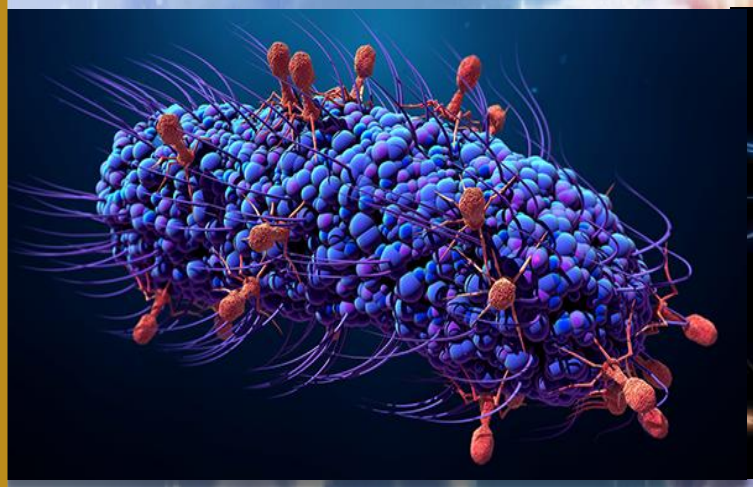
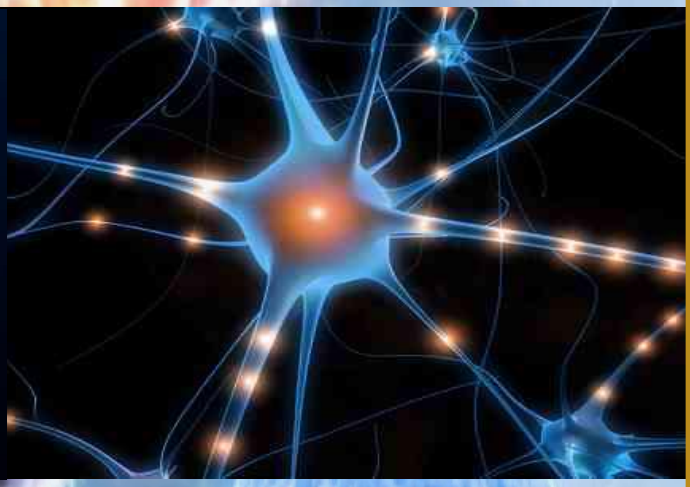
BioMer 2020

DEPARTMENT OF BIOMEDICAL SCIENCE

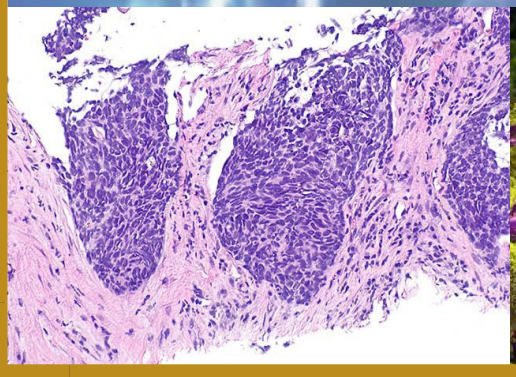
ACHARYA NARENDRA DEV COLLEGE (UNIVERSITY OF DELHI)

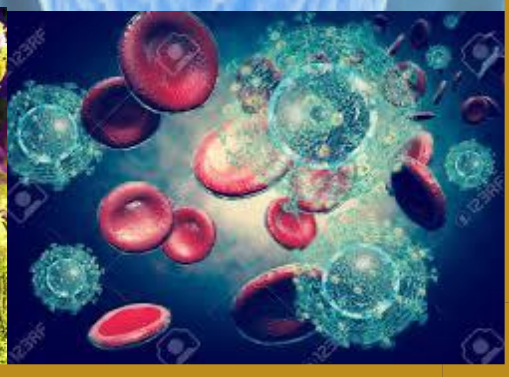
(UNDER THE AEGIS OF DBT-STAR COLLEGE SCHEME)





"PROSPECTS AND CHALLENGES IN BIOMEDICAL SCIENCE AND RESEARCH"





Special Thanks to

All the students of Biomedical Science and the Members of Teaching and Non-teaching Staff !!!

BioMeR' 2020

The Biomedical Science Reporter

Annual Magazine Released by

"Cathexis"

The Student Society of Department of Biomedical Science

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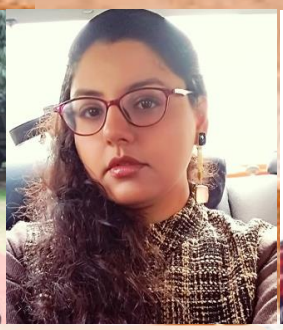

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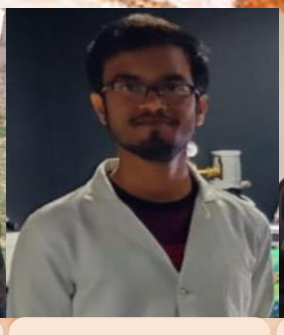

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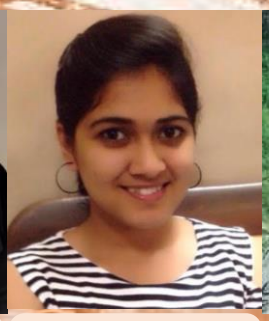

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Disclaimer

From the Principal's Desk

I congratulate Department of Biomedical Science on the completion of 20 years and for bringing out yet another issue of ***BioMer***. Over the years *BioMer* has become an integral part of the Department. This is the platform where students express not only scientific but also creative ideas. This clearly reflects that the Department focusses on overall development of the students and strongly blends with the twin ideologies— '*Beyond the Classroom…* and '*Preparing for the Future…*' of the College.

I sincerely appreciate the efforts and hard work put in by the students in collating this magazine. Surely, this will inculcate the habit of working in team, taking decisions and organizing themselves. Hope you all will enjoy reading this magazine. Wishing the students every success in all of their endeavours.

Dr. Ravi Toteja

Acting Principal

Message from the Teacher-In-Charge

Celebrating Two Decades of Biomedical Science at ANDC

Twenty years is a long time in any journey and as we look back, Biomedical Science (BMS) course has indeed been an intense one; full of toil, grit, challenges and fun as well. Since its founding in 1999, our focus has been to help students grow as thinkers, provide them with the modern labs with research facilities and opportunities and an environment where they evolve not just as good students but also as responsible, sensitive scholars with a larger vision. With great satisfaction and pride we can say that a large number of our alumni are pursuing higher studies in the best institutions and are contributing to biomedical research as professionals with prestigious assignments in the country and abroad.

On the special milestone year of completing 20 year, we have started with "BMS Alumni Lecture Series". It is heartening to see our students having carved a niche for themselves and willing to share their knowledge and experience with the current batches. A descriptive note on it is included in this edition.

BioMer is the magazine that students design, author and edit under the guidance of faculty members. I remember theme of the first edition was 'Gene Therapy' and in the successive years, topics relevant to contemporary times such as Pharmacogenomics, Anthropogenic Evolution, Global Warming, Cancer, Nanobiotechnology, Demystifying myths surrounding human health were chosen.

I appreciate creative inputs of all those who contributed articles and the diligence and hard work of the editorial committee. Hope this entire exercise helps them discover a potential writer/critic/thinker/analyst/editor/cartoonist/researcher in them. I also sincerely acknowledge the inputs of the faculty members in bringing out this edition.

Dr. Urmi Bajpai,
Teacher-in-Charge

Message from our Former Faculty

I congratulate all the members of Biomedical Science family at Acharya Narendra Dev College for completing two decades of successfully shaping the initial stages of research career of students. The Department, one of the youngest in the College, has made a significant contribution to the achievements and recognition of the College. Today one may find BMS students of ANDC at almost all prestigious institutions of the country and abroad. This has been made possible by hardworking and committed teachers, lab staff and above all committed students of the department.

I feel blessed to be part of the Department for almost 10 years. The department has played a significant role in my personal and professional growth. The eternal zeal of the teachers and students in the Department to excel in whatever they do, is evident from the long list of achievements the Department has to its credit.

Cathexis, the annual festival of Students Society of Biomedical Science, is a major event in the Department which focuses on relevant issues of science and society and help students to explore their leadership and managerial skills. The BioMeR (Bio Medical Reporter) gives them an opportunity to portray their scientific writing skills.

On this occasion, I would like to convey my best wishes to the Department and its students. I hope the Department would achieve greater heights and its students would bring more laurels to the Department and College.

Dr. Abhishek Kumar Mehta,
Scientist-C, DBT, GOI
Former Assistant Professor,
BMS, 2009-2019)

Message from the Invited Speaker

I am pleased to know that the Department of Biomedical Science at Acharya Narendra Dev College has completed two decades. Like any good institution, it has decided to celebrate its achievement with a discussion of ideas. I am very pleased to be a part of the Symposium "Prospects and Challenges of Biomedical Science and Research".

My interactions with your college and department date back to its early days, where I have given talks and interacted with students.

But more fulfilling was the opportunity to host a few undergraduate students from here in my laboratory at ICGEB, New Delhi. I am so pleased to see them doing well, which is a testament to the high standards of education they received at the college.

I take this opportunity to wish the students, teachers and leadership of Acharya Narendra Dev College a very happy 20th birthday. We would look forward to you breaking new grounds in biomedical science education, research and training in the days to come.

Dr. Shahid Jameel

CEO, DBT Wellcome Trust/ DBT India Alliance

Brief Introduction of Invited Speaker

Dr. Shahid Jameel pursued his Ph.D. in 'Biochemistry' from Washington State University-USA and his postdoctoral work in Molecular Virology from the University of Colorado Medical School (USA). Prior to joining India Alliance, he was group leader of Virology at the ICGEB. He has received the **"Shanti Swarup Bhatnagar Award**" in Medical Sciences- India's highest mid-career research award and has also received "B. M. Birla Science Prize" for his outstanding contribution to his field.

His research on virology started with his work on Hepatitis B virus, later he is known to have carried out studies on the molecular biology of hepatitis E virus (HEV) and human immunodeficiency virus (HIV) and his research has been documented and cited in texts and articles and he has contributed chapters to books published by others. Besides, he has also published three books, "Isocitrate Lyase and Proteinases from Fat-rich Seedlings", "Current Developments in Animal Virology" and "Advances in Animal Virology" and has mentored several doctoral, post-doctoral and master's scholars. He is a member of Guha Research Conference as well as the American Society for Microbiology and the award orations delivered by him include the Dr. M. R. Das Memorial Lecture of the Indian National Science Academy.

BMS Departmental Activities

Short summary of events conducted by Department of Biomedical Sciences (under the aegies of DBT Star college scheme)

Cathexis'19 Inaugural lecture

Drug Discovery against MDR Microbes

Department of Biomedical Science, Acharya Narendra Dev College, organized a "one-day lecture cum interactive session" as the Cathexis'19 inaugural Lecture under the aegis of DBT- STAR College Scheme on August 28, 2019. The organizing team comprised of Dr. Urmi Bajpai (Convener), Dr. Satendra Singh, Dr. Namita Singh, Ms. Rimpy Kaur Chowhan and Mr. Prashant Pradhan. Antimicrobial resistance (AMR) has been internationally recognized as a significant threat to healthcare systems worldwide.

It has been declared as crisis situation, nightmare scenario and global health emergency by WHO & CDC. Dr. Chopra has been working on AMR associated diseases and drug discovery against drug-resistant bacterial pathogens for more than a decade now. His talk highlighted the core issues such as, the current scenario of AMR therapeutics in India, interdependence between drug discovery and drug-resistant microbes, lack of new drugs to combat constantly emerging novel microbes, etc. Dr. Chopra shared various interesting facts associated with AMR. The interactive session also quelled lots of student queries and myths about AMR, most common being that it is not direct antibiotic intake but the antibiotic treated poultry that is the reason for alarming raise in AMR. Students gained a lot from the expertise of our honored guest.

BMS 'Alumni' lecture series

Transition from a "Cancer Researcher" to an "Engineer" and finally a "Manufacturer-Salesman"

Department of Biomedical Science, Acharya Narendra Dev College, organized a "one-day lecture cum interactive session" under the BMS 'Alumni' Lecture series on August 14, 2019. The organizing team comprised of Dr. Urmi Bajpai (Convener), Dr. Satendra Singh, Dr. Namita Singh, Ms. Rimpy Kaur Chowhan and Mr. Prashant Pradhan.

Cancer is a lethal disease triggered by unregulated cell growth and by the additional mass tissue known as tumor.

Several etiologies such as; smoking cigarettes, intake of tobacco, alcohol, poor dietary habits and UV exposure etc. are linked to cancer. Various organs such as; breast, lungs, kidney, eyes, heart, etc. are affected by this deadly disease.

Treatments like surgery, chemotherapy, radiation therapy and bone marrow transplantation are used to treat cancer in different stages. The physicality of what cancer do is hideous and inexcusable. The entire body changes inside and out which actually affects a person physically, emotionally and psychologically.

Dr. Pawan Mehrotra, a graduate in Biomedical Sciences with post-graduation in Genetics holds a Ph.D. in Cancer Sciences. He was an independent research fellow in the context of Centre for Chemical Biology and Therapeutics, a joint initiative of University of Cambridge and Department of Biotechnology (DBT) at National Centre for Biological Sciences, Bangalore before foraying into affordable healthcare product development for unmet user-centric medical needs. His team has successfully developed and launched their nascent social enterprise's first two products– 'Sampoorti' and 'Poorti' (light weight silicone breast

prosthesis), which aims at post-surgical rehabilitation of breast cancer patients supported by BIRAC, Tata Trusts, IIT-Kanpur and Translational Health Science and Technology Institute – DBT. He has the unique experience of having publications, patents and products to his credit in the field of oncology.

We believe each of such activities provide great exposure to students to meet and exchange ideas with their seniors and encourage them for the future endeavors. The talk was very informative and was followed by a passionate dialogue between speaker and participants and was highly appreciated by all the students.

An interactive session on Science Communication

Department of Biomedical Science, Acharya Narendra Dev College, organized a "one-day lecture cum interactive session" under the BMS 'Alumni' Lecture series on August 28, 2019. The organizing team comprised of Dr. Urmi Bajpai (Convener), Dr. Satendra Singh, Dr. Namita Singh, Ms. Rimpy Kaur Chowhan and Mr. Prashant Pradhan. The lecture was aimed to enhance student's enthusiasm for science communication.

Dr. Murlidhar and Mr. Chari started the lecture by commemorating their fond memories of the college, and highlighted the importance of BMS department in shaping their career and life. This was followed by a half an hour long session with approx. 100 students discussing the lack of good scientific communication articles bridging the gap of knowledge between scientists, clinicians, and common man. They motivated students to comprehend their role as future scientists to be good communicators not just for their peers but for the populace. Both

of them being closely associated with IndiSciComm (a scientific communication forum for the masses) invited students with excellent communication skills to contribute their articles. They even showed willingness to train students remotely for improving their writing and science communication skills.

Through this session, they also drew student's attention towards several not so talked about currents issues of the scientific community, such as, under-representation of women in science, unpaid internships, Scholars exploitation, etc, and urged them to break these historical norms and be the face of change.

Sci-Art

Department of Biomedical Science, Acharya Narendra Dev College, organized a "One-day Workshop" under the BMS 'Alumni' Lecture series on September 19, 2019. The organizing team comprised of Dr. Urmi Bajpai (Convener), Dr. Namita Singh, Ms. Rimpy Kaur Chowhan and Mr. Prashant Pradhan.

Sci-Art arises from a creative collaboration between the artist and the scientist to make the secrets of the world we live in a little more intelligible to the human imagination. This amalgamation of art and science is the most profound key to solve the problem of science communication, best described by Richard Feynman words "In this age of specialization people who thoroughly know one field are incompetent to discuss another. The great problems of the relations between one and another aspect of human activity have for this reason been discussed less and less in public".

Dr. Lipsa, since her school days has always been a science enthusiast and an artist at heart. Her passion allowed her to be the best person to bridge the link between Science and Art, and therefore, after completing her PhD in IGIB and Post-Doc at CCMB, she diversified her professional endeavors towards Sci-Art.

The main purpose of the workshop was to enlighten the students about the power of art in science, and expand their creativity. Students from several departments of the college

attended the workshop. Dr. Lipsa started off the workshop by giving an inspiring lecture on her journey so far, followed by another lecture on history of Sci-Art, since the beginning of civilization. Over 50 students were then provided with stationary including drawing sheets, pencils, sketch pens, poster colours, etc. by the College to perform various activities conducted during the event. The success of the workshop was apparent in the amount of SciArt submitted to the organizing committee ranging from cave paintings to the exhibition worthy arts depicting Cell division, neutrophils, bacteriophages, etc.

1. CRISPR- Cas: New Advancement in Science

Preeti Singhal, B.Sc. (H) Biomedical Science, III Year

CRISPR-Cas (Clustered Regularly Interspaced Short Palindromic Repeats and CRISPR associated protein) are genome editing tools which are currently the fastest, cheapest and most reliable method for editing genes. Genome editing is a method in which genetic material can be added, removed or altered at a particular location in the genome of an organism. CRISPR technology is adapted from the natural defense mechanism of bacteria against any foreign nucleic acid entering the cell. They are widely present in genome of bacteria and archaea and are part of their adaptive immune system. The bacteria captures pieces of DNA from invading viruses and creates DNA segments called CRISPR arrays. They use these CRISPR derived RNA to cleave specific regions of viral DNA. These viral DNA fragments are then stored to retain the memory and prevent future infections by similar viruses. Researchers used these components and transferred them to more complex organisms to edit their genomes.

CRISPRs: These are specialized DNA segments which consist of CRISPR repeat sequences interspaced by foreign segments of DNA known as spacer, a leader sequence and CAS genes. The leader sequence carry the bacteria or archaea specific promoters for transcription of CRISPR arrays and signals for the adaptation. CRISPR-Cas system basically consist of two different components:

- Guide RNA (gRNA)
- CRISPR associated nuclease proteins (Cas)

The guide RNA is a specific RNA sequence which is made up of two parts: crispr RNA (crRNA), a 17-20 nucleotide long RNA molecule which is complementary to the target DNA and another called tracr RNA (trans activating CRISPR RNA) which acts as a binding scaffold for Cas nucleases. The two join together and form a single "guide" RNA.

Cas or CRISPR associated proteins are endonucleases which bind to guide RNA and they guide Cas protein to a specific target site where it binds and introduce double stranded breaks. One of the most commonly used nuclease is SpCas9 which is isolated from bacterium *Streptococcus pyogenes.*This SpCas9 consist of twodomains: a recognition domain which upon binding to the target site with the help of guide RNA interacts with the DNA strand and scans for complementarity and a nuclease

domain, which acts as molecuar scissors and creates double stranded breaks in the target DNA. The Cas nuclease binds to target sequence in the presence of specific sequences called protspacer adjacent motifs (PAM) which serves as tags and are present adjacent to the target site. The nuclease then cuts the DNA 3-4 nucleotides upstream of the PAM sequence. Different Cas proteins from different bacterial species recognizes different PAM sequences. For example, SpCas9 nuclease recognizes PAM sequence 5'-NGG-3' ("N" can be any nucleotide) and SaCas9 (Cas nuclease from *Staphylococcus aureus*) recognizes PAM sequence 5'-NNGRRN-3' (where "R" is A or G).

Mechanism: Once the guide RNA directs the Cas9 nucleases to the target site, it binds to it and creates double strand breaks (DSB) in the target sequence.

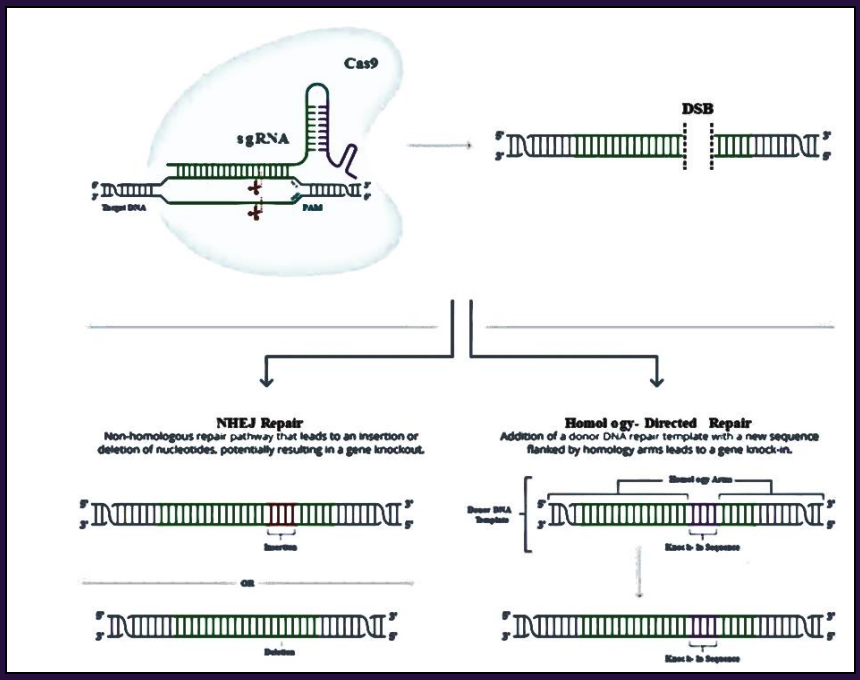

Fig 1: mechanism of CRISPR Cas

(Ref: https://www.synthego.com/blog/rnai-vs-crispr-guide)

After introducing double strand breaks the cell tries to repair it using two mechanisms:

- Non homologous end to end joining (NHEJ)
- Homology Directed Repair (HDR)

In NHEJ repair, the blunt ends created after breaks are ligated and it tends to introduce errors while doing so. It may result in insertion or deletion of nucleotide bases creating mutations which may disrupt the gene and is the preferred mechanism of knocking out the gene of interest.

In HDR repair, the break is fixed by filling the gap using complementary DNA sequence as a template to repair it. This method is usually used while knocking in or activating a gene. Several copies of the template DNA containing the sequence to be inserted is introduced to the target DNA.

This system can be used to facilitate genome editing in eukaryotic cells. The guide RNA in bacteria corresponds to phage sequences but this sequence can be replaced by a sequence of our interest and any gene can be specifically targeted in any organism. The cell uses its own DNA repair mechanism to add the nucleotides and while doing so, mutations are common rendering gene inactivated.

How CRISPR technology is better than RNAi:

RNA silencing is a method of gene silencing in which a particular gene expression can be suppressed using several non-coding RNAs like miRNA, siRNA etc. These non-coding RNAs binds to their target mRNA in sequence specific manner in association with argonaute protein from RISC complex and cleaves the mRNA inhibiting protein expression.

RNAi reduces the expression of the gene at the mRNA level so it is knockdown while CRISPR silences the gene expression permanently at the DNA level so it is knockout. One of the biggest drawback of RNA silencing is its non-specificity or high off target effects which can be detrimental to the organism. While controlling the design of guide RNA, CRISPR shows fewer off target effects.

This technique is now being explored widely in treating various diseases like sickle cell anemia, cystic fibrosis, cancer, heart diseases and many more. Not only this, CRISPR technology is also used in the food and agricultural industries to vaccinate industrial culture like yogurt against several viruses. It has been used in agriculture to improve the crop yield and enhance nutritional properties.

The CRISPR Era:

Introducing CRISPR-Cas9 genome editing tool has widely enhanced the efficiency and simplicity in the field of genome engineering. Further advancements in this field and development of high quality synthetic guide RNA has further simplified the CRISPR

experiments. The accelerating research in this field are providing us more precise and accurate genome editing technologies like never before.

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2. Women in Science

Koyel Ray, B.Sc. (H) Biomedical Science, III Year

As gender-oriented, as it may sound, it is still one of the fields that need attention, encouragement and participation. Science is a combination of a pinch of intellect with lots of experience, practical implementations and observations. It should have been an arena independent of gender where only the ideas and skills of individuals should have clashed to bring out the best. Instead, people took so long to decide whether they should "allow" women to enter this field, let alone hear out their ideas.

Although, since ancient times women have been participating and contributing to science, their acceptance amongst a male-dominant society has always been a fight song whose lyrics are hummed every now and then by the new female aspirants who have a passion for science and know no boundaries. Since the earliest, some of the many women contributing to science and becoming role models for the mass are;

Caroline Herschel (1750 – 1848): She was more of a household drudge to her parents and it was not until her brother, William, who switched careers, that she engrossed herself in astronomy and became one of the best of her time. She discovered many nebulae and star-clusters and was the first woman to discover a comet and have her work published by the

Royal Society. She was also the first British woman to get paid for her scientific work (after her brother discovered Uranus in 1781).

Mary Anning (1799 – 1847): In 1811, she along with her brother discovered what they thought were crocodile bones at the seaside cliff, near their home in England, which later were found to belong to Ichthyosaurus, the "fish-lizard." Mary's career paved towards fossil hunting which included the discovery of long-necked plesiosaurs, a pterodactyl and numerous other fossils that helped the scientists get a picture of the marine world 200 million years ago during the Jurassic. She even taught herself anatomy, geology, palaeontology and scientific illustrations. Such was her passion for science.

Mary Somerville (1780 – 1872): At the age of 14, she defied her father's injunctions and indulged herself in the study of algebra and mathematics. Her studies were side tracked by marriage, but she soon resumed it. Later, she started experimenting on magnetism to produce a series of writings on astronomy, physics and mathematics. Astronomer Pierre-Simon Laplace's 'The Mechanism of the Heavens' was translated into English by her. Even though she found her results to be unsatisfactory, she was one of the first two women to be recognized as an honorary member of the Royal Astronomical Society, along with Caroline Herschel.

Lise Meitner (1878 – 1968): She was barred from higher education, as were the other girls in Austria. But when she turned 21 and was finally allowed into Austrian Universities, she became an expert in maths and physics earning her doctorate in 1906. She then collaborated with Otto Hahn and discovered the phenomenon called 'nuclear fission'. Her partner got the Nobel Prize in 1944 but she was overlooked by the Nobel Committee for the same because of her gender.

Marie Curie (1864 – 1934): Even though she wasn't the first female to get absorbed by science but when it comes to women and science, she dominates the field. Her work basically revolved around radioactive elements and she was bestowed upon by numerous awards for the same. She was the first woman to be awarded half of the Nobel Prize for Physics in 1903,

for their study on spontaneous radiation discovered by Becquerel (who was awarded the other half). And she also became the first person to receive a second Nobel Prize in 1911 in Chemistry, this time for recognition of her work in radioactivity. The two new radioactive elements discovered during Curie's work are radium (named after the Latin word for ray) and polonium (name after Marie's home country, Poland).

Even now, "metaphors such as 'glass ceiling', 'sticky floor', or 'leaky pipeline' are used to describe the reducing presence of women as they move up on the science career graph"

(Charu Malhotra, November 2018). But defying these societal barriers, women are continuing to move forward whose recent instances include some of the revolutionary work of women in STEM (Science, Technology, Engineering, and Mathematics)-

Dr. VR Lalithambika: One of the most crucial minds behind the project of Gaganyaan, ISRO (Which plans to send humans to space) is of Control Engineer Dr. VR Lalithambika.

Dr. Sanghamitra Bandyopadhyay: She is the first female director of the Indian Statistical Institute (ISI). Her excellence in computational biology, bioinformatics, data-mining, and general administration is commendable. She has earned herself a global recognition in science and research having worked in universities and institutions with over 300 research articles published in international journals. "Her most remarkable discoveries include a genetic marker for breast cancer, determination of co-occurrence of HIV and cancers and the role of white matter in Alzheimer's disease."- (Anoushka, 2018). She was awarded The World Academy of Sciences, 2018(TAWS) prize in Engineering Sciences.

Dr. Nimmi Ramanujam: She is an Indian-American and is a professor of Biomedical Engineering at Duke University. Her research revolves around establishing innovative and cheap technology-based solutions for the rising cervical and breast cancers affecting millions worldwide. In December 2019, she completed the invention of such a diagnostic tool that would detect cervical cancer in women without causing any pain. The tool is called "Pocket Colposcope" and has undergone successful screening in AIIMS, New Delhi. It's compact and simple and can be connected to laptops or phones to carry out an easy self-screening.

Kavya Kopparapu: Using her intelligence and creativity, she designed programs called GLIOVISION and EYEAGNOSIS to visualize molecular and genetic identity of brain tumors and to automatically screen for diabetic retinopathy using smartphones, respectively. Hence, she was named one of the 25 Most Influential Teens of 2018 in the TIME Magazine.

They are just some of the many women coming forth to join hands for a better tomorrow. A tomorrow with gender equality, with equal opportunity and recognition. Still now, "the proportion of male students opting for science and engineering is much higher than that of females. Globally, one in five men graduates in engineering and one in nine graduates in science. The corresponding figures for women are one in twenty and one in fourteen"– (Charu Malhotra, November 2018).

The gap, no doubt, has reduced with time and awareness but is yet to be sealed. We can't let either half of the population live under negligence or ignorance. Both halves need to be in balance to develop a world worth living.

3. Lifestyle Influences on the Occurrence of Chronic Diseases

Kanika Bhatia, B.Sc. (H) Biomedical Science, III Year

As westernization grew over India, a new trend of diseases surfaced. These included chronic diseases like Cardiovascular Disease, Type-2 Diabetes, Cancer etc. and the lifestyle factors that manifest them included smoking, deleterious diet (red meat, fried and grilled food, excessive sugar), lack of physical activity, environmental pollutants (air, soil, water), stress, alcohol, sun exposure etc. These diseases have been marked as "Lifestyle Influenced" as they aren't specific to populations based on their demography but to a population with sedentary lifestyle. Many studies have estimated that by the year 2030, chronic diseases that are influenced by lifestyle, would be the prevalent cause of mortality. Along with this knowledge, many studies also predicted that 80% of the diseases can be prevented with certain lifestyle modifications.

Gut microbiome links a poor diet with the increased risk of chronic diseases like Cardiovascular diseases. Even the slightest dietary modification can lead to alteration in gut's

micro-biotic environment. Many factors like inflammation, stress, inadequate diet and stress can lead to changes in the microbiome known as **Dysbiosis,** imbalance in the microbial sub populations. For example, excessive consumption of red meat leads to higher risk of cardiovascular diseases. This was believed to have occurred due to excessive trans and saturated fats present in the meat but now is seen to be linked to changes in gut microflora. As a person consumes red meat, the microflora subpopulation that helps in its digestion increase in number. Through various studies it has been seen in humans that animal protein consumption leads to increased populations of ***Bacteroides, Alistipes, Bilophila*** and ***Ruminococus.*** These bacterial species break down phosphatidyl choline, L-carnitine and choline rich foods like meat, poultry including eggs, fish, dairy products which leads to the formation of **trimethylamine** (TMA). This is absorbed into the blood stream from the gut and is acted upon by hepatic flavin monooxygenases (FMO3) leading to the formation of **trimethylamine N-oxide** (TMAO). It has been seen that TMAO has atherogenic effects; meaning that it promotes the formation of fatty plaques in the arteries by altering cholesterol and bile acid metabolism as well as the activation of inflammatory responses and foam cell formation. Foam cells are formed when oxidised LDL stimulates the migration of WBCs in the artery and then the macrophages engulf the oxidised LDL particles, giving them a foamy appearance. These foam cells when die off, release their contents and with time the accumulation of LDL and cell fragments leads to plaque formation.

Type 2 Diabetes has also been associated as an inflammatory disorder in which the inflammatory response is caused by lipid depositions in pancreas and liver which leads to beta cell dysfunction and insulin resistance. A diet rich in fibre leads to decrease in such inflammatory processes via the action of gut microbiome. These microbes aid to host's health by synthesizing vitamins and many essential amino acids and by-products. One such by-product is **Short Chain Fatty Acids** (SCFA) like butyrate, propionate, acetate etc strengthen the mucosal wall by providing to the intestinal epithelia. They also reduce pro-inflammatory production of cytokines and T-cell function by regulating gene expression. SCFAs play a significant role in Type 2 Diabetes, with decrease in the bacterial species that produce them leads to enhanced inflammatory response as well as decreased inhibition of glucagon via glucagon like peptide 1 synthesis which is regulated by SCFAs. Another way by which the

gut microbiota regulates Type 2 Diabetes is through the break-down of bile acids. Gut microbes like *Clostridium sp.* convert bile acids to secondary bile acids like deoxycholic acid that regulate glucose metabolism by acting as signalling molecules and receptor ligands which leads to activation/deactivation of enzymes in cells. For example, bile acids suppress the expression of fructose-1,6-bisphosphatase and glucose-6-phosphatase in cells. Type 2 Diabetes and obesity are also linked with breast cancer as excessive fat tissue can store estradiol that contributes to aggressive breast tissue formation and hence malignancies. Dysbiosis also promotes estrogen cycling in the enterohepatic circulation leading to its accumulation.

The ideal diet that promotes the production of SCFAs by increasing *Bifidobacterium* and *Lactobacillus*is a plant-based diet (vegan diet)and a Mediterranean diet rich in mono and polyunsaturated fatty acids, fibre, polyphenols and antioxidants, plant-based protein and low in carbohydrates and dairy products. Along with an adequate diet, physical activity lead to lower fat accumulation after higher calorie intake helping in maintaining a healthy weight and reducing the risk of chronic diseases. Hence lifestyle interventions are necessary not only to prevent but also cure most chronic diseases in this health care crisis.

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4. Algae Producing Oxygen inside Blood Vessels: A new Transport Facility for Oxygen Indebt Cells

Prachi Khattar & Samridhi Didwania, B.Sc. (H) Biomedical Science, III Year

It may sound very weird, but it is true! The very same alga that forms algal blooms and cause eutrophication can serve as an oxygen factory inside the blood vessels. Recently it has been reported that algae living inside tadpole blood vessels supplies oxygen to oxygen- starved nerve cells.

The researchers from Ludwig Maximilian University of Munich showed during a conference of the Society for Neuroscience held in Chicago on the 19 to 23 October 2019 have claimed that green algae and cyanobacteria can act as oxygen producing machinery inside blood vessels and brain nerves when exposed to light. Cyanobacteria also called blue-green algae are a phylum consisting of free –living bacteria that can perform photosynthesis. They are known to be an important element for forming the earth's oxygen rich atmosphere.

Before this idea of using algae, the researchers were busy in bubbling oxygen into severed tadpole heads to keep their neurons active. Later, they came up with this idea of using blue-green alga and green alga. The team led by neurologist Hans Straka and his student Susan Özugur and others working on Sensory Motor Transformation, found that green algae *Chlamydomonas reinhardtii* and *Cyanobacteria Synechocystis* can act as oxygen supplying agent inside blood vessels of tadpoles of *Xenopus laevis*. These algae being light sensitive photosynthesizing algae so they perform oxygenic photosynthesis during the light period and

oxidative phosphorylation during dark periods. This expression is regulated by circadian rhythm. This single celled organism is injected and moves in the body of the tadpole through the blood vessel.

Chlamydomonas reinhardtii for decades has been used as a model organism in the study of eukaryotic cilia. It is great if it can be used as a treatment for patients with cardiovascular problems. This alga has hydroxyproline rich glycoproteinaceous cell wall with a large chloroplast, pyrenoid and an eyespot that is responsible for sensing light. Their ability to grow under wide range of environmental conditions such as temperature ranging from 15°C-37°C and pH range from 5-8 may help it to flourish inside blood vessels. *Synechocystis* sub strains are also used as model organisms for studies related to stress physiology and development of sustainable biotechnological applications.

'In the beginning, it sounds really funny'. 'But it works, so why not? I think it has great potential, said researcher Suzan Özugur. Neurobiologist Hans Straka along with his team had this eccentric idea to use green algae to produce oxygen. He said 'I wouldn't call it crazy, but unconventional, let's say,' admits the scientist.

Researchers took Tadpole heads and inserted single celled green algae or cyanobacteria to the latter's blood vessels. They started depleting oxygen levels in the water where tadpoles were growing just to check the oxygen producing capacity of green algae. The observation they saw was ground breaking. They concluded, when the light strikes on the tadpoles, the algae starts to send signals to the eye neurons. Consecutively When the exposure to light was reduced, the eye neurons stopped firing signals to the tadpole head and fell silent, the researchers claimed. The thing that remains unclear is whether one would call this relationship as symbiotic or just commensalism.

The algae appear slimy green in tadpole's translucent body and hence they were called Frankenstein tadpoles referencing Victor Frankenstein and his green monster, the characters from the novel by the name Frankenstein by Mary Shelley. It's not clear how long the algae would survive inside blood vessels and how humans will adjust with the algae in their blood vessels or even whether this procedure would work in humans.

According to Straka and his team, 'they are investigating the further uses of their discovery. They want to know the algae can perform other functions in the body like providing neurons with glucose or changing the cell's behavior or acting as an influencer to the neurons.

Kathleen Cullen, a neuroscientist from John Hopkins University, said, 'this study motivates further exploration of unconventional approaches to advance treatments for brain hypoxia, including stroke.' However, according to him, till now this discovery is unlikely to be used in the clinic.

The discovery can lead to the development of new therapies to fight strokes or other damage of the neural tissue caused by hypoxia. As for more futuristic and ambitious possibilities, algae could be injected into astronauts' veins on long-term space expeditions. However, not every astronaut is going to tolerate the green color. Not only this the alga-based treatment can be used to cure limb amputation i.e. a surgical procedure of removing all or some part of limb. It is done in patients with critical limb ischemia.

It's not clear what the mechanism of action of such a discovery is. Although this might help in understanding brain hypoxia better and might acts cure for neural tissue damage. In the treatment of cardiovascular diseases like stroke, coronary artery disease, arterial gas embolism and atherosclerosis can be treated using this as a therapy.

However, some topics remain unanswered. For example, till now no one has discussed about the possible risks that can occur on introducing foreign organisms like algae into the bloodstream. It may cause harm in the future by causing blood clots by growth, death or unexpected clumping or other unforeseen reasons. What could be the body's immune system response on introducing alga? There are possible reasons that some people may also show allergic responses.

Thus, this discovery will take a long time to become an effective clinical treatment.

5. Avian Influenza Type A(H7N9) Virus Infection

Dipesh Talukdar, B.Sc. (H) Biomedical Science, II Year

Influenza, commonly known as the flu, is a viral infection caused by influenza virus. It may not sound as an alarming problem to deal with, but lack of prevention and treatment can be deadly especially among high-risk groups. The mode of infection is either through air or

direct contact, due to which the flu virus mostly attacks respiratory parts such as lungs, throat, trachea, etc. The infection is not confined to any group of people. It mainly affects the individuals with weak immune system.

As the term "Avian" which means "birds or a bird", Avian Influenza refers to the infection of birds with the influenza virus. Among 3 types (A, B, C), Type A refers to one of the major strains of Influenza virus. In H7N9, H refers to "Hemagglutinin" and N refers to "Neuraminidase". These are the surface proteins present on the virus which helps in infection progression. The virus attaches to the host cell by interacting with the cell receptor with hemagglutinin present on their surface. Furthermore, neuraminidase removes the interaction allowing detachment, multiplication of viral particles. There are 18 and 11 different subtypes of hemagglutinin and neuraminidase, H1 to H18 and N1 to N11 respectively.

As mentioned above, avian influenza mainly affects poultry birds and wild birds such as fouls, goose, gulls, swans, etc. The infection was first seen in wild birds and then in poultry birds which suggested that the disease is contagious among birds and can spread from their droppings and direct contact with one another.

During 2013, the World Health Organization (WHO) reported that the Avian influenza virus has not infected a single human until the first case was found on March 13, in China. This gave rise to an Asian Lineage of the virus called Avian Influenza A(H7N9) virus or Asian H7N9 virus. It is extremely rare when there is a human-to-human infection reported as most of the population receive the virus from their poultry farms and animals. Usually mutations in viral protein causes a human infection which is why it is more fatal than ever. Ever since the first reported case, the World Health Organization (WHO) reported 766 human infections with the Asian H7N9 virus and through December 16, 2018, the reported cases rose to 1579, making it the largest epidemic of H7N9 in 2018.

The common symptoms of the infection include; Cough, diarrhea, fever, muscle aches, respiratory problems, runny nose. Currently, there is no public vaccine available for H7N9 but certain existing classes of antiviral drugs can be administered which are euraminidase inhibitors.

The preventive measures include eating fully cooked food especially poultry products such as meat. Hand washing should be done every time before eating and after direct contact including handshaking. These measures should be followed strictly if you're in the quarantine zone.

And as the old saying goes "Prevention is better than cure".

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6. Cancer immunotherapy and a new T cell discovery!

Sudeepta Singh, B.Sc. (H) Biomedical Science, II Year

Our immune system is like that of an army protecting us from various invaders. The army has two major commanders or army chiefs known as – Innate immunity and Adaptive immunity that are assisted by both the Generals named Humoral immunity as well as Cell-mediated immunity.

The layered defences of our immune system protect us from various infectious agents and can very well distinguish between self and non-self cells. Surface barriers such as skin act as the first line of defence comparable to the army brigade on the country borders. The Innate immunity commander identifies the non-self molecules by Pattern recognition receptors (PRRs). PRPs are basically the proteins expressed by the immune cells such as macrophages, monocytes, dendritic cells etc. that can identify two types of intruders- PAMPs (Pathogen associated molecular pattern) and DAMPs (Damage associated molecular pattern). The Adaptive immunity commander brings about a stronger response and memory power. Lymphocytes (B cells and T cells) can be thought of as the main captions-in-charge under the Adaptive immunity. While B cells participate in humoral immune response, T-cells work for cell-mediated immunity. The T cells have different battalions of killer (cytotoxic) cells

(recognize MHC I molecules), helper cells (recognize MHC II molecules) and regulatory cells. The B cells, on the other hand, produce antibodies against specific epitopes on the antigens.

Immune surveillance is an important role of the army that is to identify and eliminate tumors. The tumor cells have transformed antigens either TSA (tumor specific antigen) or TAA (tumor associated antigen). TSA occurs only in cancer cells however, TAA is present in healthy cells but differs in concentration, place or perhaps time period of expression in tumor cells. Cancer immunoediting is the way in which the immune system army fights with tumor cells.

Cancer immunotherapy has been developed in the past few years to stimulate the immune cells to destroy the tumor cells. As of now, CAR (Chimeric Antigen Receptor) T-cell therapy [2] is used as a weapon to fight tumor as it helps the immune system to focus on tumor cells sparing the normal ones. This immunotherapy aims at genetically modifying the patient's T cells to express a CAR for some particular tumor antigen and reinfusing them back to the patient. The T cell can be genetically modified done through viral-based transfer of, using transposons, by CRISPR/Cas9 technology or even via the direct transfer of mRNA by electroporation. The CARs recognize unprocessed antigens without the prerequisite antigen presentation through MHC in contrast to the normal T cell receptors. The technique uses a TCR called Human Leukocyte Antigen (HLA) that enables the T cell to detect tumor cells. [2]

The CAR T-cell immunotherapy is personalized for each patient because the HLA varies among individuals that increases the cost and complexity of treatment. Also, this therapy can only target a few types of cancers only and is not successful in case of solid tumors. Many other limitations and side-effects of this therapy are also seen. [1]

Perhaps these limitations paved a way for a new T cell to be discovered!

A novel killer T cell has been identified as having the potential for universal cancer therapy that means it can cure a variety of cancers such as blood, skin, ovarian, breast, bone, cervical cancer, etc. The researchers at Cardiff University, Cardiff, UK used genome-wide CRISPR/Cas9 screening and came across a T cell receptor (TCR) that recognized and killed various types of tumor cells through the monomorphic class I MHC protein, MR1, while remaining inert to noncancerous cells. This is a Human leukocyte antigen (HLA)-

independent targeting of tumor cells. In an experiment, a MR1 restricted the T cell clone mediated in vivo regression of leukaemia and it conferred an enhanced survival of the mice. The MR1 associated ligand is targeted by a MC.7.G5 T cell receptor that seems to be part of a pathway essential for the basic survival of tumor cells. The MC.7.G5 receptor doesn't respond to non-cancerous cells and developed no pathology as such in the healthy donor cells that it was grown from. [3]

Thus, the MC.7.G5 TCR can identify diverse types of cancer irrespective of HLA and thereby, serves to be an opportunistic approach for treatment of pan-cancer, and pan-population T cell mediated immunotherapy. In future, discovery of MR1-restricted ligands that MC.7.G5-like T cells can recognize will further open up new possibilities for cancer cure in all individuals. [3]

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7. Antibacterial Drug Resistance: A Curse Evolved from Antibiotics

K. Gautam, B.Sc. (H) Biomedical Science, III Year

For a surgeon, performing major surgery without an antibiotic is simply a nightmare. Your cut-open body will be exposed to a wide variety of opportunistic microorganisms ready to infect your body. It's not only about the surgery but treating the bacterial infection, bone marrow transplantation and other chronic diseases, all require antibiotics. Even Alexander Flemming wouldn't have known that he has made a revolution in the field of medicine by discovering the first antibiotic drug, Penicillin. Since then people have tried multiple ways like natural fermentation, semi-synthetic and synthetic methods to obtain new antibiotics

(both broad and narrow spectrum) to treat multiple infections and enhancing average life expectancy.

But the good days were short-lived since a phenomenon called Antimicrobial resistance (AMR) began to develop. AMR was like Armor for the microbes. For instance, bacteria that were once sensitive to an antibiotic can now flourish in that antibiotic itself, i.e., they developed resistance which forced the physicians to increase the dose of antibiotics that were initially prescribed. And when the entire bacterial population were found to become unresponsive to an antibiotic, we had to find a new one to treat the infection. Finding a suitable antibiotic that has specific toxicity to infectious microorganism and not to the normal flora of humans is no joke. Just simply imagine what would happen if this AMR kept growing? We will run out of antibiotics soon and it will be the same as pre-antibiotic era when average life expectancy was 50.

But where did this AMR came from? How does it function? What is the solution to this?

AMR arose because of us. Yes, AMR developed because of our careless use of antibiotics. The duration of the prescription given by your doctor has much importance. It is necessary to complete your course of antibiotics which ensures that the pathogen is killed. An uncompleted course results in survival of a small population of bacteria that has gained exposure to the antibiotic and is developing ways to resist it. With time, these cells grow and cause a relapse infection, but this time it can't be treated using standard antibiotics.

There are several other ways via which we allow antibiotic exposed microbes to survive and thus develop AMR, for instance, by:

- Discarding the antibiotics in the environment
- Taking a suboptimal dose of antibiotic which does not kill the pathogen
- Exposing the same antibiotic to the bacteria at non-lethal doses for a longer period of time.

How microorganisms develop AMR?

1) Changing the target site – Every antibiotic is made to bind to a specific molecule in the pathogen to perform its action. By accumulating selective mutations, microorganisms

2) Change their target molecule sequence such that the antibiotic can no longer bind to that site.
3) Changing the metabolic pathway itself – For e.g., antibiotic like sulfonamide inhibit the folic acid synthesis pathway in the bacteria but some strains of Bacillus have already switched to an alternate pathway to escape from the drug.
4) Throwing out the drug from the cell – Microorganisms have cleverly developed efflux pumps that pump out any incoming antibiotic. The similar mechanism is utilized by cancer cells to resist cytotoxic drugs.
5) Breaking apart the antibiotic – Certain bacterial enzymes can metabolize the incoming drug and making it inactive. A popular example being the β-Lactamase enzymes which cleave the penicillin before it could do its job.

To measure how powerful can the AMR be, scientists at Harvard University conducted an experiment with E.coli by exposing it to a plate with gradient of antibiotic dose (no antibiotic at both edges of the plate and maximal concentration at the center) and recorded the video. E.coli was applied on the side of the plate with no antibiotic and was allowed to grow. It just took 10 days for the bacteria to reach the center plate from the sides. This shows how quickly a microorganism can find methods to devise resistance and how catastrophic this could be at a global level.

With that being said, not all hope is lost to control AMR. We can follow following preventive strategies to minimalize AMR development in microbes:

- Antibiotics should be used when absolutely necessary. Use antibiotic that is specific to that bacteria.
- Complete your prescribed course of medicine.
- Maintain hygiene to avoid infections.
- Controlled use of antibiotics in poultry and cattle farming
- Create public awareness about AMR and the careful use of antibiotics.

The fight between bacteria and antibiotics will continue. As bacteria become resistant we have to continue finding new antibiotics or mend our ways.

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8. Immunotherapy

Purva, B.Sc. (H) Biomedical Science, III Year

Immunotherapy is the treatment based on immune system of body. In simple words, immunotherapy means utilizing body's immune system for treatment of a disease mainly cancer. Few years back, cancer treatment was based on chemotherapy, radiotherapy and involved surgical treatments. All of these are exorbitant and have enormous side effects. Also there are high chances of recurrence. But now trends have changed, scientists have discovered ways to activate the immune system in such a way that it acts specifically on the cells that have lost contact inhibition property. As in the case of cancer, James P Allison and Tasuku Honjo found a way to activate T helper cells which eventually killed the cancer cells and for this, they were awarded Nobel Prize in medicine in the year: 2018. Since then, there has been a significant boost in the field of immunotherapy.

Recently a group of scientists found - T cells could potentially kill different types of cancer cells in the laboratory such as breast and lung cancer cells. Doctors nowadays prefer immunotherapy with other cancer treatments. It is no wonder if your doctor tells you to rely on immunotherapy alone. In 2019, nobel prize in medicine was awarded for the mechanism for hypoxic environment in the cancer cells. HAF and HIf are responsible for the same and it has been found that these factors also play important role in Th17 cell proliferation; thus having potent anticancer activity. Thus, immunotherapy promises an effective cure to cancer. However, much remains to be studied and interpreted to make immunotherapy an absolute cure.

9. Being Aware of AMR

Ashwin Uday, B.Sc. (H) Biomedical Science, III Year

AMR stands for Anti-microbial resistance. This is a condition where bacteria are not killed by the antibiotics we consume to cure diseases which leads to the persistence of the disease for long and even mild diseases becoming life-threatening in nature. This happens because the bacteria intelligently find way to evade the attack of the antibiotics and survive, thus causing infections.

Earlier this condition did not prevail, but as the use of the antibiotics increased, slowly the bacteria evolved to possess various mechanisms which will help it overcome the antibiotic attack, like – modifying the drug target on the bacterial outer surface, not allowing the drugs to get into the bacterial cell, pumping it out if it gets in etc. AMR is still growing, more and more pathogens (bacteria causing the diseases) are becoming resistant to antibiotics. The scientific world is continuously making relentless efforts in fighting AMR, in terms of new drugs, alternate ways to kill the bacteria, finding newer healthcare solutions for patients suffering etc. But the common man, unknowingly is adding to the problems and sometimes even the learned ones do.

Emergence of AMR is a natural process but it is important for us to know that our actions aggravate the rate of development of AMR and it is again in our hands to reduce its progression. There are certain practices listed below which can help in overcoming this:

- **Self-medication should be stopped** i.e.; no medicine should be used without the prescription of a qualified physician. E.g. people have the habit of taking drugs like 'amoxin' and all, for the slightest of infections.
- **Medication should be taken for the complete duration** as prescribed by the physician i.e., if a drug is mentioned to be taken for 6 days, the patient should properly take it for 6 days and then visit the physician. And not stop using the medicine before halfway on reduction of the symptoms like fever and pain.
- Also **medication should not be continued for longer** than the prescribed period without consultation.

- If a symptom similar to the one observed in the past in case of a patient is seen again, the same medication should not be started immediately without consultation, because this time the symptom maybe due to some other disease in the body or maybe a different drug dose is required this time, which only the physician can decide.
- **Old medicines should not be thrown out open from the packaging into garbage or sewer**, the old medicines still have effect just that they are not consumable for humans. This will cause the bacteria in the surroundings to get slowly resistant and increased chances of we getting affected by the disease.
- Most importantly **keep personal hygiene** to reduce the occurrence of infections.

If we can follow these and start paying attention, everyone can make small contributions to save ourselves form AMR issues which quite threatens us. All those who read this please try and share the knowledge gained here so that more people know and we are finally 'Aware of AMR'.

10. The Upcoming Decade for Biomedical Research in India

Rohit R. Gokhale, B.Sc. (H) Biomedical Science, II Year

Stepping into a new year and entering the next decade is often accompanied by motivation, dedication and fervor - besides, of course, the hunger to work hard. The gusto with which biomedical researchers in India are working towards finding solutions to some of the most complex biological problems is truly inspiring. The research fraternity has been taking new strides forward every day and the energy with which they have entered this new decade has set the tone for the nation. 2020 is the "Year of the Rat" as per the Chinese calendar and we have every reason to be excited. While we may be using mice as model organisms in the lab, not all people accurately differentiate between a mouse and a rat – since in Hindi, we call either of them a "chuha". Hence, the optimistic researchers will always want to believe that this is their year to shoot for the stars- putting in the efforts on those mice in their labs! Positive energy like this has already given biomedical research a great start and it remains to be seen how far it propels us in this decade and beyond - towards a better tomorrow!

While astrology and calendar years may not always be very accurate markers to define the future, the onus of taking biomedical science to the next level is on the research community and other supporting bodies. India missed the bus in the last decade to be an active part of the revolutionary Human Genome Project but since then, Indian science has been gathering pace and we, as the future stakeholders will work to keep the graph going skywards.

An interesting fact about biomedical research is that one of the most captivating prospects also happens to be the biggest challenge. Drug development- a fundamental aim of biomedicine which involves creating new drugs to combat diseases, continues to be the epicenter of modern-day research while offering its own set of complexities. The race between new drug molecules and rapidly arising superbugs seems to be heating up faster than ever - directly putting us at loggerheads with the power of nature's evolutionary forces. In this era of biotechnology and omics techniques, designing therapeutic agents is as critical as their sustainable usage. While already facing an uphill task to compete with nature, fighting a two front war due to drug resistance caused by callous usage of these therapeutics coupled with high mutagenicity rates of the pathogens could be catastrophic!

Recent occurrences of the outbreaks of Corona virus in Wuhan, Nipah virus in Kerala and Ebola virus in Western Africa - all reminds the world the massive role biomedical science plays in the background. Deadly diseases like these can only be fought against with highly specialized chemotherapeutic agents which come into the market only after several years of research and testing. Though at present, we may have the required ammunition against these maladies, can we overtake nature in its course of evolution and eradicate such diseases is what the biggest question of this decade and the coming age is. Epidemics like these severely disrupt the lives of people as can be seen from the extreme measure taken in Wuhan to cut-off the city from the rest of the world – with all 11 billion people to stay indoors in a bid to stop the spread of the pernicious corona virus. Finding medicines can certainly revolutionize humanity but it is a game against all odds – where the challenges create prospects and the prospects in turn unearth newer challenges.

To continue our efforts, the government must be urged to provide adequate funding and allocate a larger portion of the budget for scientific research. A fund crunch will not help the ambitions of our nation at a time when we are aiming to broaden the horizons and make advancements in biomedicine. It is imperative to have proper systems in place that allow

maximal utilization of the supremely talented pool of individuals that our country possesses. Tweaking rules to create avenues for bio-entrepreneurship will certainly open doors to a new world; providing an impetus for our field besides having a positive impact on the country's economy.

The highlight of recent days has been the success of ISRO and the widespread documentation reports based on it have been viewed by all. "Spotlight incidences" like this will be hugely beneficial for research, because this great feat narrated to the common man what research feels like and what it is all about. Herd mentality in our society has ensured that every student who wishes to study science is shown only two routes - engineering and medical.

This can also in part be attributed to the fact that not everybody is aware of what a scientist really does! The work that an engineer or a doctor does is known by the young student, but he/she is simply unaware of what research is all about. Hence, it is important to popularize science as a career amongst the younger generation and bring in talent which can drive biomedical research in India. Keeping in mind the recent developments, it can be said that we are pivoting in the correct direction.

This decade marked by the year 2020 will be seen becoming like an unpredictable 20-20 cricket match - with all the countries in the world giving their best to stay ahead in the mercurial race for high quality research. It is this competitiveness that extracts the best out of people and will hopefully carve out transforming technologies in biomedicine and biotechnology besides further unraveling the mysteries of life. With a conducive atmosphere and a supportive ecosystem in place, it can be confidently said that India is up for the challenge and the upcoming decade is going to be exhilarating for biomedical research in India.

11. Prospects and Challenges of Biomedical Science and Research

Mansi Arora, B.Sc. (H) Biomedical Science, II Year

Biomedical Science is the Science of Living beings, the causes, harms, and treatment of diseases that affect living beings. This field provides numerous opportunities to the students.

Many students every year get jobs in pharmaceutical and biotechnology related companies. Few students opt for the career of a lecturer in colleges.

Academic jobs most give the person a capacity or scope for negotiation or operation especially in order to modify previous researches obtained through discussing, arguing and criticizing in various scientific talks, seminars and various conferences. IPR nowadays is the growing field that protects the inventions of human brain. Few biomedical science students every year opt for this career option as well.

Those who follow apostate career paths, opt for Science Journalism. It involves reporting about Science to public. In this, the scientists, journalists and public interact then the journalists present the articles in a way that even non-scientists can understand. It is obviously a very rewarding career because the trained person in this field can save number of lives. It was rightly said that the "next to creating a life the supreme thing a man can do is to save one".

Curing the sick and saving lives by discovery of own is a kind of activity that cannot be matched or measured by money or anything in kind. Researchers many times have to stay at their labs for long working hours which definitely affects their social life but success comes only after sacrifices. In this particular field where, hard work always pays off, few sacrifices are worth doing.

12. Microglia: Dynamic Surveillance on Action

Chandan Kumar Rajak (II year), B.Sc. (H) Biomedical Science, II Year

The evolution of present-day *Homo sapiens* from his ancestor has been a remarkable and exceptionally systematic form of evolutionary gift of nature. While during the journey of evolution it was the mental and brain development which paved a way for physical, behavioural and social changes within the mankind. Each evolved stage of human development has shown tremendous increase in the amount of brain activity in terms of their cranial capacity and cognition. The evolutionary development of hominid brain has enabled the organisms to make and use tools, invent languages and use them for communication; develop culture, societal settlement, self-consciousness and creativity. In other words, it

won't be incorrect to quote that evolution of brain has shaped the evolutionary analysis of humans. Brain is a complex casket of diverse information which holds all the answer of an organism's existence. But what happens if the brain itself starts to degenerate its efficiency and lead the man towards his death bed?

Neurodegenerative disorders are one such category of brain disorder which accounts for degeneration of brain cells due to some disrupted biochemically induced pathological abnormalities. Alzheimer's disease (AD), Parkinson's disease (PD), Huntington disease (HD), Prions disease, Frontotemporal lobar dementia (FTLD), Autism are few examples of neurodegenerative disorders that largely affect individuals around the world. To fight with any kind of disease humans have a highly developed cellular defense mechanism which works by evading foreign antigen and maintaining cellular homeostasis. In our central nervous system, this responsibility is largely managed by resident brain macrophages, namely, microglial cells.

Microglial cells like other macrophages are specialized phagocytes that gets activated by a specific cascade of immune responses to protect the body against the invasion of foreign particle by eliminating them out of the system. It is associated with biochemically induced pathological significances of many neurodegenerative disorders like Parkinson's disease (PD), Alzheimer's disease (AD), stroke, spinal cord injury, encephalitis and Multiple Sclerosis (MS) to name a few. Microglia once stimulated by any immune response; tissue injury, trauma, pathogenic insult, it gets activated and its morphology changes from ramified/resting state to active state performing further destined phagocytic function.

They are also involved in clearing cellular debris and dead neurons from the nervous tissue through the process of phagocytosis, thereby acting as a key innate immune effector cells of the CNS. This cellular function of microglial cells is known to be very crucial for (a) neurogenesis, (b) clearance of apoptotic neuronal debris, (c) formation of dendritic spines, (d) synaptic pruning, and (e) in maintaining synaptic plasticity via the release of pro-inflammatory cytokines such as IL-1β, IL-6, TNF-α, IFN-γ. Secondarily, they mediate refinement of neural connections once they're established among neurons and also contribute in their formation and timely elimination in a healthy brain.

Microglia being part of our innate immune system acts as a key cellular mediator of neuroinflammatory responses. It shows a highly coordinated immune response mechanism when encountered with any foreign material. Its activation leads to the creation of a microbicidal milieu which kills the intruder by its high toxic secretions like ROS, RNS and mediates the destruction of the pathogen. Once the particle is phagocytosed, the microglia presents the antigen via major histocompatibility complex (MHC) class 2 molecules to the T helper cells, thus giving a 'find me/kill me' kind of molecular signal to activate an immune response. It is associated with biochemically induced pathological significances of many neurodegenerative disorders like Parkinson's disease (PD), Alzheimer's disease (AD), stroke, spinal cord injury, encephalitis and Multiple Sclerosis (MS) to name a few. Microglia once stimulated by any immune response including tissue injury, trauma, pathogenic insult, etc., gets activated and its morphology changes from ramified/resting state to active state performing further destined phagocytic function. Activation of microglia is a hallmark of neurodegenerative brain pathology.

Toll-like receptors (TLR) present on the surface of Microglia are also reported to mediate the link between inflammation and neurodegenerative diseases. TLRs are a family of large number of receptors activated by different pathogen-associated molecular patterns to initiate a signalling cascade that result in production of various pro-inflammatory mediators including and cyclooxygenase-2 and cytokines, thereby playing a critical role in innate immune response. Activation of TLRs could prove detrimental or beneficial to the host depending on the cells affected and duration for which immune system remains active. For instance, prolonged activation of TLR's on microglia can make it resistant to regulation and irresponsive to neural signalling, thus impairing its anti-inflammatory responses. These changes disrupt the delicate fine balance of coordination between the immune and nervous system. Hence the normal physiologic function of microglia holds a significant contribution in brain health disruption which may potentially lead to neurodegeneration and neuroinflammation.

13. An Outline of Biomedical Research

Muskan Gupta, B.Sc. (H) Biomedical Science, II Year

'EUREKA!'- A six letter word which drives us into the 250 BCE, when Archimedes gave the law of physics fundamental to fluid mechanics. In the backdrop of almost every scientific discovery, there is a researcher who works in their laboratory till late night, and then suddenly out of the blues, the mastermind strikes an apple to the head, a contaminated petri-plate, a lightning strike to a key. All these textbook tales captivates the inquisitiveness within an individual to do something innovative for the betterment of the human health and society.

Biomedical Research is a comprehensive field of science which aims at investigating biological systems through careful observation, experimentation, testing and analysis in order to discover ways of reforming the medical sector. At present, research is being elevated from 'Bench to Bedside' with more focus on translational research.

The prominent scientists and their remarkable discoveries in this field constitute the core of Biomedical Science. Since 1660s till now, a lot of serendipitous breakthroughs have been brought up and each invention acts as a bridge connecting many more. And this is what keeps us going!

From the introduction of the first viral vaccine by Edward Jenner, recognition of Gregor Mendel as the father of genetics, drafting of the Human Genome Project in 2001 to deciphering 'how cells sense and adapt to oxygen availability' by Nobel Laureates William Kaelin Jr., Peter J. Ratcliffe and Gregg L. Semenza, there have been a tremendous progress in expanding the horizons of Biomedical Science. But this is not the end. Vanguards of health care are working towards solving the complex puzzles of coronary artery disease (CAD), cancer, chronic obstructive pulmonary disorder (COPD), diabetes, Alzheimer's disease, tuberculosis and cirrhosis.

Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) is the most advanced and powerful gene-editing tool, which could be a potential solution to the biggest health threats like cancer, blood disorders, AIDS, cystic fibrosis and most inherited diseases.

The advent of gut microbiome research has uncovered ways of collaborating with microorganisms to treat diseases in humans. Also, the Human Microbiome Project (HMP) was an initiative launched in 2007 by National Institutes of Health (NIH) to refine the knowledge about the microflora's role in human health and disease. The NIH HMP points at the characterization of the microbiomes using multiple omics technologies.

Researchers across the globe are incorporating a combination of various scientific disciplines to derive a much more efficient healthcare unit as a whole. For instance, synthetic biology is one such field which involves redesigning organisms for useful purposes by engineering them to have new abilities; Nanotechnology deals with the atomic, molecular and macromolecular level to deliberately produce materials taking advantage of their enhanced properties.

Extending the vision of Biomedical Research to upcoming years, we can spot the gross intersection of Information technology and Medicine. After the launch of the first Fitbit in 2007, the fitness tracking wearables are quite common nowadays. Not only these devices, but flexible, electronic medical tattoos and stick-on sensors can take on electrocardiogram, measure respiratory rate, check blood sugar and transmit results seamlessly via Bluetooth. This convergence of IT and medicine will have good success rates because of the exponentially growing technologies such as Artificial Intelligence, Big Data Analysis and Genome Sequencing. Eventually, what the medical-technology can do in the future is far beyond this vision. This is just a glimpse of the revolutionising field of Biomedical Science.

14. Short Sleep Shorter Life

Ankita Paty, B.Sc. (H) Biomedical Science, I Year

In this 21st century where everyone is running around in the search of success and quotes like "You can Sleep when you are dead" are inspiration, sleep is the most ignored aspect of life. Sleep is medically defined as a naturally recurring state of mind and body characterised by reduced muscle and sensitive activity and inhibition of nearly all voluntary muscles during the rapid eye movement sleep. But we can understand sleep as a reboot button in humans that

restores all original settings, helps delete viruses, checks for malfunctioning and finally increases our efficiency to its peak.

But now let us know what not sleeping does to us. In a study by Matthew Walker, Professor of neuro science and psychology and his colleagues at university of California, Berkeley for 10 years or so there were many interesting findings.

In an experiment on a group of individuals they discovered the deprivation from a single night of sleep reduces memory by 40%. It was observed that that the memory compartment of brain – the hippocampus, shows no activity when we do not get enough sleep. This has been associated with the fact that during our deepest sleep our brain produces waves known as sleep spindles which act as a file transfer mechanism from short term memory to long term. These factors are now being articulated as one of the major causes of memory loss during aging and Alzheimer's.

In another global survey performed on 1.6 billion people twice a year it was found that the decrease of sleep by an hour in the spring increases the rate of heart attacks by 24% whereas an increase in sleep by one hour in the autumn decreases the rate of heart attack by 21%. This holds nearly same value for suicide rate and accidental deaths.

The WHO has now declared any form of night work as a probable carcinogen considering the fact that sleeping for 4 hours or less, even for a single night decreases the natural killer cell activity by an alarming 70%. Sleeping less for longer periods have also being linked to bowel, prostate and breast cancer.

Last and the most the most important loss that we are facing due to lack sleep is the change in our gene activity. It was found that in a group of individuals who slept for 6 hours a day for a week, nearly 711 genes showed distorted activities. In this 711, the genes controlling immune system lowered in their activity while those like tumour promoting genes, genes related with chronic inflammation and stress increased in their activity.

After knowing all this alarming findings and what lack of sleep can do us, we all must try our best to get the best sleep we can, in ways like being regular to bed, avoiding alcohol and caffeine and keeping away from electronic devices at the time of sleeping. Without the

stigma of being lazy let us all understand the necessity of sleep and hope that everyone sleeps well.

15. Introduction to Breast Cancer

Arpit Sharma, B.Sc. (H) Biomedical Science, II Year

In today's state of affair, breast cancer is the most common female cancer worldwide and cause approximately 15% of all cancer deaths among women according to world health organization (WHO). It develops either in duct or lobule of the breast.

Most of the breast cancer occurs due to mutation in BRCA gene. It is a type of gene which is expressed only in the cells of breast and acts as human tumor suppressor gene. There are two class of BRCA gene - BRCA1 and BRCA2. BRCA, which is also known as caretaker gene. It produces tumor suppressor protein that help in preventing cells of breast from growing and dividing too rapidly or in an uncontrolled pattern. BRCA1 protein is involved in damaged DNA repairing and mutation in this can lead to breast cancer.

Research tells that the BRCA1 protein also regulates the activity of other essential genes and plays an important role in embryonic development of human. BRCA1 and BRCA2 together work in a similar pathway of genome protection but both the proteins work at different stage in the DNA repair.

Types of breast cancer include invasive ductal carcinoma, metastatic breast cancer inflammatory breast cancer, and ductal carcinoma in situ. But the question arises how to detect cancer in early stages? Breast self-examination- It is a Screening technique which is used to check for breast lumps by the individual. If you find changes in size, shape, or symmetry, puckering, dimpling or inverted nipples than there may be chance that you have breast cancer, but it is less effective than other techniques which include mammography, clinical breast examination (CSE) and ultrasound. Some of the major risk factors for breast cancer are early menstruation, giving birth at older age, late menopause, start or previous case of breast cancer. But the good news is breast cancer survival rates are improving.

Reference

World health organization report on breast cancer- report of American cancer society on cancer statatics-2019

16. Prospects and Challenges of Biomedical Science and Research

Aastha, B.Sc. (H) Biomedical Science, II Year

Biomedical science which means science of humans, for humans and by humans. It emerged the day itself when the humans started to question the nature, the environment, in fact they themselves i.e. how they eat, sit, walk, smile, etc. This field of science had a great journey from louis Pasteur who created vaccine for rabies, anthrax, cholera; with successful stories of many eminent scientists till now, who worked really very hard to save millions of lives and are still working. There were many failures yet many successful stories too.

Basic sciences are the heart and use of that knowledge leads to creation of useful medicines like aspirin, quinine, acyclovir etc. It offers unlimited prospects to the newcomers; since a very large universe is left to be searched as a bit of it is discovered yet, but this bit comprises of thousands of successful research.

"Coin" the word immediately brings 'heads and tales' to our mind, its two faces; similarly, biomedical science also is accompanied with its prospects and challenges. Before I start to release dopamine into your heads by making you aware about its amazing prospects, I would like to first disclose the challenges which scientists of early times had faced and the challenges which still scientists are facing. In the time of Mendel when no one knew about chromosome, its structure at that time he gave his three laws, which became a steppingstone for a new field of science; GENETICS. He didn't have well sophisticated laboratories as we today have, but still he succeeded to give his theories by working in the garden which was at back of his church. Moving on to the arm-to-arm method of vaccination which involved greater risk of contamination, but today more sterile and safe syringes are used. Less infrastructure, less knowledge of microscope- electron microscopes, inability to see the cells at molecular level, even it was a big challenge to isolate a cell but as time passed advancement in physics and technology lead to a greater understanding of cell at protein,

nucleotide and gene level; now we have very safe methods to work in laboratories, but wait these are not 100 percent safe; still many scientists die due to cancers caused due to carcinogenic chemicals and the organisms which they are working with. Still there are many challenges like funding, acceptance of new research in our societies like faecal transplant for enhancing the gut microbiota and industries who work hard to bring drugs for those diseases which are common in their population and neglect those diseases which have low percentage of patients in their population. One of the major challenge which accounts for slow pace of growth of research is the lack of communication and discussion of ideas in our scientific community due to the competitiveness as everyone wants to be the first one to introduce and accomplish that idea into real terms in the society, but on the other hand it is a very important part of research(discussion) as it brings about growth in knowledge of all.

"Prospects in biomedical science" was the other side of the coin. Human body is very complex starting from brain to heart, liver to kidney. Brain is one of the complex structures where functions of various parts is yet to be known. Food that we eat influences our brain's activity as few researches have shown that eating junk foods causes shrink in hippocampus when compared to the people who had a healthy diet. Junk foods and heart diseases, cholesterol deposition in arteries and veins: atherosclerosis. Science has advanced to view the genes in the DNA, yet functions of many genes in human genome is unknown. CRISPR is one of the upcoming methods to either knock a gene or to activate/repress it. Many new drugs are being searched to fight against antibiotic resistance in bacteria and for those diseases which are newly introduces to us. Vaccines for Malaria and HIV are still a big challenge. Thus, there are many challenges and prospects in biomedical science and research from the field of immunology to genetics, from biotechnology to biochemistry, from cell to gene level. But the only need is of hardworking and questionable minds who can raise new questions and seek answers of them.

Poem

सफ़र मैं (RNA) से हम (DNA) का

Rishi Dev, B.Sc. (H) Biomedical Science, II Year

मैं समझता खदु को एक पौधा हूं,
तमु भी तो धपू सी लगती हो ।
अस्तित्व विहीन हूं मैं तेरे बग़ैर,
तमु संश्लेषण के लए ज़रूरी लगती हो, अब चाहता हूं मलके तमसे नए कुछ DNA रचित करूं,
मैं तो हूं Thymine जैसा,
तमु भी तो Adenine के जैसी लगती हो । समाज पथैोजन सा हो गया है,
तमु मुझे बचाती रहती हो,
मैं हूं अगर एक कोशिका,
तो तमु भित्ती बन मेरी रक्षा करती हो।
यूं तो कभी बदला नहीं मैं कसी के आने से भी,
अब जो बदल रहा हूं तो लगता है,
मैं Enzyme और तमु Substrate सी लगती हो ।।

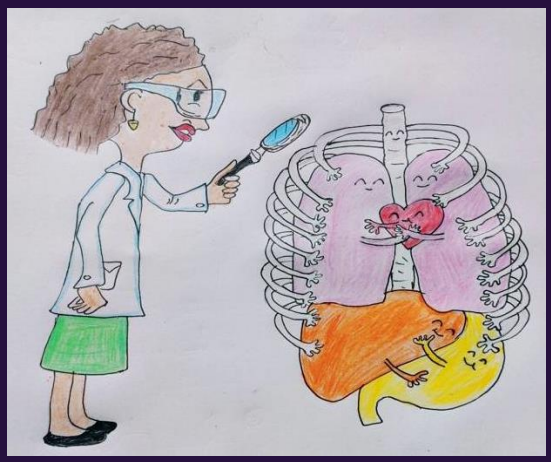
Doodles

Experiment No. 1

Niharika Upadhyay & Prashant Prakash, B.Sc. (H) Biomedical Science, I Year

AIM

Analysis of a Scientist.



STATE AND OCCURRENCE

Never found in pure state. They are always mixtures of anger, visual affliction, intellect and tons of confusion. They may be found with teachers, seniors but never with students of different groups;

generally, near libraries or laboratories but never near clubs or bakeries.

MATERIAL REQUIRED FOR THEIR PREPARATION

Study + notes + books + concentration in class + full attendance + lots of hard work + sincerity + ignoring all the negativities + facts on internet + how can I forget "the curiosity" = SCIENTIST

PHYSICAL PROPERTIES

- Not at all attractive appearance.
- Dark circles under eye.
- High mental temperature.
- Indissoluble to web series.
- Highly revolting to extracurricular activities.
- Hair fall behind the scenes.

CHEMICAL PROPERTIES

1. Such a noble gas reserved and inactive.

2. Certain reactions at high temperature under drastic conditions are:
    - Scientist+ Friends = No reaction
    - Scientist+ Laboratories= Pop sound and visible changes
    - Scientist+ Laboratories+ Professor= Research

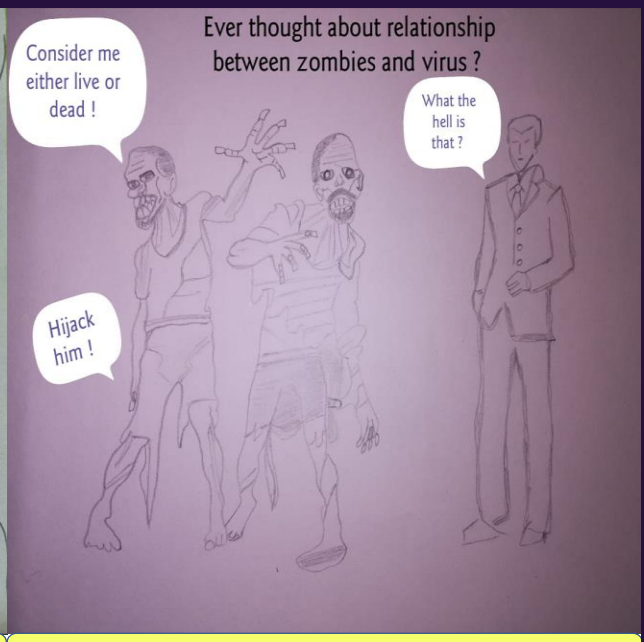
APPLICATIONS:

1. Making parents and institution proud.
2. Bring success to country.
3. Bring fame to self.
4. A perfect example of Sharma's ji son/ daughter.

RESULT:

Inner peace and lot of success.

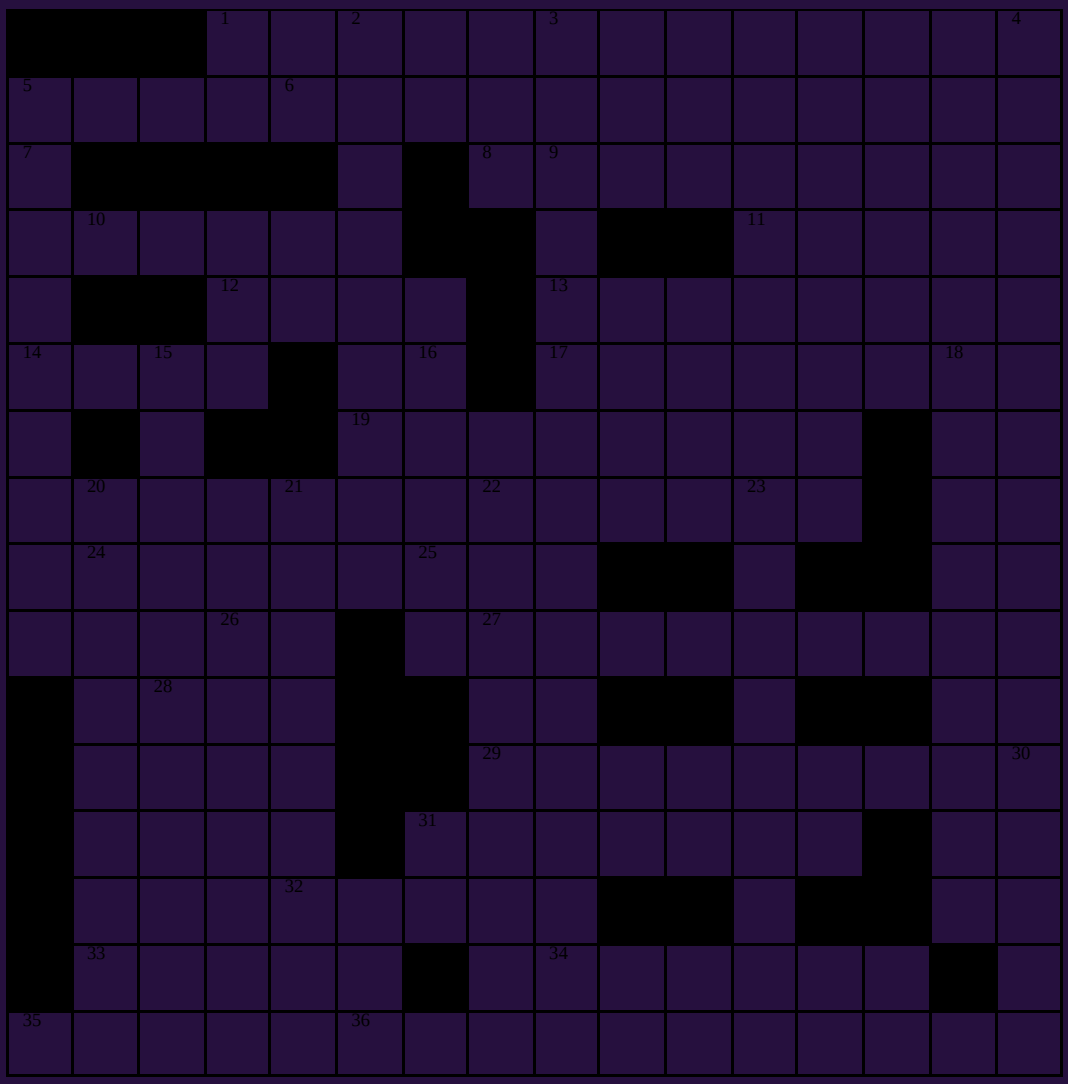
Arundhati Chaudhary, B.Sc. (H) Biomedical Science, III Year



Tamanna Sharma, B.Sc. (H) Biomedical Science, II Year

Crossword Puzzle

Kamakshi Tomar, B.Sc. (H) Biomedical Science, II Year



ACROSS:

1. A tough polysaccharide layer that falls on the outer membranous side of the bacterial structure; often considered as a cause of pathogenicity.
3. Branched chain, ketogenic, essential amino acid used in biosynthesis of proteins; side chain includes an isobutyl chain.
5. _____ patterned baldness is a hereditary androgen dependent condition.

6. Membranous structures present in the magneto tactic bacteria, comprising of magnetic nanoparticles surrounded by lipid bilayer.
8. Small proteinaceous hormone, originally isolated in thymus, plays a role in development of immune system.
10. A _____ structure is an intermediate structure formed during the replication of a circular DNA molecule (prokaryote DNA).
11. _____- Miller chemical experiment that simulated the conditions thought at the time (1952) to be present on the early Earth and tested the chemical origin of life under those conditions.
12. A sac-like pocket of membranous tissue that contains fluid, air, or other substances which can grow almost anywhere in your body or under your skin and are mostly benign, or noncancerous.
13. Sugar Acid present in the cell walls of many bacteria and blue green bacteria.
14. Metabolic pathway in which lactate produced by anaerobic glycolysis in the muscles moves to the liver and is converted to glucose, which then returns to the muscles.
17. A parasitic roundworm whose definite host is human, known to have oral-faecal transmission, flourish in areas of poor sanitation and cause intestinal and pulmonary obstructions.
19. Keto- and amino- forms of nitrogenous bases are considered as the major _____, whereas enol- and imino- forms of nitrogenous bases are considered as the minor _____.
20. The Branch of medicine that deals with the incidence and distribution, determination of health and disease determinants, and development of possible control of diseases.
24. An open sore on an external or internal surface of the body, caused by a break in the skin or mucous membrane which fails to heal and may also lead to pus formation.
25. What does ATP becomes after the loss of pyrophosphate?
27. Oyster, used to extract pearls, is a _____.
28. Enzyme that catalyses the partitioning of superoxide radical into either oxygen or hydrogen peroxide.
29. Death of tissue due to too little flow of oxygen through it.
31. _____is a particular abnormal condition that negatively affects the structure or function of part or all of an organism, and that is not due to any immediate external injury and the condition can be both symptomatic or asymptomatic.
32. Configurational change in the relaxed form of haemoglobin due to increase in proton concentration which leads to lowering of its affinity.
33. If the therapeutic index of a drug is low then, drug can become _____ even at low doses.
34. Proteinase K is a broad spectrum _____ proteinase, commonly used experiments of molecular biology.

35. One of the two ways of viral reproduction which doesn't lead to accommodation of viral genetic material into bacterial genetic material.
36. A type of infection acquired because of a particular toxin or infection that exists in a particular location, mostly hospitals.

DOWN

2. An organism that lives in or on an organism of another species (its host) and benefits by deriving nutrients at the other's expense.
4. The process by which photographs of chromosomes are taken in order to determine the chromosome complement of an individual, including the number of chromosomes and any abnormalities.
7. _____ synthase is activated allosterically by glucose-6-phospahte and dephosphorylation done by protein phosphatase 1.
9. Formation of cellular blood components in the bone marrow from hemocytoblast.
15. Machinery that carries out the replication of DNA, which consists of several enzymes such as helicase, primase, polymerases etc.
16. First Asian and Indian Nobel laureate in science during the British India and a Bharat Ratna awardee after Indian independence.
18. Nucleotide _____ is an anabolic mechanism generally involving the chemical reaction of phosphate, pentose sugar, and a nitrogenous base. Parts of nucleotides can be salvaged to recreate nucleotide or formation can start from the scratch.
21. Antigen-presenting cells of the mammalian immune system whose main function is to process antigen material and present it on the cell surface to the T cells.
22. Vaccination is an example of active _____.
23. A six carbon aldose sugar molecule primarily used for energy production by organisms through either aerobic mode or anaerobic mode.
26. Edward Jenner discovered that the early infection of _____ makes the body immune from the later infection of smallpox.
30. _____ particles are the gram negative symbiotic bacteria which make paramecium, homozygous or heterozygous for nuclear dominant gene K, killer for the paramecium strains which are homozygous for k gene.

Virus Outbreaks Timeline

Kamakshi Tomar, Nahid, Somak Nandy, B.Sc. (H) Biomedical Science, II Year

1999

March	DISCOVERY OF NIPAH VIRUS through its first ever outbreak in Malaysia
April	Influenza A H9N2 in Hong Kong
May	Marburg Disease in Congo
August	Viral Haemorrhage in Zimbabwe and Kosovo
September	St. Louis encephalitis in US
	Sylvatic Yellow Fever in South America (due to West Nile Fever)**
	Yellow Fever in Bolivia, Columbia, Peru and Brazil**
	Polio in Afghanistan, Angola and Iraq*

2000

January	Yellow Fever in Brazil (Contd. from 1999), Nigeria and Liberia
February	Viral Haemorrhage fever in Congo
April	Hantavirus Pulmonary Syndrome in Panama
July	Lassa fever in UK and Netherlands
September	Acute haemorrhage Fever in Yemen and Saudi Arabia
October	Ebola in Uganda

2001

June	Crimean Congo Viral Haemorrhage fever in Kosovo
December	Ebola in Gabon and Congo
	Ebola in Uganda (Contd. from 2000)**
	Yellow Fever in Brazil (Contd. from 1999), Belgium, Liberia, Ivory Coast*

	ISOLATION OF INFLUENZA A (H5N1) from poultry in Hong Kong (SAR)**
	DISCOVERY OF HUMAN METAPNEUMO VIRUS (MPV) by Dutch in Netherlands**
2002	
August	Influenza/Acute respiratory syndrome in Madagascar and Congo
	West Nile Virus in US and Canada
September	Viral Haemorrhage fever in Congo and Gabon
October	Yellow Fever in Senegal
December	Influenza/Acute respiratory syndrome in Madagascar and Congo
	Ebola in Gabon and Congo (Contd. from 2001)**
	Dengue in Brazil, El Salvador, Honduras and Ecuador*
2003	
February	Yellow Fever in Guinea
	Acute respiratory syndrome identified in China
March	Crimean Congo Haemorrhagic Fever in Mauritius
	SARS DISCOVERED and found as cause for respiratory syndrome outbreak in China, which led to a Multi Country Outbreak, affecting several neighbouring countries
May	Yellow Fever in Sudan
September	Yellow Fever in Sierra Leone
October	Polio in West Africa, Togo, Burkina Faso and Chad
	Dengue in India
	Yellow Fever in Burkina Faso

2004	
January	Ebola in Congo
	Human Influenza A (H3N2) epidemic gaining momentum in central east Europe
	Avian Influenza (H5N1) in Vietnam and Asian Poultry
	Development of vaccine effective against Avian Influenza (H5N1)
	SARS Multi Country epidemic
February	Nipah like virus in Bangladesh
March	Yellow Fever in Liberia
	Dengue in Indonesia
April	Lassa fever in Sierra Leone
	Avian Influenza A (H7) in Canada
May	Yellow Fever in Burkina Faso
September	Hepatitis E in Chad
	End of Ebola Outbreak in South Sudan
2005	
January	Yellow Fever in Mali and Guinea*
	Avian Influenza in Cambodia and Vietnam
February	Dengue Haemorrhagic Fever in Angola and Timor-Leste
March	Marburg Disease in Angola
	Polio in Angola, Indonesia and Yemen *
	Ebola in Congo**
	Japanese Encephalitis in India (Gorakhpur, India, from July through Nov 2005)
	Avian Influenza in Korea, China, Thailand (Contd. from 2004) and Indonesia *
2006	
March	Crimean Congo Haemorrhage Fever in Turkey

July	Lassa fever in Germany
December	Rift Valley Fever in Kenya
	Avian Influenza (H5N1) in several South Asian Countries like Cambodia and in several North African Countries like Egypt*
	Chikungunya in African Islands like Mauritius, Seychelles, Mayotte, LA Reunion Island*
	Chikungunya and Dengue in Southern and Western India*
	Polio in African Countries like Kenya, Ivory Coast and Togo *
	DISCOVERY OF HUMAN T LYMPHOTROPIC VIRUSES 3 AND 4**

2007

February	Yellow Fever in Togo
May	Avian Influenza A H7N2 in United Kingdom
June	Marburg Disease in Uganda
	Ebola in Congo and Uganda**
	Avian Influenza in South Asian Countries like Vietnam, Myanmar and Indonesia*
	Rift Valley Fever in Kenya, Somalia, Tanzania and Sudan *
	Polio in Chad and Angola**

2008

January	Yellow fever in Brazil and Paraguay
	Rift Valley fever in Sudan
February	End of Ebola Outbreak in Uganda
April	Dengue in Brazil
October	NOBEL PRIZE FOR HUMAN PAPILLOMA VIRUS (HPV) which is responsible for
	Cervical Cancer
	Avian Influenza in South Asian Countries (Contd. from 2007)

2009	
January	Ebola haemorrhagic fever in the Democratic Republic of the Congo
	Yellow fever in Sierra Leone
	Poliomyelitis in Nigeria and West Africa
February	End of Ebola outbreak in the Democratic Republic of the Congo
April	FIRST EVER OUTBREAK OF SWINE FLU Influenza A (H1N1) in the United
	States and Mexico. Pandemic of Influenza A H1N1
May	Yellow fever in Liberia
	Avian influenza situation in Viet Nam, China, Egypt and Indonesia*
2010	
January	Yellow fever in Côte d'Ivoire, Cameroon and Guinea
March	Rift Valley fever in South Africa
April	Polio in Tajikistan, first importation since Europe certified polio-free
June	Acute Hemorrhagic Fever in the Republic of the Congo
	Avian influenza in Egypt, Indonesia and China*
2011	
January	Avian Influenza in Egypt
	Yellow Fever in Uganda and Ivory Coast
February	Avian Influenza in Cambodia and Indonesia
March	Avian Influenza in Bangladesh
	Yellow Fever in Sierra Leone
August	West Nile Virus infection in Europe
September	Wild Poliovirus in Pakistan
December	Yellow Fever in Senegal

2012

January	Avian Influenza in China, Vietnam
February	Yellow Fever in Ghana, Cameroon
April	Lassa fever in Nigeria
June	Avian Influenza in Hong Kong (CHI)
July	Ebola outbreak in Uganda
August	Ebola Outbreak in Democratic Republic of Congo
September	Hantavirus Pulmonary Syndrome in United States of America
	NOVEL CORONA VIRUS (HCOV-EMC/2012) INFECTION in U.K.
November	Marburg Hemorrhagic fever in Uganda
December	Yellow Fever in Sudan, Republic of Congo

2013

April	Human infection with Avian Influenza A (H7N9) virus in China
May	Wild Poliovirus in Horn of Africa
July	DISCOVERY OF PANDORA VIRUS (a genus of Giant Viruses)
November	Polio in Syria

2014

September	Enterovirus D68- United States of America
October	Middle East Respiratory Syndrome Corona virus (MERS-CoV) in Saudi Arabia, Austria and Turkey
	Human infection with Avian Influenza A(H7N9) virus- China (January onwards)*
	Ebola virus disease in Guinea, Liberia, Senegal, Democratic Republic of Congo and Mali*
	DISCOVERY OF BOURON VIRUS, a tick borne virus**

2015

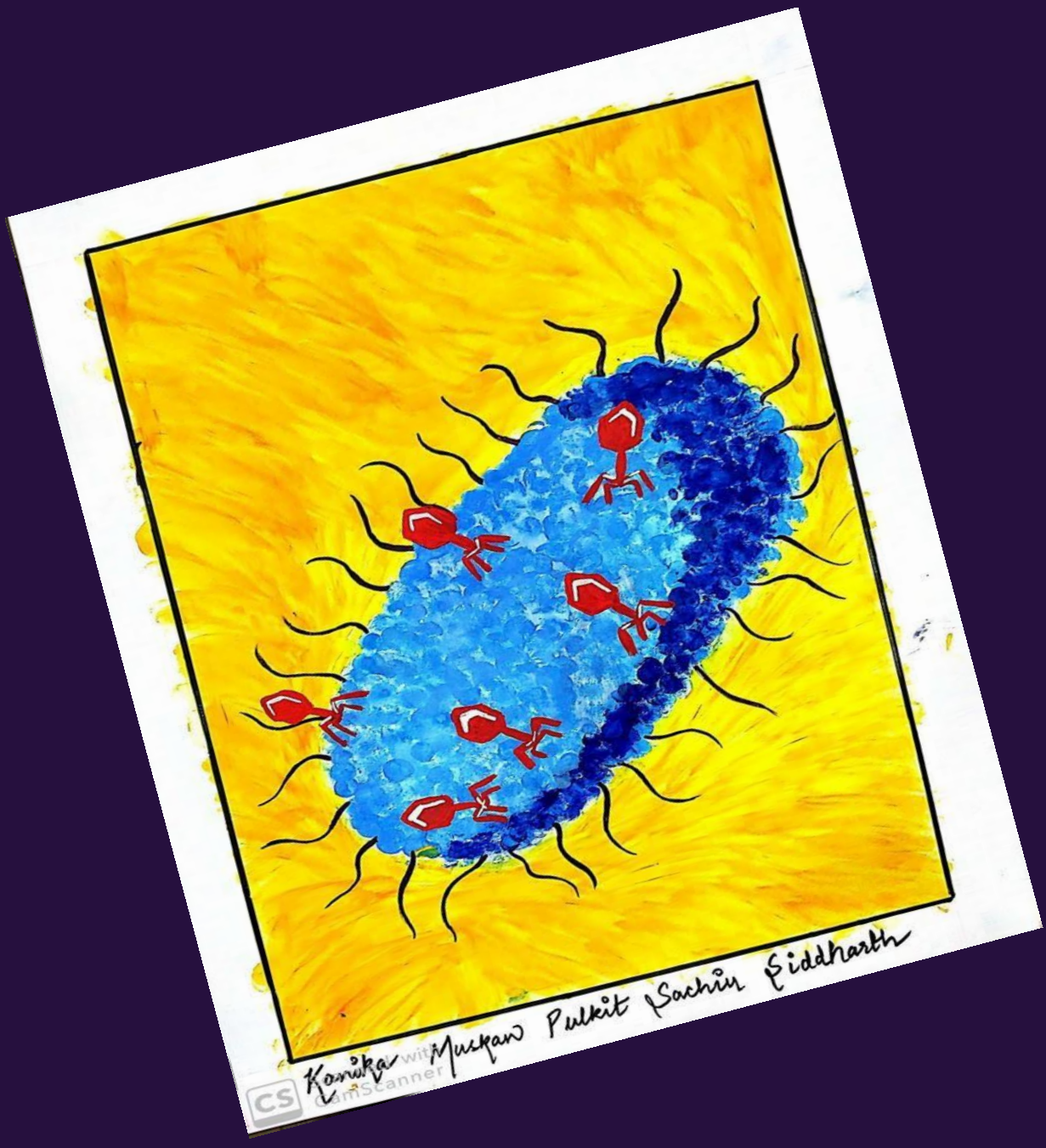
January	Human infection with Avian Influenza A(H7N9) virus- China (Jan), Canada (Jan).
February	Human infection with Avian Influenza A(H5N6) virus- China (February).
May	Ebola Virus disease- Italy (May).
	Lassa fever in United States of America (May).
July	Poliovirus in Madagascar (July).
September	Circulating Vaccine-derived Poliovirus- Ukraine (September).
	West Nile virus in Portugal (September).
December	Circulating Vaccine derived Poliovirus- Laos (December), Myanmar (December).
	Zika Virus infection in Brazil, Colombia, Suriname, El Salvador, Guatemala, Paraguay, Mexico, Venezuela, Panama, Cape Verde, Honduras (Oct Onwards)*
Jan	Middle East Respiratory Syndrome Corona virus (MERS-CoV) in Saudi Arabia
	Jordan, Oman, United Arab Emirates, Qatar, Philippines, Germany, Iran, Republic of Korea, China, Thailand, Kuwait*
	DISCOVERY OF MOLLIVIRUS SIBERCIUM (a giant virus) from 30,000 year old Siberian permafrost sample

2016

January	Human infection with Avian Influenza A(H5N6) virus- China (January).
	MERS-CoV infection in Saudi Arabia, Oman, United Arab Emirates and other neighboring countries in the following months
	Human infection with Avian Influenza A(H7N9) virus in China
	Lassa Fever in Nigeria
February	Lassa Fever in Benin
March	Lassa Fever in Togo and Germany
	Yellow Fever in China
April	Lassa Fever in Sweden

	Yellow Fever in Kenya
May	Yellow Fever in Democratic Republic of Congo and Uganda
June	Yellow Fever in Angola
	Zika Virus infection Outbreak in following countries : French Guiana, Martinique, Puerto Rico (USA), Guyana, Barbados, Ecuador, Bolivia, Haiti, Saint Martin and Guadeloupe, Dominican Republic, United States Virgin Islands (USA), USA, Maldives, Bonaire and Aruba (NED), Trinidad and Tobago, Saint Vincent and the Grenadines, Sint Maarten (NED), Argentina, France, Cuba, Vietnam, Chile, Saint Lucia, Peru, Papua New Guinea*
2017	
January	Yellow Fever in Brazil
March	Yellow Fever in Suriname, French Guiana
	Lassa Fever in Benin, Togo, Burkina Faso
May	Hepatitis E in Niger
	Ebola Virus disease in Democratic Republic of the Congo
	Zika Virus infection in India
July	Hepatitis E in Nigeria
	Marburg Virus infection in Uganda, Kenya (October-November).
	MERS-CoV- Middle East countries*
	Human infection with Avian Influenza A(H7N9) virus- China*
2018	
February	Lassa Fever in Liberia
March	Lassa Fever in Nigeria
	Circulating Vaccine derived Poliovirus type-2 in Somalia
	Ebola Virus disease in Democratic Republic of the Congo
May	Nipah Virus in India
August	Circulating Vaccine derived Poliovirus type-2 in Nigeria
	MERS-CoV in United Kingdom, Middle East countries

October	Circulating Vaccine derived Poliovirus type-2 in Niger
December	Yellow Fever in Netherlands
2019	
January	Ebola Virus disease in Democratic Republic of the Congo
	Hantavirus disease in Panama
	Circulating Vaccine derived Poliovirus type-2 in Mozambique
February	Circulating Vaccine derived Poliovirus type-1 in Papua New Guinea, Indonesia
June	Ebola Virus Outbreak in Uganda
	Circulating Vaccine derived Poliovirus type-2 in Cameroon
August	Circulating Vaccine derived Poliovirus type-1 in Myanmar
September	Circulating Vaccine derived Poliovirus type-2 in Ghana
	Circulating Vaccine derived Poliovirus type-1 in Philippines
	Measles outbreak in Samoa
November	Circulating Vaccine derived Poliovirus type-2 in Pakistan
December	Yellow Fever in Mali
	MERS-CoV in Middle East countries*
2020	
January	Novel Corona virus in China, Thailand, Japan, Republic of Korea


Kanika Muskan Pulkit Sachin Siddharth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NIKITA
SUDEEPTA
SHREYA
BISAKHA
HARSHIT
MAMTA


•SAKSHI SHARMA
•PRITIKA KWATRA
•PRACHI ARORA
•PRASHANT PRAKASH


Hisha Insaf
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BMS I st year
group II

Visit to RCB

UNESCO-DBT Regional Center for Biotechnology organized an "Open Day @ RCB" under the India International Science Festival 2019, at October 16th 2019 in the NCR Biotech Science Cluster, Faridabad. 25 students from Biomedical Science department of Acharya Narendra Dev College, University of Delhi were selected to attend this open day session. Ms. Rimpy Kaur Chowhan, Assistant Professor (Adhoc), Biomedical Science accompanied students at RCB. In ANDC, the program was coordinated by Dr. Gagan Dhawan, Associate Professor, Department of Biomedical Science. More than 300 participants from various other colleges and schools were also invited at RCB for the open day.

The session began with the registration process followed by an inaugural welcome address by the Registrar of RCB, Dr. Deepika Bhaskar. This was followed by the popular science talk by Prof. Sudhanshu Vrati, Executive director, RCB, where he beautifully explained the wonderful work done by his lab and colleagues in RCB of developing and launching rotavirus vaccination for kids of Asian origin. His talk inspired students to pursue scientific research as a tool to serve their country and improving global health. They also organized several competitive activities for the students including Science Declamation contest (अभिव्यक्ति) on "Achieving sustainable development goals through science", and sketching competition (आविष्कार) on topic "Biotechnological innovations for Societal Development", in which our students actively participated.

Afterwards, small groups of students were taken for visit to RCB labs, Central instrumentation facility (ATPC) and BSC BioNEST Bio-incubator (BBB & Cluster). Students learnt about various techniques and laboratory instruments for aerobic and anaerobic bacterial culture, PCR, Protein separation techniques and animal facility etc. They were also introduced with the new career path of being an Entrepreneur while still following their passion for science. A poster session was also organized there where many researchers from RCB presented their work, which was really informative for the students. The program was concluded with a vote of thanks and certificate distribution (for competition winners) by Dr. Deepika Bhaskar. The students appreciated the need of understanding the current research being done in our country in the field of biotechnology as well as the concept of Bio-entrepreneurship, and enhancing their knowledge regarding career prospects in these field.