

One year of the Online world...
@ the department of Biotechnology
2020-2021



Contributors

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PREAMBLE

“One year of online”, a wonderful magazine being released by the Department of Biotechnology, University of Mumbai commemorating National Science Day 2021. A booklet created during this daunting, challenging as well as “testing our resilience” Covid times.

I congratulate Dr. Varsha Kelkar Mane, Head of the Department and her entire team of faculty, students and invited contributors for this magazine. The magazine interestingly articulates regarding the webinars held by the department, chronicles the activities and achievements of the departments and has a scientific spattering of poems and articles by the students. Enjoy the engaging read!

Wishing the department the best in future academic, research and co-curricular activities!



Dr. Anuradha Majumdar
Dean, Faculty of Science and Technology
University of Mumbai

The Department of Biotechnology and glimpses of its achievements in the year gone by.....

The year 2020 started with a bang, the degree award ceremony and the alumni pre meet that witnessed a vibrancy and enthusiasm of the representatives of the Alumni as well as the present students. The interactions were lively and the alumni and students interacted, revived memories, shared their experience and extended all help needed to our students. Around 20 saplings were planted around the department as a part of the event with the current students assuring the survival of the saplings. The department faculty Dr Bhupendra and Dr Archana in their own ways conducted seminars, conferences and laboratory orientation that drew students and faculty across the colleges and universities. As work, research and activities progressed, unknowingly the pandemic struck and affected all as it did to world across. Our laboratories were shut and staff and faculty in a tizzy for a while, but soon gathered, up in *arms* with their online lectures to give and assure the students their best.



With no respite in sight the students of the department too quickly got themselves accustomed to the online world braving through the pandemic. The faculty put their best foot forward to leave no stone unturned ensuring the completion of syllabus and other guidance and counselling that the students needed.

Our other students in their final year of MSc, confronted bravely and shone as frontline warriors, sampling, analysing and collating data and samples of COVID patients across Mumbai.

The department geared up and conducted various online activities to keep the enthusiasm of the students including organization of placement drive for its PG students during the lockdown period in association with a well known company in Biotechnology. The department witnessed 90% placement in this period. The department organized online talks from eminent personalities from varied fields for its Masters students. The talks were organized on every Saturday beginning from 20th of May 2020 to boost the morale of the students.

With great pleasure, the department brings to you this small informative booklet on the occasion of the National Science Day 2021. I wish to place on record our thanks to the authorities of the University of Mumbai.



Varsha Kelkar Mane MSc, PhD, FRSC
Associate Professor and Head,
Department of Biotechnology,
University of Mumbai

Webinars for Masters students at the department



Dr Prashant Khadke, the first speaker who is not only an expert in the Health care and Clinical applications of NGS, Micro array, Digital PCR, Real Time PCR, DNA sequencing, Cell Analyzer, Cell Sorter, ELISA and electrophoresis, but also an active member of the Government of Maharashtra's active task force, spoke to the students about the Vivid Approach for Management of Covid-19. His insights about this newly emerged pandemic were eye openers.



Padmashree Dr Sharad Kale, former head of technology transfer BARC spoke the subsequent week with our masters students on microbial diversity elaborating the role of microbial systems in striking balance and maintaining the ecosystem. He mentored our students in regards to the way in which they should craft their careers. He also spoke about his famous *Nisargruna* biogas technology that uses biodegradable waste to produces biogas. He highlighted the role that microorganisms play from kitchen to industries, there is nothing to be wasted in nature. His multitude achievements and an equally humble personality spoke volumes.



Mr Bhau Katdare was also one of the speakers for the week. Vishwas Katdare, called as Bhau, is the founder of Sahyadri Nisarga Mitra (SNM) a Maharashtra-based NGO working towards the conservation of wildlife in the Konkan area. Started as a group of committed birdwatchers in 1992, the organization has been relentlessly working over three decades for conservation lesser-known species like vultures, pangolins, and marine turtles. SNM's work has transformed the lives of the local communities that live alongside them. The students were spellbound to hear about Bhau's fascinating journey and it rained questions about ecology and conservation.

Dr Sanjeev Gupte, active researcher in healthcare sector was another of the eminent speakers, enlightened the students with the potential careers that await them as they complete their masters in biotechnology. An experienced person from Industry, served as a guiding light to the students truly boosting their morals and enabling them realising their roles and responsibilities as biotechnologists.

Talks and events by faculty

The department faculty too were invited to a number of webinars live casted on Facebook and you tube by groups like Adventures in Archaeology, Down Ancient trails, Bones and Beyond on topics dealing with pandemic and climate change, Understanding life -Microbiologists perspective etc. The faculty was also a part of webinars on career guidance to students in Microbiology organized by the American India Foundation, Dell technologies, GICED and Vivekanand college.



Dr Varsha hosted the International Union for Pure and Applied Chemistry Global Womens' Breakfast on 9th of Feb 2021 along with 6 eminent women speakers from the University of Mumbai. Drawing inspiration from the video address by Prof Laura McConell and Prof Mary Garson of IUPAC, Prof Varsha boosted the intent and principle of 'inclusiveness' and "diversity" by understanding chemistry from the perspective of a biologist, herself and Prof Indu George; Prof Medha Tapiawala an economist, Prof Vidya Vencatesan a French (language) professional, Prof Namita Nimbalkar a Philosopher and Prof Ambuja Salgaonkar an ardent follower of ancient Indian texts. The event also incorporated and witnessed the use of IT and AI by Prof Srivarmangai in not only understanding the chemical reactions but also designing experiments that could be performed on a virtual platform and made available the world across. It was one of its kind event that drew appreciation.

Achievements at the department

Our post graduate students after completing their Masters examination braved the pandemic and worked as frontline warriors, sampling, analysing and collating data and samples of COVID patients across Mumbai.



With great pride, the department places on record appreciation for achievement of Mr Rishikesh Avadh who was felicitated by HiMedia for his extraordinary dedication and commitment in the fight against COVID-19



Another of our brave student Ms Bharti Agarwal who worked relentlessly as did Mr Omkar Dhanawade who were employed in a well known diagnostic lab analysing hundreds of COVID samples daily

Achievements of our faculty



Dr. Varsha Kelkar Mane, Associate Professor and Head of the Department of Biotechnology was conferred upon the prestigious title of the Fellow of Royal Society of Chemistry in December 2020

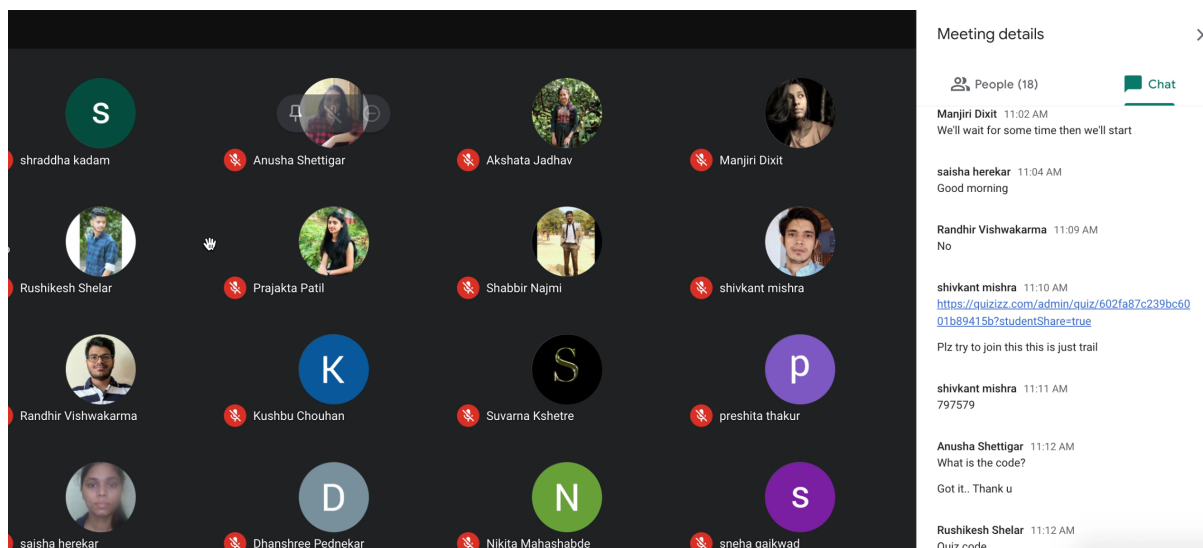


Dr. Sanjana Negi a DST INSPIRE faculty at the department was selected by “National Academy of Sciences, India” for NASI-Young Scientist Platinum Jubilee Award in the Plant Sciences Stream for the year 2020.

All about Biotech....

...Of the students and by the students

National Science Day 2021



As a part of the National Science Day 2021 the students of department of Biotechnology actively and voluntarily got involved in a number of online activities. Mr Shivkant of Semester IV organized a brain storming quiz for the in- house students. The competition consisted of two major rounds with a sum of 30 questions. The event was organized with a great enthusiasm and completed with an active participation. Three winners that stood out celebrated their success online. Khushboo (Sem IV), Alpita (Sem I) and Anusha (Sem I)

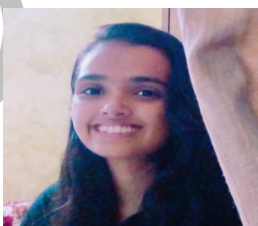
Winners of National Science Day, Quiz Competition 2021 🏆🎉🏆

1st prize



Miss. Kushbu Chouhan

2 nd prize



Miss. Anusha Shettigar

3 rd prize



Miss. Alpita Agre

The Field was New

The field was new,
about which few people knew.
Interesting it seemed,
And I decided to give it a go.

As it started it was tough and it surely is,
but when your heart is into it, everything is pure bliss.
With lots of subject combinations,
the field was beyond anyone's imagination

The journey is like a roller coaster ride,
with initial failure in every new experiment that's designed.
But as there's sunrise after every dark night,
it becomes a responsibility to solve problems and bring out a day bright.

The field might be still new,
for many people who still don't know.
But the journey from HUMAN INSULIN to COVID VACCINE,
the field surely grew.

And still with same enthusiasm and wholeheartedness,
we'll stand together to help each other in every darkness



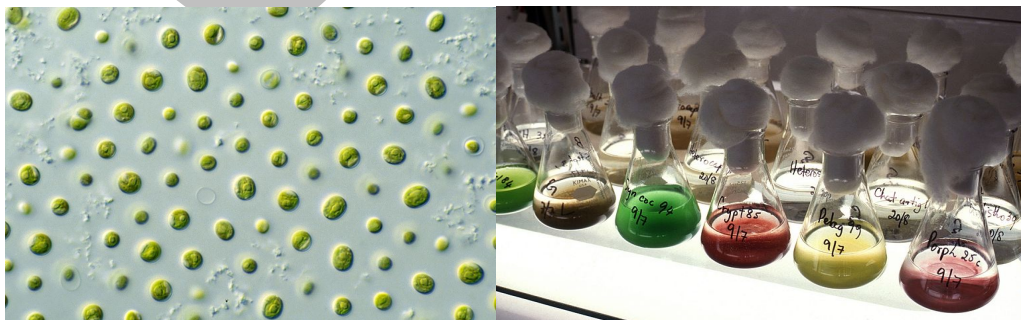
-Anusha Shettigar , MSc I

Future of Blue Biotechnology market across the world.

Blue Biotechnology, also known as Marine Biotechnology, is one of the upcoming fields. As different colours denote different areas in biotechnology, *Blue* aptly indicates application and utility of aquatic bio resources for the benefit of mankind

Far away from the shore and several meters below the surface, the conditions are extreme. Even further in the Mesopelagic region, ranging from 650 – 3,300 feet, sunlight is scarce. Aquatic animals as well as plants are well adapted to these conditions. Man's quest to understand the survival strategies of these organisms seems to be endless

Various areas such as food, energy, health, environment, industrial sectors are benefitting from Blue Biotechnology and will continue to grow and develop in future. The world is running out of conventional energy resources. With increasing population and the ever increasing fuel demand, the natural fuel reserves will soon be exhausted. An alternative is a must. Though we already have non conventional energy resources such as wind, solar, hydro, geothermal etc., the use of biomass, microalgae for the production of bio-fuel will add a push. Flights and vehicles have been tested successfully using bio-fuel displaying its effectiveness. The oceans are undoubtedly an indefinite source of these micro as well as macro-algae.



Microalgae cultures in the CSIRO Microalgae Collection laboratory
<https://commons.wikimedia.org/w/index.php?curid=35475348>

Health sector is benefited through marine derived anticancer drugs, pain-killers, antibiotics as well as cosmeceuticals. Demand for marine biotech products and their applications in the healthcare sector are on the rise. Martin Chalfie, Osamu Shimomura and Roger Y. Tsien were awarded Nobel prize for their discovery of **Green Fluorescent Protein** derived from a marine organism jellyfish *Aequorea victoria* in the year 2008. It holds a lot of importance in molecular biology. Besides the health sector, it also has its share in the development of Cosmetics and Pharmaceuticals.

Our **Environment** faces a huge problem of pollution. Air pollution has always caused breathing problems in highly populated metropolitan cities. Continuous dumping of waste into the sea has threatened numerous aquatic life forms. Plastic not being biodegradable poses a great amount of harm to the marine environment. It has also made its place into the food chain as microplastics that were found in wild fish from the North East Atlantic Ocean. Ingesting microplastic will certainly prove to be harmful. Biotechnology serves as a solution to tackle these problems via bioremediation as well as manufacturing bioplastics.

Using microorganisms that feed on pollutants like plastics, and petroleum can be used to remediate soil and water. Plastic eating bacteria like *Ideonella sakaiensis* can be the solution to clean up plastic waste.

Marine conditions are different when compared to the terrestrial conditions. That's why marine life forms have characteristics that help them adapt to these conditions. We can use the enzymes obtained from them because they can function well in extreme conditions. Marine biotech has helped the Nutraceuticals field as well.

Talking about the **Food sector**, In 1989 AquaBounty Technologies developed a genetically engineered Atlantic salmon also known as AquAdvantage Salmon. This genetically modified fish grows very quickly without affecting the size or other qualities. The FDA concluded that there were no food safety concerns regarding the Salmon. Higher production in less time adds to the market value.

With so many sectors being benefited from Blue Biotechnology, the future prospects are bountiful and the field is out for us to explore, harness and employ skilfully preserving its diversity and benefiting mankind.



-Nachiket M. Shigam ,M.Sc. Biotechnology Part II

a lot of progress. The above mentioned countries have surely progressed and there's clearly one thing in common.

India being a multi-linguistic country has managed very well in propagating science through English as more and more schools are considering English as the first language. But a huge population demands huge progress. In the end, a world wide acceptable language plays an important role for national development by strengthening international relations.

What can be the solution? Focusing on breaking down the basics. As a child grows up, making them understand science in their mother tongue will help leaps and bounds. As the course progresses, a translation of terminologies in English will help. A language barrier cannot be broken in a single year. But if a child starts learning science in the mother tongue, gradually being exposed to English terminologies and explanations as the course progresses, for example over the time period of 5 years, i.e. 4th - 9th standard, might make science fun and understandable. With the implementation of the National Education Policy 2020 I am sure that things would change and the country will progress rapidly in the field of Science and technology benefiting the society.



Nachiket M. Shigam ,M.Sc. Part II

Understanding Immunology

Immunology can be defined as the study of defence mechanisms , involved in all multicellular organisms , in combating any foreign particle/substance . It is the branch of biology , which in itself is concerned with the study of life .

Immunity is the term for these defence mechanisms or it is the defence system of the multicellular organisms whose possession confers resistance to various pathogenic bacterial , fungal , viral and other parasitic infections . Without the immunity the host becomes vulnerable to infections and since these microscopic entities are present everywhere , the human body / host is exposed to them continually .

Many of these infectious agents can cause serious abnormal physiological functions or even death , in multicellular organisms . For instance , AIDS , which stands for Acquired ImmunoDeficiency Syndrome , is a retroviral disease caused by a retrovirus namely , Human Immunodeficiency Virus (HIV) . The disease is characterized by immunodeficiency and abnormalities of the central nervous system. The consequences include vulnerability to all sorts of infections and eventually various clinical symptoms like fever , diarrhoea, weight loss and multiple opportunistic infections i.e. infections occurring more frequently in people with weakened immunity .

Now , the immunity in all multicellular organisms is conferred by the immune system comprising of a variety of cells organs , molecules which interact via a various pathways . The interlinked and coordinated activities of these cells, play a very critical role in bringing out an immune response towards the foreign entity . So immune response is a cascading event brought up by various components of the immune system to finally discard the invading foreign particle referred to as an antigen. Antigens are thus said to be immunogenic i.e. they elicit an immune response in the host.

Cells of the immune system:

1. Blood leukocytes, the WBCs (white blood corpuscles), are the mobile units of the immune system. It is formed partially in the bone marrow (through a highly regulated process called hematopoiesis) and partially in lymph tissues. These can be further divided into granulocytes and agranulocytes namely, eosinophils, basophils and neutrophils and lymphocytes and monocytes respectively.

Monocytes give rise to macrophages and dendritic cells, both of which play critical roles in innate and acquired immunity, through phagocytosis and antigen presentation to the T cells for their activation and eventual immune response, respectively. In the case of granulocytes, neutrophils are present abundantly and are phagocytic in nature whereas the others are less abundant. Basophils and mast cells play critical roles in inflammatory and allergic reactions.

On the basis of the nature of occurrence, the immune system can be divided into innate and acquired/adaptive immunity, wherein the former is inborn or natural immunity and the later is acquired through life when the particular antigen is exposed to the host body for the very first time. The cells playing critical roles in acquired immunity are the lymphoid cells or the lymphocytes namely, B lymphocytes and T lymphocytes, also their natural killer cells (NK cells).

B cells and T cells promote humoral and cell mediated immunity respectively, it is their mode of action that brings out an immune response wherein these cells are members of the clonal populations distinguished by antigen receptors of unique specificity. B cells synthesize and display membrane antibodies whereas T cells display T cell receptors (TCR). Here, the B cells can recognize an intact antigen whereas the T cells can respond to antigen only when they are bound to specific molecules namely, MHC proteins with the antigenic unit, present on the surfaces of the antigen presenting cells in the lymphoid tissues. Three important types of antigen presenting cells are B cells, dendritic cells and macrophages among which dendritic cells are the potent ones.

MHC stands for major histocompatibility complex, a gene cluster located on chromosome 6 in humans and chromosome 17 in mice. The alleles of MHC gene clusters encode MHC proteins, the glycoproteins, these bind to the peptide fragments of antigen proteins, degraded through either endogenous or exogenous pathways, inside the APCs and then transport them to their cell surfaces. In humans, the MHC is referred to as human leukocyte antigen (HLA)

Three classes of MHC molecules namely, class 1 MHC , class 2 MHC and class 3 MHC molecules. Class 1 MHC molecules present antigens to cytotoxic T cells and are present on all nucleated cells whereas class 2 MHC molecules are present on the APCs only and present antigens to helper T cells. So, it is through the mediation of MHC protein molecules that APCs and other nucleated cells present the antigenic fragments to the T cells and eventually they get activated, proliferate and differentiate into effector cells with antigenic specificities.

The class 3 MHC molecules are part of the complement system ,whose secretory proteins possess immune functions.

B cells during their course of immune response mature into plasma cells, from resting naïve B cells to mature plasma cells , which secretes the antibodies. T cells are further subdivided into two major types namely, helper T cells and cytotoxic T cells expressing CD4 and CD8 respectively hence called CD4 T cells and CD8 T cells , respectively.

So , the WBCs work together in two ways to confer the immunity, by actually destroying foreign invaders through phagocytosis and also by forming antibodies and activated or sensitized T cells.

The primary and secondary lymphoid organs , the former are the sites where lymphocytes mature and develop whereas the later are sites where lymphocytes actually act through their encounter with foreign invader . B cells develop and mature into bone marrow in mammals and in birds it is the bursa fabricius , T cell maturation occurs in thymus but the T cell precursors come from the bone marrow , hence these are the primary lymphoid organs . The lymph nodes , spleen and loosely organized sites distributed throughout the mucosal system like MALT i.e. mucosa associated lymphoid tissues , are the secondary lymphoid organs.

The complement system , a part of the immune system, comprises serum plasma proteins present in inactive forms in the circulatory system prior to their activation to complement the functioning of the immune system and bringing of immune response. These can include enzymatic mediators , membrane binding components called opsonins, membrane attack proteins, etc.

Innate and acquired immunity:

The innate immunity is accomplished with various barriers, like skin, the very first line of defense then comes other barriers like the mucosal lining of the respiratory tract, secretions by various glands, etc. The acquired immunity is the third line of defense wherein the antigen has entered the host, it is the primary response towards the antigen. Acquired immunity is pathogen specific and is characterized by presence of the memory cells of first encounter, so through the subsequent encounter of the same pathogen the intensity of the response increases and further results in the fast secondary response, through mainly the activated B and T cells though various other components of the immune system are involved.

Now the barriers of innate immunity include physical barriers comprising the body's skin, preventing the entry of microorganisms, the mucous secretions through the epithelial lining of the respiratory tract, gastrointestinal tract, helping to trap the foreign invader. Physiological barriers include HCL in stomach secreted by gastric glands, also tears from eyes helping to prevent the microbial growth, the cellular barriers include WBCs and lastly there are cytokine barriers like the interferons, specific for virally infected cells.

Innate and acquired immunity can be further classified into active and passive immunity depending upon the active participation of the host to bring out an immune response. In passive immunity there is no active participation of the host wherein readymade antibodies or lymphocytes are provided through various external sources or antibodies from mother to foetus through placenta and also the presence of antibody IgA in colostrum during breastfeeding are examples of the passive immunity.

Artificially acquired active immunity is through vaccination whose principle is based upon the presence of memory cells of the first encounter of the particular antigen.

Vaccine is the biological preparation of the antigenic proteins, which can be in various forms like live attenuated wherein the specific pathogen is live but removed from his virulent factors that confer infections. Also there are purified subunits of antigenic proteins and even in the form of killed or inactive antigen capable of giving an immune response.

Immunization, wherein preformed antibodies are given to patients requiring immediate response is called passive immunization e.g. Tetanus vaccine/ Tetanus toxoid, a toxoid vaccine used to prevent tetanus.

The immune response:

The body's innate immunity represents the first and second line of defense however, when a particular pathogenic microorganism overcomes these defenses and enters into the body there the role of the immune system comes, the most potent immune system in multicellular organisms. So, acquired immunity is through the activation of immune system and bringing out an immune response displaying certain characteristics contrasting to the innate immunity namely, antigen specificity and diversity in recognition, immunological memory and discrimination between self and non-self.

When an antigen enters the host body it is first trapped by macrophages in the lymphoid tissues, further which it undergoes phagocytosis wherein engulfment, degradation and digestion of antigens into antigenic fragments takes place, referred to as antigen processing after which their presentation through the mediation of MHC protein molecules to T cells takes place when a particular T cell engages with antigen presenting cells. Their interaction is through T cell receptors, TCR, present on the cell surface of T cells.

Helper T cells play a critical role, wherein its receptors bind to class 2 MHC molecules, present only on APCs like macrophages, and get activated to undergo clonal differentiation by producing effector clones of helper T cells. This is again through the mediation of interleukin 1, a cytokine produced by APCs. Then these sensitized helper T cells secrete interleukin 2 which promote the proliferation of cytotoxic T cells engaging with class 1 MHC molecules present on all nucleated cells. These interleukin 2 also activate B cells to secrete antibodies hence, also providing the humoral immunity in contrast to the cell mediated immunity by sensitized T cells.

Clonal selection is the process through which the activated B cells and T cells undergo proliferation wherein the cell actively grows and produces a population of antigen reactive cells or effector cells specific for antigen they are engaged with.

The whole cascade of events brings out an immune response to finally discard the foreign invader out of the host body.



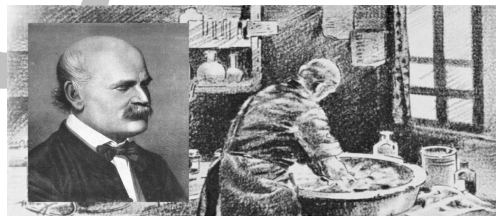
Saisha Hereka, MSc I

Story of two *not so* celebrated hygiene warriors

The pandemic has taught us the impact of washing our hands after every *touch*, this got me searching into the history/timeline of a procedure called handwashing, and this is what unfolded....

Somewhere around a century ago, in the year 1881, came a great revolution in the field of medicine. This was when Louis Pasteur, a well renowned French microbiologist gave the world the link between the 'germs' and diseases, by what he called as the germ theory.

Our story dates between the 1820s to 1840s, 50-60 years before the germ theory. This was the time when we did not know what made people sick. Believes that foul odors and evil spirits caused diseases were prevalent and predominant then. The doctors rarely practised cleanliness and their clinics smelt so awful that one had to press one's scarves against the nose whilst walking across or into the clinics. The doctors lived with the hospital stench and operated in equally dirty rooms. Washing of hands or instruments was rare and the operation tables were a liken to the stained wooden tables of a butcher. People avoided coming to the clinics, dreading death and no less the thoughts of being put up in such ghastly conditions. This was however set to change thanks to the contribution of two people in the field of medicine, a physician and the other a nurse. The name of the physician scientist was Dr Ignaz Semmelweis and that of the nurse was none other than Florence Nightingale.



Dr Ignaz Semmelweis (<https://www.flipscience.ph/health/ignaz-semmelweis-handwashing/>)

Dr Ignaz Semmelweis practised simultaneously in a two clinics in Vienna whereas Florence Nightingale served the British and allied soldiers in Turkey during the War. Whilst working in two clinics, Dr Semmelweis noticed that the pregnant women did not prefer delivering in one of the clinics and opted for the

other one or at times preferred to be delivered at home or on streets. Dr Semmelweis was puzzled by this approach and decided to investigate. He noted every small thing about the two clinics, including religious practices if followed and to his surprise the only difference was in the medical staff that was attending the patients.

The clinic that wasn't preferred by the patients was run by the medical students/would be doctors unlike the second clinic that was used for training midwives. He decided to probe further into this and what he noticed is set to change the field of medicine and surgery. He noticed that the doctors and medical students performed autopsies as a part of their teaching and learning and subsequently visited the maternity wards, whereas the midwives were not required to conduct any surgeries or autopsies and were thus limited in their exposure to the cadavers.

He made a note that the doctors and medical students carried on their hands cadaverous particles which they then were passed into the maternity wards. Semmelweis decided to impose a new rule that mandated hand washing with chlorine for all the doctors. With this simple practise the rates of death fell dramatically. This was the first proof in the history of medicine that cleansing hands can prevent infection. However, notions in science that then existed, that water was a potential cause of disease and envy a characteristic of human nature did not allow this innovation to be popularized. Semmelweis tirelessly tried to persuade other doctors in European hospitals of the benefits of handwashing, but to no avail.



<https://www.biography.com/news/florence-nightingale-hygiene-handwashing>

A few years later, unaware of Dr Ignaz's contributions, Florence Nightingale too realised lack of sanitation as a root cause of the high death rates amongst the soldiers in the war hospitals. She developed a plan to balance ten environmental elements of hospitals that included, ventilation and warming, light, noise, bed and bedding, personal cleanliness, food observation recording etc to cure the patients from any disease and/or illness. Sadly, both of these hygiene practices lay into

oblivion for over a century. It was only in the 1980s, that a chain of foodborne outbreaks and similar healthcare-associated infections highlighted the significance of hygiene especially hand hygiene as one of the most significant ways to prevent the spread of infection.

The biographies of scientists are a window to their thought process and the stories above have a lot to give;

Observations are crucial, if one has to make a breakthrough

Use whatever is available as did Nightingale, who put her theory into action, changing lives of hundreds of soldiers. Our work can change the perception of a so-called simple profession as did Florence Nightingale . Dr Ignaz could have been an agent of change, had he published his findings in the medical journals, which he did not for 14 long years. Dr Ignaz was a hero as he had the opportunity to improve and change the system. However his traits of insulting his enemies, accusing superiors of causing the deaths, abandoning friends, being arrogant and angry with his own self, ended him up in an asylum where he died a death of an unsung hero.

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Head, Department of Biotechnology



The biotech family continues to stand by its staff and students and society in this time of transit.....