoliths that are loose within the ear in abnormal locations, their stones have indeed been rolled. In no other world would Albert (one stone) Einstein, theoretical physicist and whose brainchild is the theory of relativity and the Rolling Stones debuted first twelve years after Mr. Einstein passed would be known together.

Sip away!

Cabernet, Chardonnay, Chianti, Merlot and Riesling:

The shades of red inspired each gene to be named after a variety of wine, each of which shares a similar hue with the fish's blood. Several zebrafish mutants have alterations to their genes that result in a decreased red blood cell count. The alterations cause each fish to have blood that varies in colour.

The norm pairs wine with cheese

Emmental is a yellow cheese with pores that originated in Switzerland, commonly called 'Swiss cheese', familiar from the cartoon comedy series - Tom and Jerry.

The Swiss cheese gene mutation in the humble fly causes glial hyper wrapping and brain degeneration. On visualisation, the brain of mutant flies has holes, just like Swiss cheese.

Caffeine joins

A double espresso and steamed milk topped with milk foam makes a cappuccino but capu, short for the gene cappuccino is required for localisation of molecular determinants within the developing Drosophila oocyte. The cappuccino gene product organises a mesh of actin filaments in the oocyte cytoplasm. Capu mutants lack this mesh. When active, it assembles an actin mesh that suppresses kinesin motility to maintain a polarised microtubule cytoskeleton. When inactive, unrestrained kinesin movement generates flows that wash microtubules to the cortex. Assuming that the relatability is to the latte art generated by the foaming and frothing during the making of the caffeinated drink.

Momento mori

When two genes - grim and reaper work together, they help guide cells in Drosophila through their death process, by apoptosis. Much like that belief of 14th century folklore, the Grim Reaper. In the 14th century, the Plague destroyed the world, killing at least 50 million people.

Silly serendipity!

What a great deal of fluke it is when there is INDY - I'm not dead yet, a reference to a scene in Monty Python and the Holy Grail, a 1975 movie about King Arthur and his knights who go in search for the Grail, encountering very many silly obstacles. The indy gene encodes for an intermediate transporter protein in the Krebs Cycle. A mutation in this gene increases the lifespan, making them 'not dead' and they live twice as long as wild type flies.

Zebrafish gives company

One more addition to the gloomy family is dracula (drc) in zebrafish encoding ferrochelatase and its mutation makes a useful model for erythropoietic protoporphyria in humans. Zebrafish have an essentially transparent periderm for the first days of development. A mutation in *drc* manifests in the form of light sensitivity and a light-dependent lysis

of red blood cells similar to how Dracula would react when faced with the sun except garlic repellents would be to no effect.

Starry night

Source : https://www.vincentvangogh.org/

Vincent van Gogh is a name synonymous with his work 'the starry night' but the gene Van Gogh determines the polarity of adult Drosophila cuticular structures and a mutation results in swirling of hair on the wing, hence, the artistic reference.

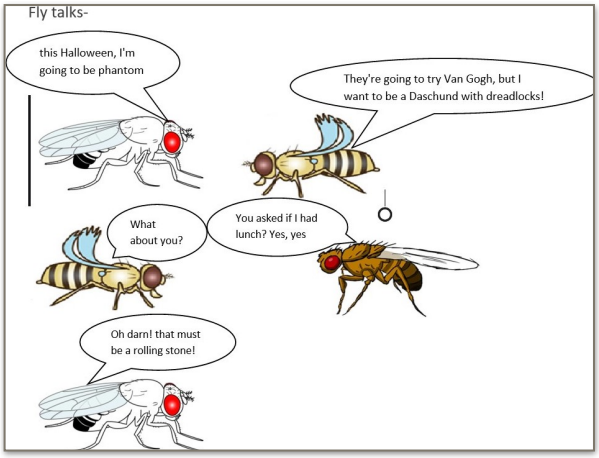
D for Dachshund and dreadlock

The dachshund gene encodes a nuclear protein that is required for normal development of the eye and leg. Mutations resulting in flies that have crippled legs, short like a dear Dachshund.

The dreadlock gene encodes an adapter protein which is required for the targeting and photoreceptor axon guidance. The R cell projections in dreadlock gene mutants become disorganised and clump together, like dreadlocks.

It's Halloween!

A group of genes namely, disembodied, spook, spookier, shadow, shade, shroud and phantom encode P450 enzymes which are involved in the synthesis of steroid hormones. Flies with mutations in Halloween genes have altered exoskeleton development, giving the embryos a spooky appearance



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2. https://www.cell.com/trends/genetics/pdf/S0168-9525(98)80016-4.pdf

3. https://www.ncbi.nlm.nih.gov/pubmed/ - for information about genes

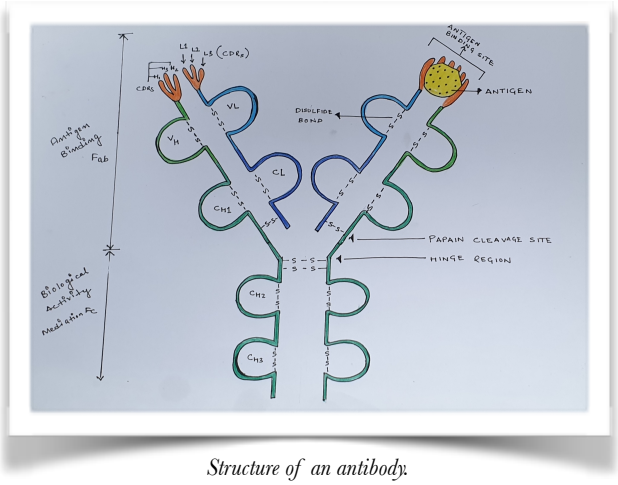
- Madhuri Srinivasan, II M.Sc. MBHG

Antibody Discovery and Engineering

With the emergence of new diseases and the shift towards targeted therapy, the medical field has seen a rise in the discovery of new drugs and methods to eliminate and control disease. To facilitate this unremitting discovery of new therapies, the existing drugs are modified and developed to suit the needs of the freshly evolved targets. On a broad note, the drug discovery process is an elaborate one, sometimes taking more than 10 years to release one drug against a disease. The discovery process is split into small molecule and large molecule research process to enable faster and efficient discovery of therapeutic molecules. While small molecules consists of organic compounds which regulate biological processes and weigh less than 1KDa, large molecules comprise of biomolecules such as proteins, RNA etc., which are higher than 900Da. In the large molecule discovery, antibodies form a major chunk of research due to their specificity and affinity towards relevant targets. An antibody structure containing the dual constant and variable domains, allows it to have multi effector functions thereby triggering more than one kind of immune response. Also due to multiple disulphide bonds and glycosylation, it is one of the most stable molecules in the laboratory making it easier to handle and manufacture. The process of antibody discovery comprises of five critical steps and each step requires stringent selection, validation and multiple screenings of each antibody before it can enter the clinics.

Target Selection

It's important that before proceeding with an antibody discovery program, the target (Antigen) molecule should be well defined in terms of its contribution to disease pathology and progression. Not only the association of the target with the human disease must be confirmed through human genetics data, its role in the mentioned pathways must be defined through various knock out studies in relevant animal models. While there is a checklist of criteria to fulfil, the key lies in the physiological accessibility and location of the antigen to the antibody. In most cases, the target molecule is located either on a cell surface, or extracellular space or in circulation. Another consideration is the action of the antibody- whether it internalises in a cell or cross-links on the surface resulting in downstream signalling and subsequent effector functions. In a nutshell, there should be enough scientific evidence to support the relevant molecule to qualify as a target for an antibody discovery program.



Structure of an antibody.

Project Planning and Execution

After identifying the target, the next phase in a discovery program is the generation of antibodies in-vivo. First, an endotoxin-free antigen is prepared and mixed with the relevant adjuvants and injected onto an animal model.

The immunisation is carried out at regular intervals and with different procedures so that a strong immune response is elicited towards the antigen. Once the immunisation program is completed, the hybridoma program is initiated with B-lymphocytes isolated from the animal's harvested spleen. After the hybridomas are

generated, the rigorous screening process for an ideal monoclonal antibody begins.

Screening

Screening is the phase when the monoclonal antibodies generated from the hybridoma undergo an intensive and stringent selection process to check on their binding ability to the target. Screening assays typically include primary, secondary and tertiary assays. Primary assays such as ELISA and Fluorescence Activated Cell Sorting (FACS) are used to check the binding of the antibody to the antigen. It's a time consuming and laborious process, wherein the antigen or cells are coated onto a 96- or 384-well plates and then screened. From the primary assays, some antibodies that show good binding are hand-picked and used for the secondary and tertiary screening process. The secondary assays are usually high throughput plate assays (ELISA) and tertiary assays are cell-based like a receptor/ligand binding assays. During the screening process, a reference antibody that is already known to bind to the target is used for comparison with the newly generated mABs.

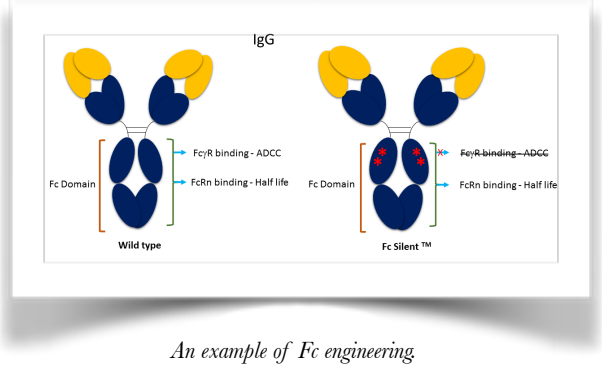
Hit Generation and lead Selection

'Hits' is usually the term used for antibodies that are selected from the screening process and 'lead selection' refers to the further interrogation of the hits in a vigorous and multi-step process to identify the 'Lead' which is the possible candidate for further trials. In general, the sequence of the lead antibody is identified and produced in small quantities using transient transfections and purified by affinity chromatography. The antibody is characterised at the molecular level and in-vitro characteristics such as expression titres, purity, aggregation, size, etc. are assessed.

If the hits show optimal physiochemical properties then they pass onto the next step; otherwise, their biophysical and biochemical properties are altered at the sequence before they proceed.

Lead optimisation and characterisation

Additional molecular engineering is endowed to the lead molecule to accrue drug-like properties. This is the step just before the antibody enters the clinical trials. Humanisation, Fc engineering and affinity maturation are the three major steps to optimise the lead. Humanisation is the process in which the IgG sequence of the host animal is replaced with Human IgG sequence to eliminate any immunogenicity derived from the host IgG sequence. A normal immunoglobulin molecule elicits 3 types of immune response: Antibody Dependent Cellular Cytotoxicity (ADCC) via the Fc Gamma receptor pathway, Complementary Dependent Cytotoxicity via the C1q binding and the antigen-antibody binding leading to downstream effector functions. Fc engineering is the alteration of each of these functions to modulate the functions of the IgGs in specific applications. Example: Site directed mutagenesis in the Fc delta receptor binding domain not only avoids ADCC but has also shown to increase the half-life of the IgG molecule. The final bit of engineering is affinity maturation wherein the binding sites increase the binding affinity of the antibody to the antigen.



An example of Fc engineering.

https://absoluteantibody.com/coretechnologies/second-generation-recombinant-antibody-formats/fc-silent-engineered-fc-domain/

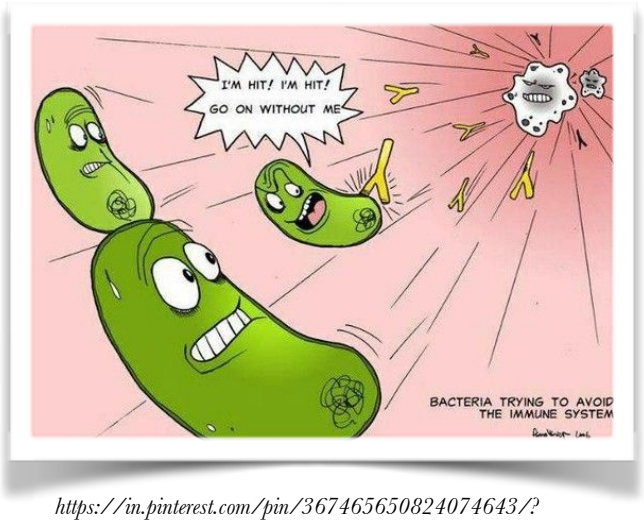
Candidate selection

The final step in antibody discovery and development, this is the pre-clinical step and marks the decision if the antibody can qualify for the clinical trials. Several criteria need to be met before proceeding to clinical trials - 1. A comparable animal/cellular efficacy of the antibody with that in a human 2. Dose response studies 3. Preclinical pharmacology and the pharmacokinetic studies supporting the dosing route and routine 4. Determining safety risk as low 5. Relevant biochemical and biophysical properties 6. Manufacturability of the antibody in large

quantities. Additional *in vitro* and *ex vivo* assays take place at this stage to determine systemic toxicities and safety assessment of the antibody before entering human trials. Candidate selection also marks the end of the discovery program and the beginning of clinical testing.

An antibody discovery program is not only comprehensive, but also elaborate, time-consuming and cost-intensive. Beginning with abundant candidates, only a handful (<10) reach the pre-clinical stage, with one or two entering the clinical trials. Some molecules fail at the clinical trials due to unsolicited immune response implying a fiasco in the complete discovery program. Due to this slow rate of progress, different routes of drug development towards the same target is considerable. This has also pushed the industry to explore other IgG formats like bi-specific antibodies, VHH, antibody-drug conjugates which provide some benefits in comparison to the limitations of a regular antibody.

In a nutshell, an antibody discovery program is an arduous journey of intense research, extensive planning, hard work and unwavering patience



https://in.pinterest.com/pin/367465650824074643/?nic=1a&sender=588916226181416227

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- Mallika BN, M.Sc. MBHG (2006-09) Alumnus

Words of Wisdom

Dr. R.S. Jayasree

Source: https://twitter.com/BloreIndiaNano/status/1070601397069078528

Dr. R.S. Jayasree is a scientist at the Sree Chitra Tirunal Institute of Medical Science and Technology, Thiruvananthapuram who is currently working on several projects including Development of optical and MRI imaging probes, Development of Photodynamic Therapy probes, Optical Molecular and cellular Imaging, *In vivo* and *ex vivo* Fluorescence Spectroscopic and Imaging techniques for oral cavity disorders, brain tumour and cardiovascular disease.

She is the recipient of several noteworthy awards and has made significant contributions to this field of science.

Can you tell us about yourself and your work?

I did my education in physics. Starting from my UG, I did my B.Sc., then M.Sc. in physics from Kochi University of Science and Technology in Kerala. Then I took a gap of few years because I got married and had two children. I did my Ph.D. program the Kerala University, where I worked on Raman spectroscopy and infra-red spectroscopic analysis of inorganic sulfates and bromides, which I finished in 1996. I joined the Sree Chitra Tirunal Institute of Medical Science and Technology, Thiruvananthapuram as a physicist, in the National Laser Program in the Department of Atomic Energy, Government of India, as a laser scientist. In 3-D technology, at that point of time, we were using lasers directly for the therapeutic applications in the patients. Under the guidance of Professor Valiathan, we started some programs like laser angioplasty, which initially was not successful. So, we tried laser-assisted balloon angioplasty which was very successful. Later on, we moved on to other procedures like percutaneous laser disc decompression for the treatment of back pain. This was very well accepted and it is widely used now. We also started treatment of osteoid osteoma (a bone-forming tumor) that is also well treated with lasers. Procedures like treatment of meningioma, varicose vein and other certain standardized procedures which were performed for the first time in the country, we standardized them at our hospital. I also started working in the field of biomaterials, where I specialize in the field of optics.

I currently work on photonics, biophotonics and nanophotonics, that way I developed materials that can be used for therapy or diagnosis of various diseases. For example, in diagnosis these materials can be used as class contrast agents under various imaging applications like MRI, optical imaging, CT imaging but for that you should understand what is wrong with the current ongoing programs and the currently adopted techniques. For MRI, gadolinium-based contrast agents are highly toxic and their chelated forms are used, but still it is highly toxic because long-term toxicity has been recently reported by radiologists as well as the imaging industries, so they are looking into newer type of contrast agents with the less toxicity. Likewise, optical imaging is an emerging field, many contrast agents are tested so that they can be used in the clinical field as optical imaging has the advantage of using non-radioactive imaging sources as light source whereas X-ray imaging have the disadvantage of using ionizing radiation so developing these emerging imaging technologies could help us overcome such disadvantages.

We also investigate if the materials being developed can also be used as multi-purpose. The same material can be used for thermal therapy, photodynamic therapy or hyperthermia treatment, or it could be used as a drug carrier. Using such

material can increase the specificity of the carrier thereby reducing the damage to the surrounding tissues. To sum it up, I have worked in the fields of physics, medicine, chemistry and biology.

Your work is very fascinating. You talked about the toxicity of gadolinium and I also read your article in The Hindu, on brain imaging. Are there any limitations on the interactions of physics with biology?

The field of biology despite being fascinating, many of the physicists do not try to learn more about it, other than this limitation, there are not many others. As a physicist, I felt like biology is tougher than physics. Likewise, biologists also think that physics is tougher than biology. But when we work together, we find that there are a lot of things that we can complement each other on. We can learn so much from each other. There are many contributions a physicist can make to a medical field that no one else can, similarly, chemists and biologists can contribute to the material side so we should learn to work together and collaborate.

As a woman have you faced any social challenges during the course of your career?

Good question. I had a break during my career. I also had a delay in getting a permanent position due to this break. I acquired a permanent position only in my late forties, which was a setback when compared to other people who were the same age as me and had gone through similar situations but are now in very high positions. Other than this I have not faced much and I feel that there is not much that women cannot conquer. There is no limit to what we can do.

How do you think we can eliminate these social challenges?

As I mentioned, I had to take a break in my career and since I could only take a limited number of holidays, I had to resign from my job and re-join, which setback my career. Now we have paid maternity leave which solves this problem. So, for the time being, I feel like the present generation does not have to face such problems and there is not much that limit women presently.

Can you tell us a little more about your current research?

I am working on gold nanoclusters for imaging applications, gold nanorods for therapeutic and sensing applications, quantum dots for imaging applications, and graphene and hybrid material for imaging and therapeutic applications. I mostly focus on cancer imaging and cancer therapy, and I have even patented some of the material because we find that many of them have better properties than the currently used material in cancer treatment. For example, when you look at gold clusters, they have the unique property of fluorescence signaling, which we can use in imaging. This material we have modified for brain imaging and drug delivery to the brain, as you know the entry to the brain is through the blood-brain barrier and the cluster being very small (the order of a few nanometers) and having just few gold atoms which will not be toxic when applied in small concentrations. We use this property on drugs and target specific areas effectively.

Now I am working on Alzheimer's disease to dissolve the amyloid beta plaques. Another project is gold nanorod based where nanorods are conjugated with porphyrin (approved photosensitizer) for photodynamic therapy. Gold nanorods have surface plasmon resonance which generates heat in the presence of a laser so that temporary heat is good enough to kill cancer cells. So, what we do first is we target the cancer cells with cancer antibodies conjugated to these materials and then we irradiate so that only the cancer cells are destroyed. Porphyrin also has fluorescent emission property can be used for imaging applications. The designing of these materials is tricky so you can design it in such a way that once it is in the cancer environment, because of altered physiological conditions, the material releases the drug. For example, depending upon the pH of the environment the material can emit fluorescent properties which are used for imaging and the drug can be used for photothermal therapy. That is a dual property probe. There are many other things that I have mentioned before on which I am working on.

Do you think hospitals in the medical community are actually utilizing these techniques currently and if not for how far do you think it is until they do?

Currently, the limitation with my work is, I am using mostly metallic nanomaterials. Very recently I have switched to bio polymers, biocompatible polymers like PCA, PLGA etc. The message I want to impart to the researchers entering the medical field is that it would be better if you can take already approved proper materials and modify the material. So, with the advancement in the field of synthetic chemistry, you can play with designing the more modified material. Start with FDA-approved materials so that the regulatory issues are already less. That is currently what I am doing. I have started working with biopolymers and this can definitely come to the clinic. Otherwise, there will always be a question of whether the particles will remain in the body and the harm it can cause. In the case of biopolymers, we are sure that it will completely get disintegrated and cleared from the body. Since I am in the Ethics Committee for many institutions, I have seen many nano-formulations entering clinical trials and already there are many that have entered the market. There are about one thousand five hundred different nano-formulations in drugs that are being sold already.

I see this field is growing very fast and I can't help but recall the 2017 Nobel Prize they got for cryo-electron microscopy. What do you think is the next revolution in this field?

I don't find any major revolution in clinical imaging. For example, MRI, SPECT scans are doing very good. Maybe over time something new will be invented. For research, of course, I can think of cryo-transmission electron microscopy. You can also imagine that infrared imaging which was not possible with samples of containing water but now it is with the help of modern techniques and so in the research field many things can happen. Confocality is also a new technique being used now so maybe some new imaging techniques could emerge out.

I've already asked this question but in a broader perspective to the field, what do you think are the limitations and challenges biomedical imaging as a whole, faces?

The major issue is the complexity of these imaging techniques like if you have been to the MRI room there are complex sequences that need to be run when a patient is inside, and it takes a long time for even a brain scan. We cannot afford the complexity of the equipment like the complexity of the RF signal, RF coils and the need for experts. We need experts to handle such equipment. So, during an emergency, we cannot go for an MRI. This complexity can be addressed with the help of artificial intelligence, maybe in the future. For example, if you acquire one, or a sequence of X-ray images, and with the help of artificial intelligence, if you can reconstruct it to something comparable to CT images or MRI images, then that of course will be highly useful. Maybe one day we can expect something like that.

While we're on that page, how far do you think we are from applying artificial intelligence in our work? Being a member of the Ethics Committee itself, what are your views on this?

The Ethics Committee cannot really decide right now as we have not reached that stage yet. Once AI enters the field then we have to formulate standard guidelines and procedures for how far it can be used in diagnostic procedures. Currently we cannot comment on that. There can be false diagnoses that can happen but if we can use the support of AI through the generation of a huge database, we could make perfect diagnosis.

On a final note, what advice would you like to give to the readers of VIVUS?

When you do something, focus on that. When you are a student, you always should have goals. You should be highly ambitious. And you should have a focus on what you are moving towards. That's the main advice I can give to the readers.

- Yash Goel (III B.Sc.)

creativity
beyond this
page!

Just Smile

-Ipsita Pujari

(Dr. TMA Pai Ph.D. Scholar, Department of Plant Sciences)

When the world gets dark
and you need a glimpse of light to walk ahead, Just Smile..
When the dullness starts
and you need a star bright enough to guide you through the tunnel of your head, Just Smile..

As life has always been the summation of ups and downs,
But if you search rightly, true joy is constantly around.

Never chase and never race,
Do not frown and do not get bound.

Days do get tough sometimes,
But grow larger than your wound and believe in the ecstasy of being found.

When setbacks make a mark
and you need a massive dose of happiness to act ahead, Just Smile..
When your integrity and veracity fall short to build a spark
and you need a miracle boost to continue on the path of virtues in your head, Just Smile..

Smile..
Because, it will always stay as the best style.
Smile..
Because, it will assist you in creating a best life profile.
Smile..
Because, it will always make you accomplish an extra mile.

And largely, it will make THIS JOURNEY WORTHWHILE.

And yeah, if you gather maximum of these smiles, spread them around may be once/twice/thrice in a while.

Humour for the strong

It's always fun reading something you were not supposed to. Especially if it belongs to a maniac;)

Day 369:

My goodness Journal. I'm in grave danger. Someone has been messing with my life. What if they're a creep? What if they're a stalker? EVEN WORSE... What if they're a robber who's behind my precious bottle cap collection? I'll keep the details enclosed. Who's to say they won't read my journal. The other day someone made changes in my auto-correct which made me print out "Literally Club Meeting" instead of "Literary Club Meeting". Guess what happened when I went there. I started my talk by asking everyone to take a seat and all of them did. LITERALLY. They took a chair each and left. Two days back in the laboratory I had to make a mixture of Cerium and water for one of the professors. So, I started making the mixture only to find out someone replaced the bottle of Cerium with Cesium and I accidentally blew up the whole laboratory. I tried convincing them I didn't do this on purpose and someone intentionally tried to mess with me, but was forced to plead guilty. (I was threatened to get suspended). Boy oh boy, you blow up a laboratory once and the laboratory technicians don't want to have tea and biscuits with you suddenly. Not just this, there have been obscene cartoons of mine drawn all over the college walls. In every one of these cartoons I have a big bobble head and a stick like figure (I wonder why everyone finds it funny). This person clearly must be mistaken because I am a very nice person as per my knowledge. Why would anyone try to sabotage my perfect life? Unless they're jealous. I wouldn't be shocked if someone was envious of my perfectly balanced life. That's a possibility. I'll look into this matter. It can't be someone close to me, neither of them would dare to do this. Besides if it were someone of proximity my vigilance would've helped me figure this out. Whoever this is I'll get you. Watch out.

Alfred the assistant: *This is one crazy scientist I deal with. There's no defeating this one. So narcissistic, so delusional! What can I even tell about this insane blob of human mass! Tyrannical and oppressive is all that my "scientist" boss has learned all through these years of college. If there was a Nobel Prize awarded to imbeciles for their obstreperous behaviour and throwing tantrums like a starved baby, then no one would hold a candle to this devil of a being. Every minute with the nerd pushes me over the edge. Never have I ever been so driven to act on my evil thoughts like in these years. As if that's not enough, that idiot classmate of mine sticks to me everyday and I have to be seen with him throughout college hours! And then he has the nerve to call me his assistant! Being a science student myself I have learned a thing or to about neurology and the art of studying a specimen, their ticks, behaviour and life cycle. I'll use this very science that the mad "scientist"*

loves so much for their destruction. We'll see who'll be laughing in the end. We'll all see! °‿‿-

Day 422: MY GOODNESS JOURNAL, THIS HAS GOTTEN FAR OUT OF MY CONTROL

This cartoonist has gone rogue. I wonder what this puny human is thinking to themselves¿ That they'd mess up my whole life and get away with it. This individual did the unthinkable. Came into my dorm room replaced all my candies and chocolates with wax and hardened wheat dough. Imagine coming to your room after a strenuous day, a long one... where all you thought about was how amazing it'd be to return home and have the best, most delicious chocolates from Belgium instead you bite into dough. IT'S NOT EVEN COOKIE DOUGH! What monster would do that?! I thought it was some packaging error so I bit into every single candy and chocolate just to check. There was so much wax on my teeth by the end of that day one could've lit up my mouth and I'd illuminate the room for a week. I mean this person ought to be obsessed with me. Who in their right mind would go through the trouble of replacing each candy piece with wax and chocolate with dough just for a prank?

Trust me Journal when I get my hands on this prankster, there'll be an avalanche of tears flowing. I'll hand it to this bully! Whoever this is, better be remorseful!

weeks later

Day 579:

My goodness journal! Please don't mind if I commit too many errors while making entries because I am emotionally, mentally and physically distraught. The previous two weeks were end semester university examination-weeks. I find this entire system unfair. Absolutely unjust! I mean I pay for this college I come and attend the classes and you test me?! On what basis? My memory on what you said couple of months back? Why must I provide proof that I'm learning what you teach, right? Can't our professors take our word for it? We are children after all, we most certainly wouldn't lie to them about something that'll decide whether our future is safe and secure now, would we?

Since THEY have trust issues with us students being diligent and studious, we are supposed to suffer and give examinations on a regular basis.

I mean does it help in self-analysing my own capabilities? Yes, it does. Does it help me shape a good future with finer grades translating to better job placements and remuneration? Sure, it does!

But at the cost of what? My sleep cycle, my diet and crippling anxiety? No thank you. Another weird thing happens to me during examinations. All my friends become completely distant act aloof and don't seem to hang out with me. Keep talking about how unhealthily competitive I can get. I don't believe that's true at all. I just think that the rest of my friends don't happen to be as passionate as I am about my academics. My passion demands that I am the best in my field and that no one must come close to my level of achievements. I wouldn't call that competitive at all! They say that examinations bring out the

worst in me. Just because I flipped a table across the room when I lost one mark doesn't make me "competitive" or "insufferable" as my friends call me. It's just a method of letting out frustration that I am not efficient enough to even score a perfect grade on these ridiculously easy examinations! Especially this one friend, or should I say library acquaintance? This person and I studied together for the whole week and she scored far better than I did in all of the tests. And I did what any hard-working industrious student would have done, I went to the library while she was studying and ripped her notes apart while I yelled 'TRAITOR' in I-study-too-well-and-make-perfect-notes face. All of a sudden she acts like she's not associated with me at all. Well, if all of this was just an acquaintance-ship agreement then I'd like her to return all the favours I offered her. She's the betrayer after all! I personally think that all of my acts through these weeks are completely reasonable and justified, be it stealing someone's notes to see if they're better than mine (I returned it, by the way) or flipping a table. I don't feel the need to absolve myself of any guilt or even apologize to anyone because I'm not guilty! PERIOD.

Besides all this telenovela drama in my life I'm trying to figure out what black magic is involved in deciphering the secret behind Time-management. This one is really the worst brain teaser ever. You could give a calculus problem and I'd do it. You could ask me to derive the toughest of equations and I'd follow through. But this task? Error 404 - ability to formulate plans not found.

So, this is how it works with me or doesn't work with me. Basically, the same thing. The examination time table comes out. That's my cue to prepare a time table. A simple table that will allow me to carry out my daily activities with a little bit of cut-downs, obviously. Along with the studying and preparation for the tests. It's an effective method. Proven to be the best at times. But NO! My dysfunctional brain can't seem to comprehend this piece of information. The other day when I gave it a shot and failed miserably, I smacked my forehead and it made a blaring thud. It all made sense to me because my goodness my empty vessel makes the loudest noise. I just wanted to yank my brain out and toss it in the bin but I doubt even the dustbin would've wanted something that useless.

Let's break it down to the simplest! It's a table with hours of a particular date involving details about every little activity that you'll be doing for the working hours of that date from the day ☀ all the way through till the night 🌙⏰💤. Within this you'll include the activities basing them on their priorities and how immediately they need to get done along with the breaks of the day.

Great. Now I have a plan. It's been documented. It's a good reminder of all I have to do as well. Even if I manage to figure out all the things I'm supposed to get done by that day. I don't know how to time the events. Do I give an hour for this subject and take a fifteen minute break or the other way around? Do I really need to eat three meals for a day or can I just use that time to sleep? I must say I never thought college would bring me down to the point that I'd have to choose between eating and sleeping. After all this effort I finally have a proper time table with all my duties for the day. It might be a little bit more biased to my academics and ignore self care by a lot. Alright, to be perfectly honest it's completely focused

on my tests and practical examinations and heeds no attention to self health care at all. But that's okay by me. Thanks to this time table I now know I can survive only on water for eight days straight. And maybe some cornflakes once every three days. Little did I know that you can trick your mind into thinking that your body's cry for food is just an alarm to remind you that you might fail. Who knew the fear of failure is a driving force that can keep your body intact and in stand-by mode. I remember being so sleep deprived that I walked into a glass door and apologized to it for being rude on the day of this very important examination. But the fear of failure with this particular test was so strong that I almost didn't even blink during the test hours to prevent losing any time. Once you're in there, each second is valuable. As soon as you're out the room, you're back to being your usual sleep deprived starving individual. I know this because I walked into the same door and repeated the same actions.

All this planning for one university examination. This gets torpedoed in seconds by a huge wrecking ball of a problem called procrastination. One would be shocked at my ability to procrastinate and not get things done. Things on which my life depends. I think I just took the worst meaning out of pushing it to the limits because I just don't know when to stop. Procrastination can be a dangerous game, hazardous especially when you tend to be a perfectionist. You think you've overcome that problem then there's always another. It's like etched in the stars that students should stay in a continual state of anxiety and misery. I'm intermolecular space close to giving up on this course. Imagine having to set an alarm for crying because you're so beyond help that all you can do is cramp everything into your tiny little mushy mind and cry.

Here comes the problem train. All aboard. Well in my problem train you'll get a board with no writing in it. Cause it's all blank. Just like a huge white canvas and I'm the artist. I'm bad at art. Really bad at it. So bad they could name an award after me. Apparently, I'm supposed to know what prioritizing is. So, the world tells me that I'm responsible for what I want, what I pursue, and manage my life depending on my interests. This just came out of the blue to me. No warning. I don't think it would've done my parents any harm had they given me a tiny heads up at least! Imagine if childhood ended at a cliff and being an adult was the equivalent of jumping off it. My family and peers drove me up till this point of the cliff kicked me out the vehicle and rode off the cliff. Only difference is they're equipped with the right tools to do so. It's like they have their custom-made parachutes metaphorically representing all the skills they have to face life in general. Taking responsibility, financial stability, decisiveness, proper food cycle and what not¿¡ Once you're this good at handling being an adult, the fall isn't even bad. It's like landing on a giant bouncy castle which offers you a happy satisfied future. All I got from my parents was "Be safe" and "Don't do bad" . Now along with the pressure of succeeding in life and building a future I have to worry about being safe and not dying. You can't let your parents down now, can you? Can you?

Day 666:

Hello journal! Everything here seems fine. Remember my obsessed stalker? All of their acts seem to have subsided and those caricatures only seemed to have made me more popular than I already am! You know what they say! No publicity is bad publicity! Luckily enough the humour article seems to have written on its own or someone else volunteered to write it (Funnily enough they thanked me for it later. I guess talking to me might have lightened up their life) I can be such a ray of sunshine sometimes!

Besides there's some gossip going on about some random college student's journal being leaked. Imagine being that sad individual. How terrible! I'm just glad I am not that person. I mean to have all my thoughts so personal to me displayed like a comedy skit in front of the whole college would effectively end my social status. Basically take away all my credibility. At least I'm not as stupid as this individual to leave my personal documents out in the open making it easily accessible to the public. That's why I have a minion to guard my precious journal. That poor little assistant of mine might be a good for nothing door. But he sure can guard a journal. After all I'm the boss. My word's the final word. As if he'd dare to oppose me! Out of respect for the person I didn't read their journal or actively take part in knowing whose journal was leaked. But a little part of me wonders who it could be....

After all its none of my business! It's only a matter of time before someone babbles and spills the tea. I'm just glad I'm not going to be the one cleaning up!

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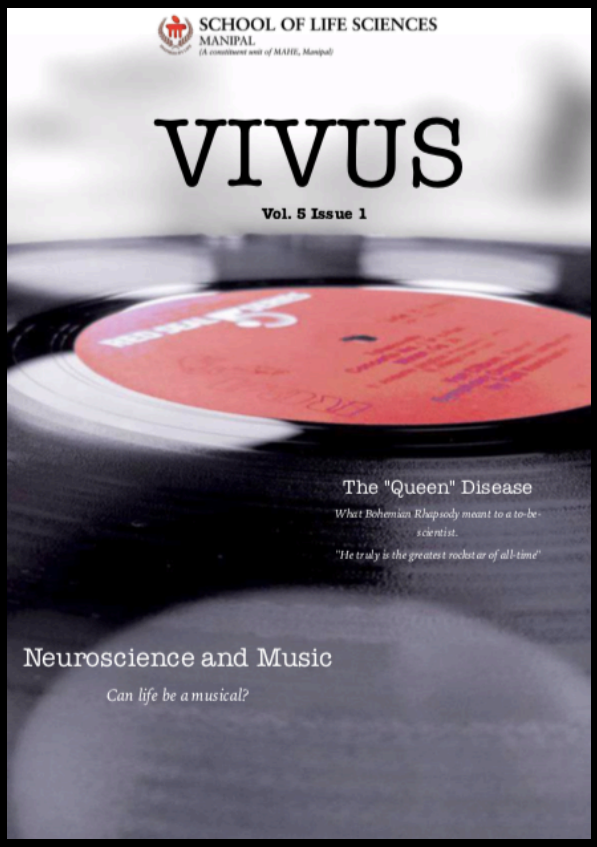
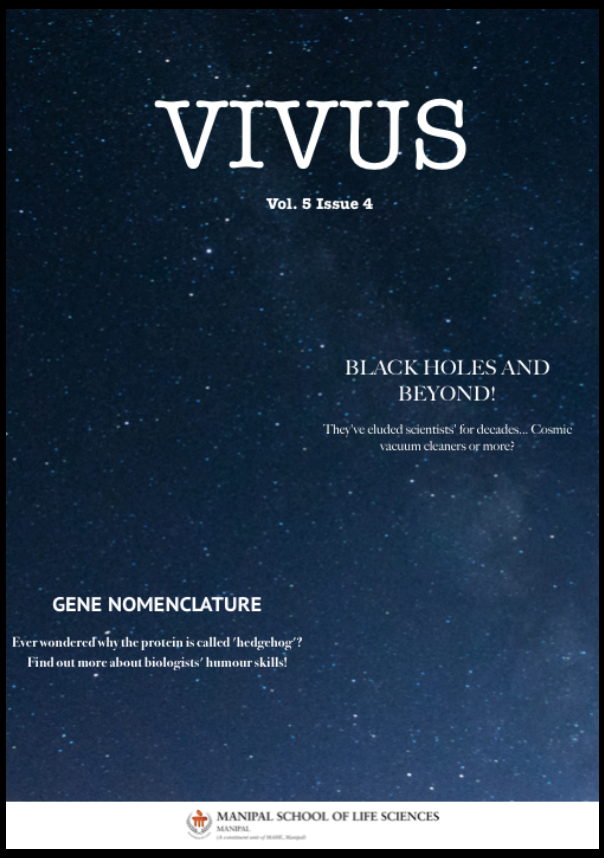
- The Editorial Board 2018-'19





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