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# PATHWAYS

FORMULATING THE FUTURE



AWAITING YOUR DESTINATION



# EDITOR'S DESK

"One man's magic is another man's engineering. Supernatural is a null word."

-Robert A. Heinlein

The above quote goes to show how every aspect of our life today has been modified for the better and engineering has a major role to play in it. Our inaugural edition themed "Awaiting your Destination" is an ode to all Chemical Engineers around the world who have dared to venture into unknown domains of all spheres and have given us the world we have today.

This edition is a special dedication to the first year students to give them a brief insight on what Chemical Engineering has to offer.

Welcome Readers,

"Pathways" is back this year and back with a bang. We ensure you that every edition will be as resourceful, as innovative, as cackling as can be.

In accordance with the theme you will find as you read the contributions made by chemical engineers in various fields and what their role entails. Following this up we have an array of other articles on various new found innovations and latest technological developments and so on and so forth. Being August, keeping with the "RIO Fever" we have a piece on it and we also bring you scientists and innovators born in the month of August and their contributions.

We have also incorporated a special section this year dedicated to the IChE to keep abreast of the happenings here on campus. Our other sections include Chemical of the month, internship experience to help students familiarize themselves to the opportunities available.

On a more lighter note we've got word search to jog your minds, jokes to get you crackling, monthly horoscope to show you what your future beholds and to all you fiction lovers "Train of thought" to keep you on edge waiting for the next edition.

This year we have also introduced "ACT Diaries", which will give you an insight into the life of an ACTian and a couple of dos and don'ts, as well as Alumni corner wherein our alumni put in their thought and give opinions on various issues.

We are also proud to introduce for the very first time our own official website "[pathways.mnmserve.com](http://pathways.mnmserve.com)" where we will keep you updated on various issues and also an avenue to view our e-copy. Feel free to get in touch with the pathways team on [pathwaysteam16@gmail.com](mailto:pathwaysteam16@gmail.com) for any suggestions or queries.

HAPPY READING!



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## MESSAGE FROM HEAD OF DEPARTMENT



For students, a switchover from school to college is no doubt a life changing experience. For few of them, it is a maiden venture of living independently. This not only debars them from a socially cushioned lifestyle; they also have to juggle various aspects of life. A lot of planning in terms of picking a career is expected which could be overwhelming for a young adult to manage apart from managing academics.

The inaugural edition rightly Themed “Awaiting your Destination” is particularly for the first year students to ease this transition as well as see what Chemical Engineering as a field has to offer. The various aspects that this edition holds will also give a head start to a new chapter of a student’s life in our campus.

“Pathways”- our department magazine is a unique platform for students to explore and express their understanding through the written word. It’s an opportunity for the young and inquisitive minds to delve into their potential and make best use of it. The editorial team works ceaselessly to deliver a monthly edition which has been welcomed with great response by students and faculty members alike. This year the introduction of the official website and incorporating the IICHE section into the magazine are noteworthy mentions.

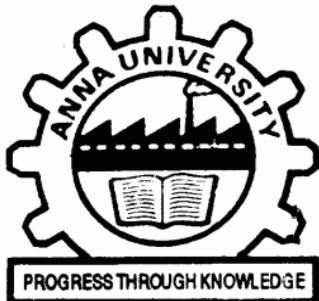
The chemical engineering department here at ACTech is focused on devising innovative and suitable solutions to difficult problems, whilst ensuring that the solutions execute optimally.

I welcome all the students to join in this effort to help create a better tomorrow for everyone.

DR. N. NAGENDRA GANDHI

HEAD OF THE DEPARTMENT

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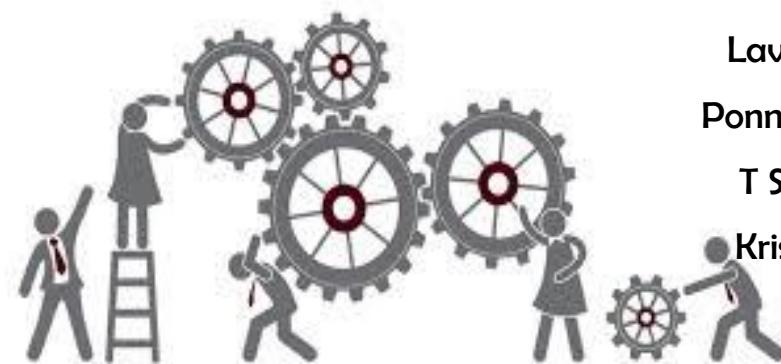
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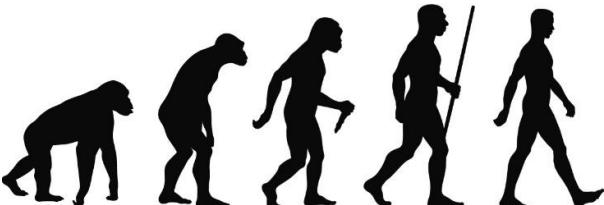
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# Chemical Engineering - The Origin



**George E Davis, Founder  
Of Chemical Engineering**

Chemical Engineering, the branch of engineering that is more versatile than any other engineering on the planet was known to be established in 1887 but the origin of Chemical Engineers predate the establishment of the course. There have been a few arguments on the identity of the first Chemical Engineer. Some say that the first Chemical Engineer would be a German-Dutch named Johann Rudolf Glauber (1604 – 1670) who had discovered the production method of HCl, HNO<sub>3</sub> and sodium sulfate whereas the others point the arrow to an Irishman who goes by the name of Robert Boyle (1625 – 1691), known for putting forth the Boyle's Law, which serves as the fundamentals of Physical Chemistry and Chemical Engineering.



**Robert Boyle, One of the  
first Chemical Engineers**

Chemical Engineering had found its way into the limelight during the middle years of the industrial revolution; through a Mr. George Edward Davis who was known for develop Unit Operations which serves as the core of the course as we see today. The field had quickly gained recognition during the time due to the ever increasing demand of chemicals vital to the production of domestic items and war machinery and artillery.



**Johann Rudolf Glauber,  
One of the first Chemical  
Engineers**



**Cologne in 1411**

During World War II, war gases were introduced and were in trend during the time, thanks to a certain German dictator known for his moustache coupled with stupid and racist ideals. This had accelerated the demand of Chemical Engineers to develop torture chambers, gas grenades and other inhumane devices capable of inflicting slow and sudden death and also machines capable of propagating death in a wide, precise and swift manner. After the war ended, France had to give up most of its perfume industries located in a city called Cologne to West Germany. The Germans had renamed it to Köln.



**Cologne during WWII**



**Köln, present day**

In the present day, Chemical Engineering, the branch of engineering which has such a rich and brutal history still survives because of satisfying the ever growing demand of chemicals and will continue to do so in the upcoming eras.

-M.A. RAMAIAH KUMAR (3rd Year, Chemical Engineering)

# TO INFINITY AND BEYOND



The art of getting a rocket of such heavy load off the face of the Earth and making it capable to withstand the harsh conditions in space presents a challenge for any engineer. The aerospace industry has long been perceived as the domain of both physicists and mechanical engineers, even though the primary method of providing the thrust necessary to launch a rocket into space is chemical in nature. As a result, it has been assumed a chemical engineer plays little role in the project of space exploration. However, as space exploration takes flight and attain new heights by moving further into the cosmos, the need for more chemical engineers to step into this field has risen.

The thrust necessary to get a rocket to leave the Earth's atmosphere and the additional propulsion needed for it to move away from Earth, all depends upon the fuel. Rocket propellant used is either a high oxygen containing fuel or a mixture of fuel plus oxidant, which produces a chemical reaction resulting in reaction mass ejected at high speed from a rocket engine to produce this thrust. Hence, a chemical engineer ensures that gaseous compounds like hydrogen and oxygen are liquefied and becomes dense enough to use for rocket fuel. Since it is not feasible to carry large amount of fuels for round trips during deep exploration, it becomes increasingly more important to find new means to produce fuel during mid-flight or find an alternative form of fuel to sustain long durations of flight with minimal usage.

However, as space exploration takes flight and attain new heights by moving further into the cosmos, the need for more chemical engineers to step into this field has risen.

Since the conditions presented in space are demanding and harsh, only highly specialized and high-performance materials will be capable of withstanding the rigours of space travel. Chemical engineers manipulate internal structures of materials so they can create new ones which are capable to survive in extreme temperatures and in severely erosive and corrosive environments. High-performance plastic, ceramic and metal have been produced possessing characteristics like exceptional strength, lightweight, temperature resistance, chemical resistance and dimensional stability. This has been possible through the advances in matrix composites and combination with other non-ferrous metals or ceramic dispersed throughout a metal matrix for enhanced characteristics. These materials then find their way into various equipment, electronic components and automotive engine parts present in the rocket.

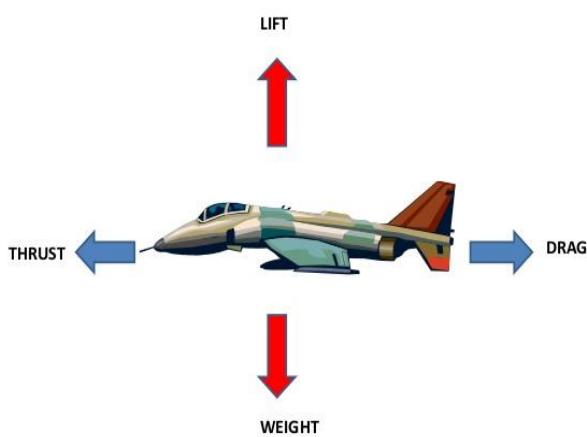
With mankind's curiosity at its peak and with little knowledge about space itself, there will never be an end to space exploration until every edge has been visited. Fuels and materials being a main crutch for space exploration, more research is needed to further refining them. As new projects come about, the role of a chemical engineer becomes even more prominent as they pioneer into manipulating chemistry to discover new propellants and high-performance materials.

-Jebin (2<sup>nd</sup> Year Chemical Engineering)

# FUELING AVIATION

In the complete operation of an aircraft numerous engineering expertise like aerospace, mechanical, electrical and others are required but the most important among these is chemical engineering mainly because of its vast application in aerodynamics, design and fuel processes in the engines.

One obvious question might be who chemical engineers are specifically. This question bears a lot of importance as it emphasises on the importance of chemical engineers and chemical engineering. Chemical engineers are the ones who translate processes developed in the lab into practical applications for the commercial production of products and then work to maintain and improve those processes. They rely on the main foundations of engineering: math, physics and chemistry. The main role of chemical engineers is to design and troubleshoot processes. They are most often employed for large-scale operations to maximize productivity and product quality while minimizing costs.



Aerodynamics is the study of the properties of moving air and the interaction between the air and solid bodies moving through it. On the other hand, chemical engineering is the field in which the transport phenomenon and process operations are the main basis of study. From a general point of view, the use of chemical engineering in aviation can be easily argued upon. But according to a study conducted by **Stanford University** in 2013 which states that - ***No other branch of engineering has such a numerous amount of applications in other fields of engineering as chemical engineering.*** Further in the study it is stated that the aerospace engineering is among the top 3 fields where chemical engineering has vast influence. Thus chemical engineering plays an important role in the field of aviation. So what can be the use of a chemical engineer in aviation industry!

The design of an aeroplane consists of three major parts- conceptual, preliminary and detail design phase. Certain factors like safety, propulsion and aerodynamics should be taken care of. The design of plane is vastly influenced by factors like- the air resistance at a certain altitude, the conditions at that altitude, the atmospheric pressure, the heat of the surroundings etc. among other factors. This is where chemical engineers come into the use. The calculations of all these factors are carried out by using expertise from chemical engineering field. In structural design sector the wing design is very important. It has a mechanism to open and close against high wind resistance to provide the thrust. Here also the mechanism about how by fluid movement inside thin pipes (present in the wings) help the lower part of the wing to open is done by chemical engineers. Next major factor is propulsion. This is the most important part of aircraft design. The propulsion is given by gas engines which help in the movement of the aircraft. The maximum propulsion can be given when the engine is at its highest efficiency level. This can be achieved by using a special grade of oil (nowadays purified kerosene blend is used). Fuel injection mapping which involves the combustion engineering also plays a vital part in the propulsion mechanism. All these features come under the scope of chemical engineering in aviation.



The importance of chemical engineering is immense. Even the composition of alloys used for designing the frame of the aircraft is determined by chemical engineers so that optimum light weight is obtained which can easily withstand the various atmospheric parameters. From design of the aircraft to the type of fuel being used, chemical engineering plays a vital role in this field. Chemical engineers work in almost every aspect of this industry and affect the almost every operation involved.

-Arpan(3<sup>rd</sup> Year Chemical Engineering)



# THE TRANSITION



The popular advice that every student would have received in their schools is, "Work hard, get good marks in your examinations and then enjoy your college life!" Welcome to the ENJOYMENT.

The moment you step into college, your dreary uniforms are replaced by vibrant clothes and your backpacks would have been transformed to a sling bag or in the worst case scenario, to a single long size notebook. You will be very eager to experience the college life that you had imagined based on the hearsay from friends, family and your older siblings on how college life is filled with excitement. The truth is - it entirely depends on you.

The first thing you need to learn is handling the freedom that is given to you. No one will force you to do things. The boundaries between work and leisure will become hazy. Things will be a little more complicated if you stay in hostel. It will be a very different world from school where everything revolves around a timetable. In college, you will realize that timetable is a mere guide.

People from different backgrounds enter this phase of life with the same amount of enthusiasm and hope. This phase of your life is very crucial as it is the foundation for your future dreams. Life perspectives will change. You will need to work more on your personality development amongst other things. A large number of organizations are available for you to develop various skills that are useful for you survive in this competitive world. You will be given umpteen opportunities along with a load of responsibilities. Multitasking - a word you may have used in your school just to boast your talent of watching television while writing your essay, will be an integral part of your day to day life here in college. However, the end results will be on your side if you ace the act of balancing.

## MAINTAINING A BALANCE

Though the term work-life balance seems a bit elusive; it isn't. You need to learn two things to get things straight.

### 1. Say "NO"

Yes, you can always say NO. There will be a lot of things which may attract you but, you need to restrict yourself according to your potential. In simple words, don't bite off more than what you can chew. And saying NO will not be misconstrued as lack of interest. Many organizations like NCC, NSS, YRC, etc. are available to improve your talent. In addition to those, there are various clubs and student bodies where you can learn a lot.

### 2. Prioritise

Prioritizing your work is the most important trait which helps you attain a balance. Set goals in their order of importance. This will help you ignore the trivial things that you come across. If something can be done the next day, do it the next day and focus on the problem that requires your immediate attention.

To all the freshers, Welcome to ACTech! This campus will give you a lot of things, but whether you make this your best four years or the worst four years, is in your hands.

- Sriram R (Alumini AC Tech  
Chemical Engineering  
Batch 2012-2016)





## AGRICULTURE - THE BACKBONE OF INDIA

Chemical Engineers - Sowing seeds for a better tomorrow.

Who are **Chemical engineers**? People who work in chemical industries? No. They are much more. They are versatile. Even known as '**Universal Engineers**' because of their vast technical and scientific knowledge, they convert raw materials into finished products at least cost. So, obviously they play an important role in every possible fields including **agriculture**. Let's see how.

**Chemical fertilizers** which paved the way for **green revolution** in India are the important contribution of chemical engineering. It has made India self-sufficient in terms of producing cereals and grains. **Channeling tractor exhaust** ( a known pollutant ) into a soil enriching additive, combined with the prospects for significantly lower operating costs from the elimination of fertilizer is yet another achievement of chemical engineering.

**Drip irrigation** is a technique of providing water right at the roots, instead of any other irrigation. 30% more yield is produced using this new method due to the major changes in the '**mass transfer**'(an important aspect of chemical engineering) associated with the root structure of the tree. Continuous soil moisture at near-optimum levels allows the plants to devote a greater portion of its energy to synthesize foodstuffs for growth and development thus increasing the yield. Chemical engineering has made significant contributions to **agricultural engineering** which deals with design of machines & equipment used in agriculture, irrigation, etc. Modern farmers have utilized new chemical advances to improve agricultural production with fertilizers & pesticides to develop plentiful food supplies. Plants need carbon, oxygen, hydrogen & nitrogen for growth. Among these,

Nitrogen is not easily available to plants. So, we use fertilizers.

Pesticides are used for protecting plants from damage caused by insects, pests,weeds or disease.

They include **herbicides**, **fungicides**,**insecticides**.

Not only the present but also the future of agriculture is clearly in the hands of chemical engineers. The concept of '**vertical farming**', planting urban farms in towers,skyscrapers or underground,with hydroponically fed crops & artificial lighting to increase food production could be well suited for chemical engineers. They could drastically increase our food yield & reduce further environmental damage. We need **306 million tonnes** ( approx.) of food grain production by **2030** to feed **1.45 billion Indians** & this is not possible without the help of more chemical fertilizers & pesticides.

India is the world's largest importer of chemical fertilizer. So,in future,chemical engineering can help in developing an indigenous source of chemical nutrient. Thus making India an economically developed country. Only the chemical engineers can do something to increase productivity with the help of safer chemicals like the pesticides that undergo photochemical transformation to produce metabolites ( non-toxic to humans & environment). Chemical engineering thus **directly & indirectly impacts agriculture** & assists in its every level. The role of chemical engineers in agriculture is essential to put up with the increasing demand for agricultural output.



-V.Reshma Sona  
(2<sup>nd</sup> Year Chemical Engg)

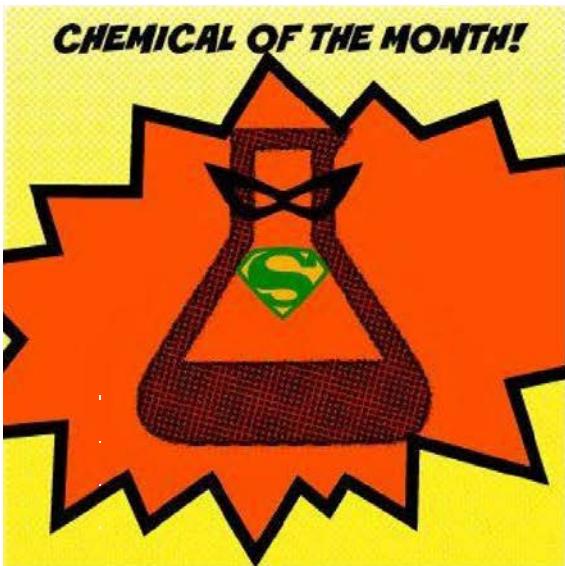
# NANOROBOTICS

The world has changed so much since the time of evolution, that we are in a state of fleet and everything should be handy and ready to go. That's where Nanorobotics comes into play. Nanorobotics is an emerging field of technology creating machines or robots whose components are close to the scale of a nanometer. Nano-machines are largely used in the research and development phase. Some of the main areas of application of nanorobotics are Biochips, 3-D printing and nanomedicine.

3D printing is the process by which a three-dimensional structure is built through the various processes of additive manufacturing. Nanoscale 3D printing involves many of the same process, incorporated at a much smaller scale. In order to print a structure in the  $5\text{-}400 \mu\text{m}$  scale, the precision of the 3D printing machine is improved greatly.

The most important use of the Nanobots are in the field of medicine. The potential applications of the nanobots include early diagnosis and targeted drug delivery. The future medical nanotechnology is expected to employ nanorobots injected into the patient to perform. Another useful application of nanorobots is assisting in the repair of tissue cells alongside white blood cells work at a cellular level. Such nanorobots intended for use in medicine should be non-replicating. Because of their small size nanorobots could attach themselves to the surface of recruited white cells, to squeeze their way out through the walls of blood vessels and arrive at the injury site, where they can assist in the tissue repair process. Certain substances could possibly be utilized to accelerate the recovery. Nanorobotics is clearly a way of the future.

-Supraja (3<sup>rd</sup> year Chemical Engg.)



### TRANSFORMATIONS & SUPERPOWERS:

IUPAC NAME	<b>2-(2-Carboxylato-ethyl)-1, 1, 1-trimethylhydrazinium</b>
FORMULA	<b>C<sub>6</sub>H<sub>14</sub>N<sub>2</sub>O<sub>2</sub></b>
MOLECULAR MASS	<b>147.19 g/mol</b>
TRADE NAME	<b>MILDRONATE</b>
MELTING POINT	<b>85-90 degree Celcius</b>

Meldonium (or Mildronate) is a drug that made it into the news a while back, thanks to the former number one tennis player Maria Sharapova, who tested positive for same. Since 1 January 2016, it has been on the world Anti-Doping Agency list of substances banned from use by athletes before which it was on the 2015 WADA's list of drugs to be monitored. It has been classified as a 'metabolic modulator' which basically means that it has the ability to modify how some hormones accelerate or slow down different enzymatic reactions in our body.

According to the drug's designer, Ivar Kalvins, it was created to increase the body's oxygen carrying capacity. It is principally used to treat angina, heart attacks and in some cases, help reduce withdrawal symptoms in people with alcoholism. Other uses include treating stomach ulcers, eye trauma and infections of the lungs and the upper respiratory tract.

The problem with this drug is that very little information has been published regarding its safety. However, it does have a clear mechanism of action, which could help both the heart and athletic performance. It inhibits a substance called L-carnitine in our body (Heads up: L-carnitine transports fatty acids to the mitochondria, where they are burned for energy). Therefore, by blocking it, Meladonium forces our mitochondria to metabolize glucose for energy instead, which requires less oxygen. In other words it enables efficient use of energy. For these reasons, it enhances athletic performance and shortens recovery time after a strenuous workout session, which are reasons enough to make it into the list of banned drugs.



# CAMPUS DIARIES

Alagappa College of Technology was started in 1944 after Alagappa Chettiar donated five hundred thousand rupees for its establishment. After seven decades, it's become a college known for its rich heritage and timeless reputation for the different courses it offers in B. Tech programs. Chemical engineering, textile technology, and biotechnology are some of them. It still stands proud and tall with students passing out and being remembered as outstanding alumni. The college has a much-needed reputation to handle so the syllabus will be broad and tough to handle as compared to other colleges. Moreover, it gets periodically updated to keep up with the modern day technology and advancements. AC Tech, in short, will be a place where your talents can be showcased and aid you in bringing out your best potential but it's also a place where lasting friendships and memories can be made.

Just like any fresher, even I had hopes and dreams when I entered into my first year in college. The first major lesson I learnt was, nothing, I repeat nothing is like the movies where they depict college as a time full of glamour and party. However, I learnt what living and enjoyment truly are during my first year. Balancing studies, sports and social life is no easy feat, but over the course of a year, I did learn a trick or two.

Studying had always been a stressful thing even before entering college but with the new found freedom, it was rare for me to make time to study when I had no proper incentives. So it all went down the last minute studying and pulling an all-nighter so that I may clear the subject leaving no arrears. I always had this wrong mindset that keeping arrears were part of college life and it would be cool to be part of this wonderful tradition, but sanity won me over when I realised the extra workload would be too straining for anyone to handle. So back to the reference books and notebooks I went, hoping and praying simultaneously that clearing the subject would be a task I would ease through.

Frankly, I love football. Totally adore the game and have a huge enthusiasm when it comes to playing the sport with anyone. So my love for the game brought me down to the pitch and started playing for the college. It had always been an amazing thing to see the seniors play the game flawlessly also teach you on how to attain the same level of expertise they have. Once I started playing with the crowd, I came to see the whole experience isn't only about the game but also getting to know your fellow players who are in both ACT and CEG campus.





Students from different parts of Tamilnadu and from other states end up in our college bringing about a vibrant community. I was blessed with a lively class who would do anything from sitting quietly in class and studying to screaming from the top of their lungs when the celebrities walk up the stage. Everyone I met throughout the year had one way or another influenced me, generally shaping my first year. One of my best experience was taking part in competitions during grand scale technical and cultural events like Kurukshestra ,Techofest, Kalakrithi and Sampradha. There isn't any better thrill than giving it your all, along with your team-mates, while trying to aim for the first prize in any competitive event. It just came to show with time and freedom in my hands I become the master of my future and dictate how I want to prioritize my time.



Be it the times where I attended classes and studiously took down notes or those times where sleep deprivation made my eyes too heavy. Be it the moments where I took an initiative to take part in competitions and attempt to win it or just let myself loose and danced to the tunes during DJ night . Be it the tension that assessments and semesters brought me or the joy of attaining unexpected grades and marks for any subject studied mere hours before an exam. These were my experience as I lived through my first year and pretty much the same situation for anyone in this college. But if you are a first year who is reading this, remember this is only my version of a diary, it's time for you to make your experience and write your own ACT Diary.

-Jebin(2<sup>nd</sup> Year Chemical Engineering)



# SUMMER INTERN!

Beaches along the east coast & part of the West coast of our country's long coastline contain an assemblage of heavy minerals like Garnet, Ilmenite, Rutile, Zircon etc., I was informed that these deposits are known as "Placer deposits". Our country has the largest reserves of such beach Placers in the world. India ranks first in the exports of Garnet & Ilmenite in the world in the last decade, pushing Australia, China behind. Of the four states exporting Garnet from our country, Tamil Nadu ranks first.

I had the privilege of doing my "in-plant training" at INDIAN OCEAN GARNET SANDS (IOGS) in Tuticorin starting on the 27<sup>th</sup> of June for a period of 4 days.

Why did you do an intern very early??? You are just in the first year, you haven't even gone into the core of chemical engineering, why do an intern now?? These were the questions that were posed to me by my friends and professors. To answer all their queries, Firstly I did an intern so that I could get a basic insight of working in a plant. This trip has taught me a lot of things which will definitely be useful for me when I join the industry. It has taught me the values of punctuality, perseverance, diligence and patience, qualities which are an absolute necessity while working in a factory. Secondly, Instead of whiling away my holidays reading novels and watching television all day long, I thought I could use this opportunity to ease the burden of doing a project in my final year and focus my time on studying for the entrance exams for PG.

IOGS (INDIAN OCEAN GARNET SANDS LIMITED) located in Tuticorin is one of the leading exporter of Garnet for the past three decades. They have established four mineral processing facilities with most modern & sophisticated Plant & Machinery, the bulk of them were imported from USA & Australia. One is located near the mine site, called 'Pre concentration' unit, while the rest three are located in Tuticorin for exporting Finished Garnet via the Tuticorin Port, located 14km away from Tuticorin. IOGS, have been securing Awards of excellence in the exports of Garnet maintaining the best Environmental standards from the Govt., of India for the past 20 years consecutively. Garnet (General formula A<sub>3</sub>B<sub>2</sub>(SiO<sub>4</sub>)<sub>3</sub>) is the general name used for a large group of minerals. It is found in many colours and many shapes but is generally dark red in colour and in the form of pebbles, small aggregates and crystals. Garnet has been used as a gemstone for 150 years, it is a good abrasive and is used as a filter media.

## ABOUT THE PROCESS:

1. The raw heavy minerals [beach] sand comprises 55-60% of Silica; 30- 35% of Garnet; 3-5% of Ilmenite and small quantities of Rutile & Zircon.
2. The constituent minerals are in loose & un-combined form.
3. The minerals have varying specific gravity; Magnetic and Electrical responses. These properties are being made use in the separation of the heavy minerals in the 'dry state' without using any chemical reagents.

## PRECONCENTRATION:

This facility is located about 7 km from the mining area in Navaledi village, about 90 km from Tuticorin. Since the raw sand mined from the coast contains 60-65% of silica, the bulk of it is being removed in the Pre-con unit, which is equipped with a bank of spirals and cross flow separators. Three separate streams of concentrates are recovered—

- Silica tailings containing 96-97% Silica.
- Garnet stream having 70-75% garnet, 1-3% Ilmenite and Other heavy minerals.
- 75-80% Ilmenite and 10% of Garnet.

Thus the garnet content of 30-35% in the raw sand is upgraded to 70 - 75% in the 1<sup>st</sup> stage. Over 85-90% of water is recycled. Since no chemical reagents are used in the process, the discharged water does not contain any harmful elements.

## GARNET FACILITY:

This unit is located near Tuticorin. The Garnet Concentration {output} of the Pre-con unit is the "feed stock" for this unit. Here the concentrate is passed through "Magnetic drums" & Magnetic rolls. Three fractions of concentrates- Silica {non-magnetic}, Garnet {Paramagnetic}, Ilmenite {highly magnetic} are recovered. The Garnet concentrate so recovered in the 2<sup>nd</sup> stage contains 98.5 -99.0% Garnet. The upgraded {Pure} Garnet concentrate {product} is passed through adjustable, vibrating screens to obtain different grades such as # -20 + 40; # -30 +60; # -60 +80 ; # -80 +100. The # -20 + 40 mesh size [Coarse grade] is used in "Water filtration". The -30 +60 mesh [Medium] size is called the "Abrasive grade" and is used mainly in the ship maintenance for the removal of rust, salt encrustations on the surface of the ships. The # -80 mesh [Fine] size is called "Water Jet" grade, which is used in Aircraft industry. The different grades are packed in Jumbo bags for exports.



# IOGS

means

## Indian Ocean Garnet Sands Company Private Limited



### Quality Control:

IOGS have set up a fully equipped Laboratory for conducting rigid Quality checks on the Garnet sands meant for exports. The "Chloride level" is monitored closely, since the tolerable level in the Abrasive grade is only 20 PPM { 0.000020%}, since it is likely to affect in the "surface preparation" in the Ships.

### Environment Aspects:

Since the mineral separation processes at all stages are being done in the "dry state" and as the units are provided with dust collector systems, there are no Air and Dust pollutions within the plants. Likewise the Water discharged from the Pre con unit does not contain any harmful elements, since no chemical reagents are used.

### Tests:

The technicians (at the factory) conduct a number of tests to test the quality of Garnet produced. Only when the Garnet satisfies all the tests is the product packed for sale, otherwise the wasted garnet is then processed again until it satisfies the tests. The tests involved include conductivity test (conductivity meter), chloride test (done using titration), purity test, turbidity test (nephelometry) and sieve analysis.

### About the experience:

The trip was an instructive and memorable one. The exposure of working in a factory and interacting with various experts in the field has helped me accumulate heaps of knowledge on the topic and will keep in good stead for the future. This trip has shown me that chemistry is everywhere/omnipresent and even the smallest things in life matter a lot for example even from the smallest grain molecules in sand we can create something useful for mankind. I thoroughly enjoyed this intern and I look forward to going one pretty soon in the future.

### Acknowledgements:

I would like to place on record my gratitude to Mr. M.Ramesh, Mg. Director of IOGS for having permitted me to undergo the training in the IOGS facilities, as a special gesture.

My profound thanks to Mr. Cm. Mani, Technical consultant {Ex- GM of Indian Rare Earths, a Govt., of India Enterprise} for his guidance and lectures, in the midst of his work.

My sincere thanks are also due to –

Mr. Madhankumar, GM & Process Engineer and Mr.S.Arumuhum, Senior Geologist and other Supervisors and Technicians in the four units.



Srikanth V Srinivas (2<sup>nd</sup> Year Chemical Engineering)





## IICChE : INDIAN INSTITUTE OF CHEMICAL ENGINEERS

Indian Institute of Chemical Engineers was born just before the Indian Independence during the days fomenting with nationalistic inspirations. Dr Hira Lal Roy was the great visionary and pioneer of chemical engineering education in India who went on to inaugurate it on 18 May 1947.

The activities of the Institute are spread across the country through its 33 Regional Centres and 58 Student Chapters apart from the HQ located in a five-storied building at Jadavpur University campus. The Regional Centres promote and complement the activities and objectives of the Institute within their respective territorial limits by organizing meetings, conferences and seminars, arranging workshops, refresher courses and counselling sessions; promoting research; guiding chemical engineering students in career planning and initiating any other activities which are of social, technical and professional relevance to their members. They serve as an open forum to its members who regularly gather for informal get-togethers and exchange notes. The Regional Centres also confer awards, prizes and scholarships.

Student members pursuing under-graduate degrees in Chemical Engineering form Student Chapters, under the auspices of the respective Regional Centres. The Student Chapters also arrange lectures, seminars, short courses, plant visits, etc., at regular intervals to better equip and empower the students when they come out of their academic precincts. Academic activities apart, Student Chapters organize cultural events and sports activities for their members.

Indian Institute Of Chemical Engineers is a confluence of streams of professionals from academia, research institutes and industry. It provides them the appropriate forum for joint endeavours to work hand-in-hand for human beings through application of chemical engineering and allied sciences. If you are interested about, attached to or involved in chemical engineering related activities – whether as a student or as a seasoned professional - you shall find the programme of IICChE immensely beneficial, opening up doors to new possibilities.

Over the years the Institute has developed a distinct profile of its own. Even as the IICChE is always moulding itself and playing a proactive role to keep up with the ever changing needs of the society and the economy, the basic objectives remain largely unchanged since its inception.

One of our primary focus is to make CHEMCON a successful event. CHEMCON is a national level chemical conference held every year in various centres in India. It is associated with **the 69<sup>th</sup> annual session of IICChE and the Indo-Canadian international symposium on SUSTAINABLE ENERGY-energy for all.** The theme for CHEMCON 2016 is chemical engineers towards a sustainable development. It is grand event wherein thriving chemical engineers present themselves the opportunity of being a part of numerous technical sessions . This year it is to be held in Chennai and all the IICChE student chapters are competing for the title of “best student chapter 2016”.

In ACT, CHEMCON'2016.

Chairman: Dr.N.Nagendra Gandhi

#### Technical committee

- Convener: Dr.M.Velan, Professor
- Co-convener: Dr.Lima Rose Miranda, Professor

#### Finance committee

- Convener: Mr.S.Sekar, EC Member, IChE CRC
- Co-convener: Dr.D.Mohan, Professor

#### The Publication committee

- Convener: Dr.N.Balasubramanian

Being a member of IChE gives one access to unlimited resources from journals published at the National level to the various options of being a chemical engineer.

Monthly lectures will be organised giving students a flash of the chemical engineering world. Wide variety of events are conducted giving everyone involved with chemical engineering a platform to showcase their talents, ideas, innovations and knowledge. And events such as WORLD ENVIRONMENTAL DAY PROGRAM and INDUSTRIAL SAFETY have been conducted as well.

A chemical engineer plays a vital role in every aspect of life – from generating power to producing paper , so any innovative idea or a scratch of thought is appreciated and IChE guides one such candidate to come forth in life.

Due to the incessant support from the faculty members of ACT, IChE has been able to create a well renowned name seizing new members every day.

The IChE welcomes all into its fold - the aspiring chemical engineers of the future as well as veterans with vast experience. The membership to the Institute in itself is an accomplishment that stands good in one's future career. The horizon of chemical engineering is fast widening with newer disciplines merging with it and new ideas emerging. As a member of the Institute, one gets plenty of opportunities to share the platform with many well-known academicians and established professionals in one's field. These interactions help one to constantly update and equip oneself so as to keep pace with the fast-changing professional scenario. Also equally important, as one becomes a member of this network of fellow professionals with multifarious connections, one can derive rich dividends to further one's professional goals.

So what are you waiting for? Stand to become a member of IChE.



# EXPLORING THE DEEP BLUES AND BEYOND

Some chemical engineers match the stereotype of an 'ivory tower' researcher, tightly focused on a narrow specialty that's studied in isolation. Others are the exact opposite, engaging in multidisciplinary studies where numerous specialities intersect and interact. Chemical oceanography is an example of a multidisciplinary field. It intersects with geology, marine biology, physics and biochemistry and other branches of oceanography.

## Chemical Oceanography Basics

To a chemical oceanographer, the world's oceans are a complex chemical solution. Its exact composition varies sharply from one location to another, depending on its levels of salt and other chemical substances. The oceans' chemical processes both reflect and affect a number of other factors that influence their behaviour, ranging from the physical effect of currents and coastline to the daily activities of aquatic plants and animals. Defining the interactions between the ocean's chemistry and those other factors is a chemical oceanographer's primary role.

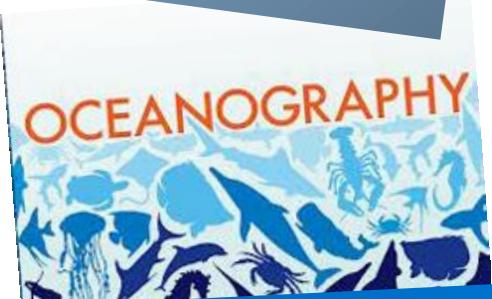
## Skill set

Chemical oceanographers draw on a broad and complex set of skills. They must have a specialist's understanding of chemistry, including biochemistry and biochemical processes. Their work also requires a broad grasp of the other branches of oceanography, including the geographic and physical forces at work in the oceans. Analyzing water samples and creating sophisticated computer models to explain, replicate or predict ocean behaviour are among the most important parts of a chemical oceanographer's job, so high-end computer and programming skills are also valuable. Chemical oceanographers also need a strong grasp of advanced mathematics and statistics to interpret their research data.



## Area of study

The earth's surface is relatively well explored, but the oceans are still rich in untapped research opportunities. A chemical oceanographer might study the effects of pollutants on sea water and oceanic life, or the ability of some oceanic life to break down and trap pollutants. The interactions between the ocean and the atmosphere, and especially the ocean's role in trapping oxygen, are other areas of interest. Chemical oceanographers also study hydrothermal vents, the deep-sea geysers spewing hot, chemical-rich water into the ocean. Many specialized species have adapted to a life based on the energy and chemicals from these vents, and chemical oceanographers play a role in understanding these relationships.



## The Career

Oceanographers usually begin their career with an undergraduate degree in oceanography or marine science. Chemical oceanographers typically minor or double-major in chemistry, or begin with a bachelor's degree in chemical engineering and add a graduate degree with chemical oceanography. Oceanographers with a bachelor's degree can participate in field work, but most positions require a master's degree or doctorate. The Bureau of Labor Statistics projects 16 percent job growth for geoscientists, a group including oceanographers, by 2020. The actual number of job openings is likely to be higher, as older researchers retire and make way for new scientists.

-Abhinav (Final year, Chemical Engineering)

# BONKERS ABOUT ANGRY BIRDS AND SPACE

YOU MUST BE WONDERING HOW GAMES AND SPACE BE INTERLINKED. DURING EXPEDITION 30, NASA COOPERATED WITH FINLAND-BASED ROVIO ENTERTAINMENT, CREATOR OF THE ANGRY BIRDS FRANCHISE, THEY MADE A VIDEO BY USING AN ANGRY BIRDS CHARACTER TO EXPLAIN HOW PHYSICS WORKS IN SPACE, DEMONSTRATING TRAJECTORIES IN MICROGRAVITY BY CATAULPTING A RED BIRD THROUGH THE SPACE STATION. NASA STATED THAT SUCH COLLABORATION SHARES THE EXCITEMENT OF SPACE WITH THE GAME COMMUNITY, EDUCATE USERS ON NASA'S PROGRAMS, AND CREATE INTERACTIVE EDUCATIONAL EXPERIENCES FOR THE PUBLIC. A FOOTAGE WAS RELEASED BY NASA BOTH ON ITS OFFICIAL SITE AND YOUTUBE ALONG WITH ANOTHER COMMERCIAL VERSION BY ROVIO TO ANNOUNCE THE LAUNCH OF NEW GAME ANGRY BIRDS SPACE.

THE GENIUS BEHIND THIS IS DONALD PETTIT, WHO IS A CHEMICAL ENGINEER AND A NASA ASTRONAUT. HE IS A VETERAN OF TWO LONG-DURATION STAYS ABOARD THE INTERNATIONAL SPACE STATION, ONE SPACE SHUTTLE MISSION AND A SIX-WEEK EXPEDITION TO FIND METEORITES IN ANTARCTICA.

WHO COULD EVER IMAGINE USING THE MATERIALS WE SEE AND LEARN IN SPACE CAN BE USED IN ANGRY BIRDS OR IN VIDEO GAMES FOR SHORT. MY DEAR READERS ITS TIME TO BUILD THE FLOORS FOR BUILDING YOUR KNOWLEDGE. IF YOU ARE INTERESTED IN SPACE AND EXPLORING THE WORLD BEYOND THIS ONE I STRONGLY SUGGEST YOU TO OPEN YOUR DOORS AND FLY AS YOU HAVE CHOSEN THE RIGHT FIELD TO DO SO. WE BEING ENGINEERS HAVE THE ABILITY TO BE A PART OF THE SOLAR SYSTEM AND NOT JUST THE PART OF THE LARGE ARABLE-GREEN MASS.



Donald Pettit

- LAKSHANA V (3<sup>RD</sup> YEAR CHEMICAL ENGINEERING)



According to statistics, there are still more than 1.1 billion people in this world who don't have access to electricity which means that when the sun sets, these people have to rely on sources such as kerosene lamps to carry out their daily chores. Now, the thing about kerosene lamps is that not only are they expensive - but they also pose as a serious health hazard. Another pressing matter here is the fact that the burning of Kerosene for lighting produces 244 million tonnes of Carbon Dioxide annually.

One might believe that the end to this issue would be by using solar powered lighting. But then multiple problems arise even in this case as the energy from the sun needs to be stored in a battery to produce light when it gets dark. The amount of energy stored depends upon the size of the batteries and the panel, which once again brings us back to square one as these are very expensive.

The ultimate solution was given by two Designers Martin Riddiford and Jim Reeves who truly realised the need to look beyond solar and battery powered devices. One of the first basic designs involved a slowly falling weight attached to a bicycle wheel. Upon further modifications, the final prototype was prepared by 2012. However, in order to get this product out there and get the required feedback, funding became crucial. So they took to a crowdfunding campaign on Indiegogo and within 30 days they had raised \$399,590.

This overwhelming support enabled the team to further improve the design and make it more accessible.

So how does this work?

Using the Gravity Light simply requires removing the small white lamp from its bag, hanging it up, filling the bag with about 20 pounds of dirt or rocks, and attaching the bag to bottom of the device. Gravity powers a generator, light fills your room, and every 30 minutes, you hoist the bag back up. The duration and power level/brightness are adjustable between just over 30 minutes and about 18 minutes depending on what the bag is filled with.

Also it has been found that gravity light is more efficient than kerosene lamps which is a huge bonus.

Hence, gravity light could truly prove to be a simple yet effective replacement of conventional lamps.

-Sucharita (3<sup>rd</sup> Year Chemical Engg.)

# ORGANIC FARMING

The demand for Organic product is the latest trend in this era. Organic products are considered to be healthier, more nutritious compared to inorganic products.

Inorganic products not only contain additives such as sweetening chemicals for sweetness or preservatives to give the product more life- but inorganic products right from farming are being exposed to chemicals.

The farming pattern plays a vital role in the quality of product cultivated. Farmers these days, in order to control pests, use chemical pesticides like cypermethrin, epoxiconazole, D-tetramethrin. These are chemicals that are harmful to humans when used in excess. These chemicals cannot be washed off by simple washing of crops before consumption.

Apart from the use of chemicals alone farmers also use specific chemicals such as insecticides, fungicides and herbicides. All these chemicals drain our pockets.

Organic farming doesn't only give a very posh look but also establishes the fact that the style of farming and cultivating is different from that of ordinary products.

Straight from the use of fertilisers to the plantation of seeds it follows a complete organic procedure. The crop is never exposed to any form of chemical pesticides or harmful chemicals, they are cultivated in a complete organic method free from chemicals.

Organic products vary from fresh fruits, vegetables, herbs and even breads.

Essential oils which are prominently considered organic nowadays are made up of mineral oils so as to increase the shelf life of the products.

Mineral oils are added in cooking oils as well as in cosmetics; the major reason behind its usage is the excess availability of mineral oil compared to organic healthy cooking oils such as sunflower oil etc. producing such oils organically and selling it under the section of organic products making them available for everyone. Some of the famous organic cosmetics are Forest Essentials and Kama Ayurveda.

The use of organic substances in manufacturing cosmetics ensures good quality. The demands for such products have gone up irrespective of its expenses.

Lately entrepreneurs have taken an interest in organic farming and in the substantial production of organic products. Shri Gowtham Balaji is a successful entrepreneur in the field of organic farming. He has established farming grounds in Thanjavur.

Nowadays a lot of rural farmers have opted for organic farming. It's not rocket science to know the pattern and process, once taught the farmers are able to produce rich organic crops.

The government has also contributed in the idea of organic farming and organic merchandises. Organic products ensure good quality, high nutrient content and it a better alternative for products produced in the presence of chemical. The government's interest in organic farming is to boost the economy. It aims to create a well-recognised standard in farming as agriculture is the backbone of the nation.

Though organic products are sold at a higher rate compared to inorganic products, they are worth the buy.

## BIRTHDAYS OF NOTABLE SCIENTISTS AND ENGINEERS IN AUGUST

August 8

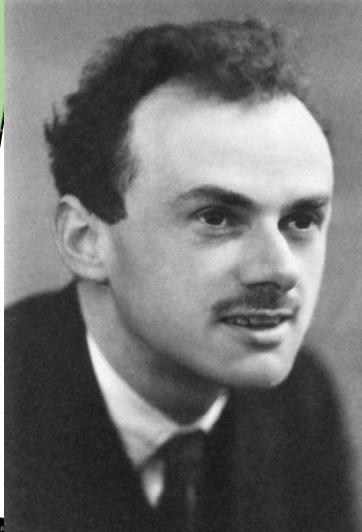
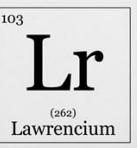
**1901** Ernest Orlando Lawrence (August 8, 1901 – August 27, 1958) was a pioneering American nuclear scientist and winner of the Nobel Prize in Physics in 1939 for his **invention of the cyclotron**. He is known for his work on uranium-isotope separation for the Manhattan Project, for founding the Lawrence Berkeley National Laboratory And the Lawrence Livermore National Laboratory. Chemical Element number 103, discovered at the Lawrence Berkeley National Laboratory in 1961, was named **Lawrencium** after him.



**August 8 1902**

Paul Adrien Maurice Dirac (8 August 1902 – 20 October 1984) was an English theoretical physicist who made fundamental contributions to the early development of both quantum mechanics and quantum electrodynamics. He was the Lucasian Professor of Mathematics at the University of Cambridge, a member of the Centre for Theoretical Studies, University of Miami, and spent the last decade of his life at Florida State University. Among other discoveries, he formulated the Dirac equation, which describes the behaviour of fermions and predicted the existence of antimatter. Dirac shared the Nobel Prize in Physics for 1933 with Erwin Schrödinger, "for the discovery of new productive forms of atomic theory". He also did work that forms the basis of modern attempts to reconcile general relativity with quantum mechanics. He was regarded by his friends and colleagues as unusual in character. Albert Einstein said of him, "This balancing on the dizzying path between genius and madness is awful".

His mathematical brilliance, however, means he is regarded one of the most significant physicists of the 20<sup>th</sup> century.



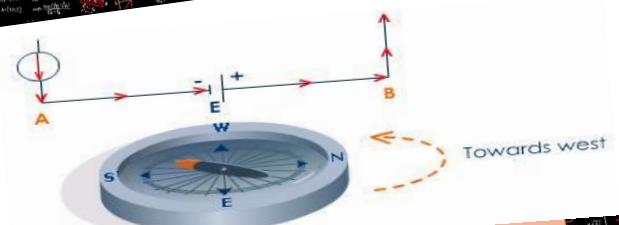
Dirac Equation

$$\left( \beta mc^2 + \sum_{k=1}^3 \alpha_k p_k c \right) \psi(\mathbf{x}, t) = i\hbar \frac{\partial \psi(\mathbf{x}, t)}{\partial t}$$



1777

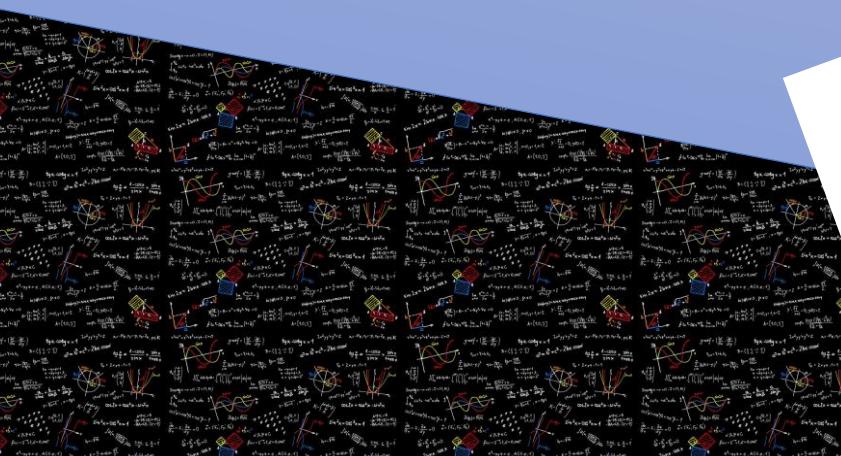
Hans Christian Ørsted (often rendered Oersted in English; 14 August 1777 – 9 March 1851) was a Danish physicist and chemist who discovered that electric currents create magnetic fields, which was the first connection found between electricity and magnetism. He is still known today for Oersted's Law. He shaped post-Kantian philosophy and advances in science throughout the late 19th century.



**August 24, 1918**

Otis Ray McIntire was born in Gardner, Kansas on August 24, 1918. After graduating from the University of Kansas with a B.S. degree in engineering in 1940, he went to work as a research engineer for The Dow Chemical Company. During World War II, when rubber was in short supply, McIntire's work focused on developing a rubber-like substance that could be used as a flexible insulator. In an experiment, in which he combined styrene with isobutylene, he created a unique material that was solid yet flexible due to the tiny bubbles formed by isobutylene within the styrene. McIntire had invented foam polystyrene, more commonly known by its brand name Styrofoam that was 30 times lighter and more flexible than solid polystyrene. It was also inexpensive and moisture resistant.

McIntire remained at The Dow Chemical Company for his entire career. He was promoted to research director, and later worked in the company's consumer and venture capital divisions. He retired in 1981 as Dow's director of technology and acquisition. In March 2008, McIntire was inducted to the National Inventors Hall of Fame.



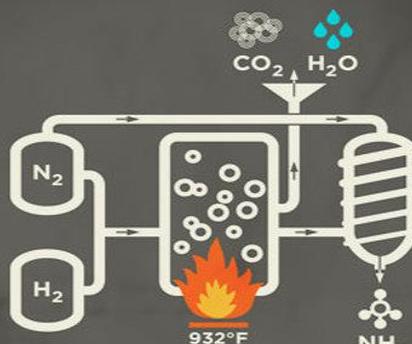
## August 26, 1743

Antoine-Laurent de Lavoisier (also Antoine Lavoisier after the French Revolution; French pronunciation: (26 August 1743 – 8 May 1794) was a French nobleman and chemist central to the 18th century chemical revolution and had a large influence on both the history of chemistry and the history of biology. He is widely considered in popular literature as the "father of modern chemistry". It is generally accepted that Lavoisier's great accomplishments in chemistry largely stem from his changing the science from a qualitative to a quantitative one. Lavoisier is most noted for his discovery of the role oxygen plays in combustion. He recognized and named oxygen (1778) and hydrogen (1783) and opposed the phlogiston theory. Lavoisier helped construct the metric system, wrote the first extensive list of elements, and helped to reform chemical nomenclature. He predicted the existence of silicon (1787) and was also the first to establish that sulphur was an element (1777) rather than a compound. He discovered that, although matter may change its form or shape, its mass always remains the same.



## August 27

1874 Carl Bosch (27 August 1874 – 26 April 1940) was a German chemist and engineer and Nobel laureate in chemistry. He was a pioneer in the field of high-pressure industrial chemistry and founder of IG Farben, at one point the world's largest chemical company. His most notable achievement is the Haber-Bosch process where he took Fritz Haber's table top demonstration of a method to fix nitrogen using high-pressure chemistry into an important industrial process to produce megatons of fertilizer and explosives. His contribution was to make this process work on a large industrial scale.



-Sehaj Singh Walia (3rd Year Chemical Engineering)



# WHAT'S INSIDE YOUR SMARTPHONE ?

## SMARTPHONES - SMART CHEMISTRY

**To Pathways**

**Smartphones** -One of the necessary things to live on planet Earth. Fact !Over 967 million smartphones are sold worldwide every year. Ever wondered what is in your smartphone. It is purely smart chemistry.Of 83 stable (non-radioactive) elements in a periodic table, about 70 are used in an average smartphone.(i.e.)84% of all the stable elements.. Actually we can divide a phone into 7 components:

**DISPLAY**  
Rare earth elements play a vital role in producing colours in the liquid crystal display of a smartphone. Yttrium(Y), Europium(Eu) and Dysprosium(Dy) are responsible for the colours in the display. Lanthanum(La),Terbium(Tb) and Gadolinium(Gd) give the screen its glow.

**GLASS**  
Aluminosilicate glass, usually made of alumina( $Al_2O_3$ ) & Silica( $SiO_2$ ),along with sodium ions, is used.'Gorilla glass' which can withstand 100,000 pounds of pressure per square inch, is the latest in the market. It is just a glass dipped in molten potassium salt at  $400^{\circ}C$  ,wherein  $Na^+$  ions in glass are replaced by larger  $K^+$  ions from salt bath.Larger ions occupy more volume & create a surface layer of high residual compressive stress, thus resulting in its strength.

**TOUCH SCREEN**  
Glasses do not conduct electricity.So,a thin transparent conducting layer of Indium tin oxide ( a mixture of  $In_2O_3$  &  $SnO_2$  ) is applied over the glass.When you touch the screen,a change in the electrical field occurs and communicates your finger's location to the phone's chip.

**CHIP**  
The chip is the phone's brain. It has many transistors, which act as paths and switches that tell the phone to follow or stop following commands are made of antimony(Sb),phosphorous(P) and Gallium arsenide (GaAs).The chip is embedded in oxidized silicon(Si) ( non-conductive ) to channel electricity only through the conductive transistors.

**CIRCUITRY**  
For every million cellphones processed ,over 17 tons of Copper and 1/3 of a ton of silver is used.And each smartphone has 300 mg of gold and 30 mg of silver in it.You can find them in the microelectrical components of the circuit board. The connectors are coated in gold .Microcapacitors are made of Tantalum(Ta).The wiring is copper(Cu).Solder-an alloy of tin(Sn),silver(Ag) & copper(Cu)-bind parts of the circuit board.

**BATTERY**  
Most of the phones use Lithium-ion batteries in which Lithium cobalt oxide is used as cathode and Graphite as anode.The battery's casing is made of aluminum(Al).

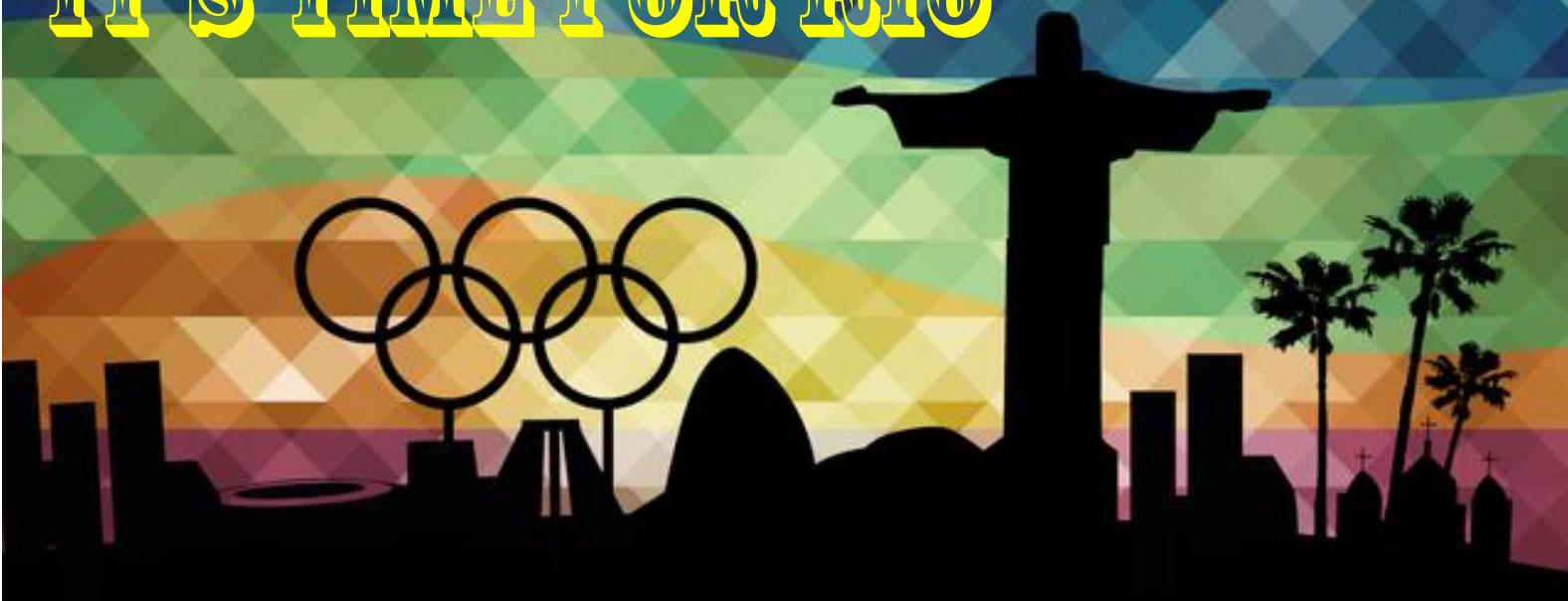
**MICROPHONE & SPEAKERS**  
The microphone's wafer thin diaphragm, which vibrates when sound wave strikes it,is made of nickel(Ni).The vibrations are converted into an electrical current that becomes the audio signal.Magnets of microphone &speakers are the strongest neodymium magnets( $Nd_2Fe_14B$ ).

**iMessage**

So, whenever you think of your phone, remember you're having a little treasure chest in your pocket. Because it is immensely **PRECIOUS !**

-V.Reshma Sona (2<sup>nd</sup> Year Chemical Engineering)

# IT'S TIME FOR RIO



Sports are one of the function systems of modern societies. It is generally recognized as a system of activities which are based on physical athleticism or physical dexterity. And the Olympics is one of the major events to go by the above definition. The Games of the XXXI Olympiad, and commonly known as Rio 2016, is a major international multi-sport event in the tradition of the Olympic Games in which over 11,000 athletes over 306 nations are taking part. The lead-up to these Games have been marked by controversies including the significant pollution in the Guanabara Bay, health and safety concerns surrounding the Zika virus, as well as the doping scandal which has affected the participation of athletes in the Games.

The Zika virus also known as Zika fever is a member of the virus family Flaviviridae. It is spread by the day time active Aedes mosquitoes. Since the 1950s, it has been known to occur within a narrow equatorial belt from Africa to Asia. Brazil has been severely affected by this outbreak and due to this quite a few high-profile athletes have been pulled out of the Olympics and several others have expressed their concerns over the virus.

Another major problem faced at the Olympics is the usage of self enhancement drugs or doping by the athletes. The kind of drugs taken by them can be in the form of blood doping, narcotics, stimulants or by intake of alcohol. The World Anti-Doping Agency listed about 40 banned substances and techniques in the year 2011. The basic use of the drugs is to increase the level of blood cells thereby improving oxygen transport and athletic endurance. The use of these drugs dates back to as early as 1807, when a Britain contestant used Laudnum, in order to stay awake for a whole week to compete. Some of the banned drugs are, Ephedrine, Nandrolene, Methylhexaneamine. In 2015, due to allegations of an extensive state sponsored doping program in the Russian Federation, the World Anti-Doping Agency (WADA) commissioned an investigation into the accusations. Due to this, 389 athletes sent for the competition by Russia, only 278 of them were eligible to participate in 2016.

Despite the consequences faced by the athletes or a country as a whole, The Olympics is a platform that showcases one's true passion for the sport.

As quoted by Heywood Brown "Sports do not build character, they reveal it."

-Supraja (3<sup>rd</sup> Year Chemical Engineering)

# HOROSCOPE

## ARIES (March 21-April 20)



Pleasure trips should be on your agenda. Don't let situations get out of control. Plan to get together with someone special later in the day. Opportunities for love will develop while traveling or while attending religious functions. Your luckiest events this month will occur on a Sunday.

You might find group functions tiring. Don't invest too much of your own money. Get together with those you find men tally stimulating. An older loved one may be having problems. Your luckiest events this month will occur on a Sunday.

## TAURUS (April 21-May 21)



## GEMINI (May 22-June 21)



Abstain from getting involved with married individuals. You will gain a lot if you listen. You may find that purchases or entertainment could be expensive. You can make major accomplishments while on short trips. Your luckiest events this month will occur on a Thursday.

## CANCER (June 22-July 22)

You're likely to encounter new partners if you take short trips. Your emotions will be touched off concerning recent encounters with your lover. Build on friendship rather than starting out in an intimate encounter. You need to look into some private matters before you can proceed with your plans. Your luckiest events this month will occur on a Sunday.



## LEO (July 23-August 22)



It will be all around you. This may not be the day to get involved in risky joint financial ventures. You will learn valuable skills if you sign up for seminars this month. A lot can be accomplished if you organize your time. Your luckiest events this month will occur on a Wednesday.

Don't be too quick to judge others. Chances to express your ideas and beliefs can bring popularity as long as you're not arrogant. Your reputation may be at stake if you partake in gossip. Lowered vitality could affect your work. Your luckiest events this month will occur on a Sunday.

## VIRGO (August 23 -September 23)



## LIBRA (September 24 -October 23)



Don't do something silly just to get back at your mate. Help elders with their concerns. Don't start a dispute unless you're prepared to accept irreversible results. Love relationships will flourish. Your luckiest events this month will occur on a Wednesday.

Avoid confrontations with co-workers who aren't pulling their weight. You have to let go of your past if you wish to get out of any sentimental mood that might be hanging over your head. Do not lend money or belongings to friends. You will have no problem getting your point across to those in a position to help you. Your luckiest events this month will occur on a Tuesday.

## SCORPIO (October 24 - November 22)



## SAGITTARIUS (November 23 -December 21)



Do you really want to start something with someone you can't reason with? Concentrate on spending quality time with children. Talk to someone with experience about budgets or consolidating debts. You can write beautiful love letters this month. Your luckiest events this month will occur on a Thursday.

Expect temper tantrums on the home front if you haven't been letting someone have their way. You may find travel to be most rewarding. Don't be shy; if you want to spend more time with a special person, make a commitment. Money can be made if you are willing to take a chance. Your luckiest events this month will occur on a Sunday.

## CAPRICORN (December 22 - January 20)



## AQUARIUS (Jan. 21 -Feb. 19)



Put your efforts into job advancement. Don't be too open or put your faith in unreliable co-workers. Your colourful conversation may attract new mates. You may want to get involved in financial investments presented to you. Your luckiest events this month will occur on a Sunday.

You may find yourself in a heated dispute with a friend if you try to change your mind. You can expect the fur to fly on the home front. Make changes in your domestic scene. You may find that getting together with colleagues after hours will be worthwhile. Your luckiest events this month will occur on a Friday.

## PISCES (Feb. 20-Mar. 20)





-Neel Barge (3<sup>rd</sup> Year Chemical Engineering)

Goa today is known for 3 F's football, fish and fenny. the priority. Feni is a quaint, exotic spirit that wafts Cashew feni and Coconut feni. Cashew feni is whereas Coconut Feni is distilled from the toddy which is more popular is made from cashew apples obtained from cashew trees. This tree is native to South Eastern Brazil, and was carried to India by probably the French, Portuguese, English, Dutch or Arabs. No wonder how goan's thought of distilling this fruit into feni.

## Spirit of India FENI

With man's early romance with Bacchus, feni tops through the Goan air. There are 2 types of Fenis distilled out of the juice of the cashew apples, collected of the coconut trees. The cashew feni

### Preparation of feni

In the traditional method of making cashew feni, only tree ripened cashew apples that have fallen are picked and taken for the crush. The seeds are separated first and then it is put in the stomping area. This area is called a **colmbi** and is usually a rock cut into a basin shape. The cashew apples are stomped to release the juice mostly by using the age old method of crushing under the feet by wearing gum boots. The cashew apples, release juice or **neero**. This neero is also consumed directly as a refreshment.



The neero is then collected in a large earthen pot called **kodem**. This earthen pots are buried halfway in the ground and left while the juice ferments for several days. The juice is then allowed to sit for three days as it ferments. After fermentation the fermented juice is then transferred to **Bhatti**. Bhatti is the traditional distillation vessel which is an earthen pot where the fermented juice is heated to certain temperature for distillation to occur.

In the distillation process a circular copper or Earthen pot containing the fermented cashew apple juice is heated by a flame or steam. The alcohol vapors in the wash rise through the swan like neck And are collected in Liquid form after passing through a coiled or Serpentine enclosed in the water cooled condenser.

Cashew feni is a triple distilled spirit. The first distillate of the fermented neero is known as **urrack**, about 15% alcohol. Urrack is then mixed with neero in a proportion determined by the distiller, and redistilled to give a spirit called **cazulo** or **cajulo** (40-42% abv). Cazulo or Cajulo is again distilled with urrack to give a high strength spirit called feni (45% abv). Cazulo is generally sold as feni.



### Author's Suggestion

Feni is a country made liquor and it is not allowed to be sold outside of goa. So the only way to enjoy it's trip is when you are in goa. Goa being its birthplace it is also sold in plastic bottles wrapped under the name packaged drinking water. So not to judge book by its cover because it will surely be a memorable experience for you.



# Genetically Modified Foods

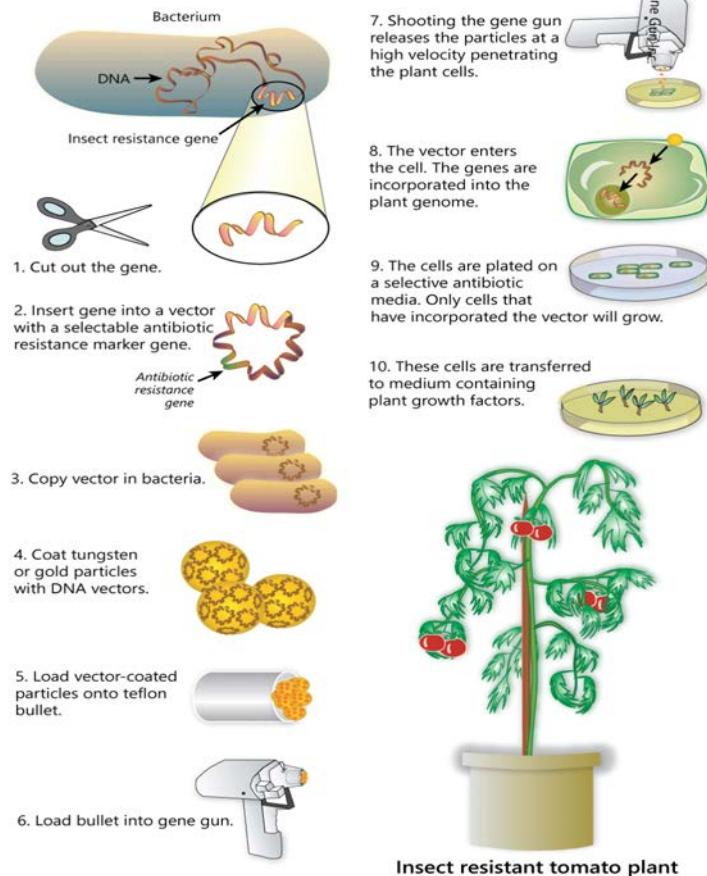


Genetically modified foods are produced using so-called recombinant deoxyribonucleic acid (rDNA) techniques to produce desired changes in the characteristics in plants, animals, and food-related microorganisms (such as yeasts and enzymes). Recombinant DNA techniques are used today to give genetically modified crops greater nutrient content, greater resistance to damage by herbicides and pesticides, as well as crop-damaging diseases, faster ripening or delayed softening, and less allergy.

Chemical engineers work with food scientists and biotechnologists to advance the techniques needed to effectively transfer genetic materials from one organism to another. Historically, researchers have sought to produce desired traits by cross-breeding plants over multiple generations—a relatively hit-or-miss approach. By comparison, genetic-modification techniques allow researchers to identify one or more genes responsible for a particular trait and then insert them into a plant or microorganism with greater speed and precision. This process results in safer and more predictable results.

The first agricultural product generated using rDNA in the U.S. was introduced in the 1990s with a plant producing tomatoes with a longer shelf life, which was achieved by genetically modifying the plant to produce less of the enzyme that causes tomatoes to ripen and soften rapidly. Since then, other rDNA-derived crops for fruits, root and leaf vegetables, and grains with desired traits have been introduced.

## Creation of an Insect Resistant Tomato Plant



## Benefits and risks of Genetically Modified Plants

**Cross-breeding with wild populations.** A primary concern is preventing genetically modified versions from mixing with the naturally existing populations of plants from which they're derived. Plants rely on the transfer of pollen, via insects or the air, to breed and produce offspring, and it's difficult to control how they cross-breed in the wild.

**Toxicity or allergic reactions.** Many people suffer from allergies to various food items, including nuts, wheat, eggs, or dairy products. There is concern that the protein products of introduced genes may be toxic or allergenic to certain individuals.

When farmers start growing genetically modified crops, they stop growing the old varieties. These old varieties are important sources of diverse genes that give plants other desirable characteristics. For example, a new pest or disease could come along and destroy the genetically modified rice. If one of the old rice varieties has a gene that makes it resistant, it could be cross-bred to make the saltwater rice resistant as well. **If we lose the old varieties, we also lose their useful genes.**

## THE BENNU EXPLORATION

How do you study the topography of an asteroid millions of miles away? Map it with a robotic cartographer!

NASA's Origins, Spectral Interpretation, Resource Identification, Security-Regolith Explorer, or OSIRIS-REx, will launch in September 2016 and travel to a near-Earth asteroid known as Bennu to harvest a sample of surface material and return it to Earth for study. But before the science team can select a sample site, it needs to know a little something about the asteroid's topography.

The OSIRIS-REx Laser Altimeter, or OLA, is provided by the Canadian Space Agency and will be used to create three-dimensional global topographic maps of Bennu and local maps of candidate sample sites.

"OLA will measure the asteroid's topography and shape in a detail that is unprecedented compared to other asteroid missions," said Michael Daly, OLA instrument scientist at York University in Toronto, Canada. "This 3-D shape will be the foundational dataset for the other instruments."

To create the 3-D models, OLA uses LIDAR, which stands for light detection and ranging. LIDAR is similar to radar, but uses light instead of radio waves to measure distance. OLA will emit infrared laser pulses toward the surface of Bennu as the spacecraft moves around the asteroid. The laser pulses reflect back from the surface to a detector. The team will measure the time difference between outgoing and incoming pulses to calculate the distance between the spacecraft and Bennu.

"OLA is the first scanning LIDAR to fly on a planetary mission," said Beau Bierhaus, an OLA team member at Lockheed Martin.

"Because the LIDAR can articulate independently of the spacecraft, the LIDAR provides improved operational flexibility, and more importantly, much greater spatial coverage and resolution."

So to navigate around the asteroid and guide the spacecraft to the selected sample site, science team uses the high resolution topographic data.

"We're measuring topography down to one centimeter," said Olivier Barnouin. The three-dimensional maps will also give geologic context to the returned asteroid sample. Just as geologists on Earth document where they collect their samples in the field on topographic maps, OLA will allow the science team to take their measurements and observations of the collected sample and apply them to their broader understanding of Bennu.

What happens on asteroids is that you take that gravity dial and turn it way down," Bierhaus said. "The dynamics of how regolith moves on the surface of the asteroid are foreign to us. OLA data will give us a greater understanding of how granular material behaves in space which is important for future missions."



Collaborating on this project reminds us of the unique relationship between Canada and the United States," said Daly. "It provides both countries access to additional technological expertise and people that they would not otherwise have."

OSIRIS-REx is the third mission in NASA's New Frontiers Program. NASA's Marshall Space Flight Center in Huntsville, Alabama, manages New Frontiers for the agency's Science Mission Directorate in Washington.

NASA to explore asteroid Bennu during its close encounter with Earth:

Ask us why?

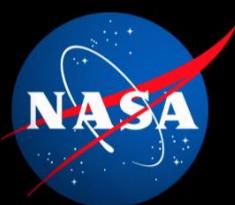
It is because a near-Earth asteroid that is coming towards our planet after being dislodged by a gravitational pull can indeed strike us and cause massive destruction, but according to experts, it has only a one in 2,700 chances of hitting. This will not take place for 150 years and the people living in the year 2135 would know whether the asteroid named Bennu posed an actual threat to hit Earth, ABC News reported on Monday. The OSIRIS-REx Mission, headed by NASA and the University of Arizona, plans to launch an unmanned spacecraft on September 8 in the efforts to reach Bennu in August 2018.

OSIRIS-REx will launch from Cape Canaveral, Florida, on an Atlas V 411 rocket. It will orbit the Sun for a year and then use Earth's gravitational field to assist it on its way to Bennu. In August 2018, OSIRIS-REx's approach to Bennu will begin. It will use an array of small rocket thrusters to match the velocity of Bennu. The spacecraft will begin a detailed survey of the asteroid two months after slowing to encounter Bennu.

After the selection of the final site, the spacecraft will briefly touch the surface of Bennu to retrieve a sample. The sampling arm will make contact with the surface for about five seconds, during which it will release a burst of nitrogen gas. This will cause rocks and surface material to be stirred up and captured in the sampler head. In March 2021, the window for departure from the asteroid will open and OSIRIS-REx will begin its return journey to Earth, arriving two and a half years later in September 2023. The sample capsule will separate from the spacecraft and return to Earth.

From the above findings it is ensured that it is possible to save our planet from each and every disaster that is going to happen in future. This is the excellence of SCIENCE AND TECHNOLOGY.

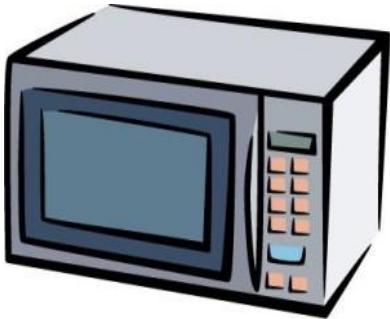
Hard to imagine a world without it !



- Durga (4th Year Chemical Engineering )

# MICROWAVE OVENS- are they really a healthy option ?

Microwaving is a simple, convenient cooking option for people on the go. The microwave oven has been a mainstay in the world for 30+ years, virtually transforming society and how we view food. But despite its wonders, the question that's been avoided remains: are microwaves the healthiest cooking option? The answer is, of course, no, as there are much better options available that will ensure nutrients will remain in your food.



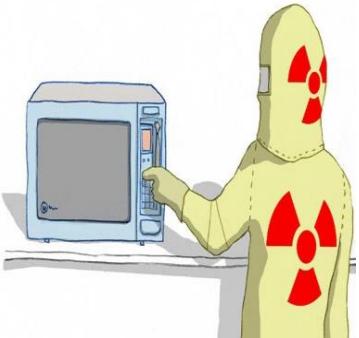
## How Does Microwaving Work?

Before we dive into the research on the possible effects and safety of microwave ovens, let's clarify what a microwave is. A microwave is a form of non-ionizing radiation. As a matter of contrast, ionizing radiation changes the electromagnetic nature of atoms, or ionizes them. This alters the way they interact with other atoms and molecules around them. X-rays, gamma radiation, and nuclear medicine (CT scans, barium swallows, and mammograms) are types of ionizing radiation. Your food is being zapped by high-frequency waves of heat, and some people argue that this radiation can be harmful to your health.

Microwaving cooks the food at very high temperatures in a very short amount of time. This results in a great deal of nutrient loss for most foods, especially vegetables. Our foods are also subjected to nutrient loss when we boil, fry, or roast our food. Boiling vegetables, for example, leeches most of the nutrients (including antioxidants) into the water. The best option for cooking vegetables that will result in only a minor loss of nutrients is steaming. Sautéing and baking at low temperatures is also a viable option that will retain more nutrients than microwaving, boiling, or frying. Of course, by making the majority of your diet raw, with some added dietary fat to help absorb the fat-soluble vitamins (A, D, E, and K), you'll ensure a high level of nutrient intake.



## The Best Cooking Options for Maintaining Nutrition



When it comes specifically to microwaves, damage to the food itself isn't the only concern. Many microwavable foods are processed and in packaging that contains an assortment of chemicals. Chemicals found in many of these containers include benzene, toluene, polyethylene terephthalate (PET), xylene, and dioxins (known carcinogens). At high temperatures, it is likely that chemicals can absorb into the food, and intake of these chemicals presents a high health risk. What's more, the chemicals in the food themselves are also a cause for concern.

Perhaps one of the most dangerous contaminants in microwavable food is BPA (Bisphenol A). A watchdog report from the Milwaukee-Journal Sentinel found this estrogen-like plastic leaked from all packaging into the food tested. BPA disrupts normal hormone activity. Infertility, low-libido, cardiac disease, mental disorders, allergies, high blood pressure, and weight gain have all been linked to BPA exposure.

The simple fact is, when you use a microwave, you're getting a lot more than the food you eat. So is it really worth all that ?

## Adding To the Toxic Load



Over the last 30 years, the science and research has come a long way to understand how microwaves affect proteins, antioxidants, and overall nutrient content of food. We've also learned how many toxins flood our food when zapped in the packaging. Today we shouldn't be surprised by these dangers. Instead of microwaving, stick to raw foods as the primary aspect of your diet. So, when you cook, try steaming and baking as your main cooking methods.

## One final thought

-Abhinav (4<sup>rd</sup> year Chemical Engineering)



# TRAIN OF THOUGHT

“The complex hierarchy of the Invicta is a highly classified chain and most of them never make direct contact with each other. The Invicta controls the world. The Invicta indirectly controls the human mindset”

## THE INVICTA

Conspiracy. Simply put, a secret plan by a group to do something unlawful or detrimental. Conspiracy thrives everywhere; in all sorts of scales amongst the minds of people may they be vile or noble. Here is where the Invicta come in. Established by a group of affluent noblemen in Vienna in 1764, as council that spoke against the governance of the time, they soon took over the entire city. Conspiracy theorists, even at the time knew that something wasn't right about the Invicta and that their rise to power was too quick. It was too random and spontaneous for a bunch of rich nobles, in spite of all their contacts and resources. Eventually they were outlawed and banned as a trail of bodies and bribes surfaced. Their hierarchy was affected greatly by the discoveries made, as the entire organization was wanted dead or alive. Henceforth, The Invicta disappeared completely. They are now a secret organization and to the outside world and government the entire organization is nothing more than a giant conspiracy theory. The complex hierarchy of the Invicta is a highly classified chain and most of them never make direct contact with each other. The Invicta control the world. The Invicta indirectly control the human mindset. They are what they are today solely because of subconscious manipulation. Theorists claim that the Invicta are responsible for multiple conspiracy events such as the world wars, the economic crash, 9/11, the 2008 crisis, JFK's assassination, e.t.c. The word Invicta translated from Latin means indomitable/impregnable, but that all changed today. Since their silent rise to power, mostly because of the fact that they were in the shadows, no one from any government or organization had ever been able to find the Invicta. This was the first and probably the only opportunity for an outsider to infiltrate the Invicta. Ezra Dirac was the one man who had that opportunity. Presented to him on a silver platter, by his uncle who unbeknown to Ezra was a Master of the Invicta. The masters, being an extremely high rank in the Invicta, were allowed to select a worthy successor whom they trust closely to be their Apprentice. In most cases the Apprentice is blood related to the Master.

The Apprentice trains under the Master for a period of five years until he attains the role of Companion. The Companion is given the role of master either when his master dies or retires.

His uncle Cadmus. His blood. The man who he thought was nothing but a business mogul, a Master of the Invicta, had absolutely no idea that Ezra had been recruited by the British intelligence agency MI6 early in his university days. This clash of confidentiality is what led to a link into the worlds most powerful top secret organization.

Ezra stood there, his hand on his chin and his mind racing. What was this opportunity going to present? What was his uncle Cadmus thinking, standing three feet away and observing Ezra queerly? He looked his uncle dead in the eye, smiled, and said, “I'd be mad to reject an offer with a eight digit paycheck”. Even after speaking to Cadmus for three hours about the Invicta Ezra was still unsure about what was to unfold. “I'll see you at 9am tomorrow then, dear nephew” said Cadmus, with a smile. And with that Ezra stood up and left, with more knowledge on the Invicta in his head than in the entire MI6 intelligence files.

Pathways' 'Train of Thought' section is a corner that will let your imagination run wild as we bring you a vivid story that will continue through every edition. So take a peek and let it transport you to another world, and you have the power to alter the course of the story! The following editions will feature a continuation of the story written by you! So send in your entries to [pathwaysteam16@gmail.com](mailto:pathwaysteam16@gmail.com)

# WORD SEARCH

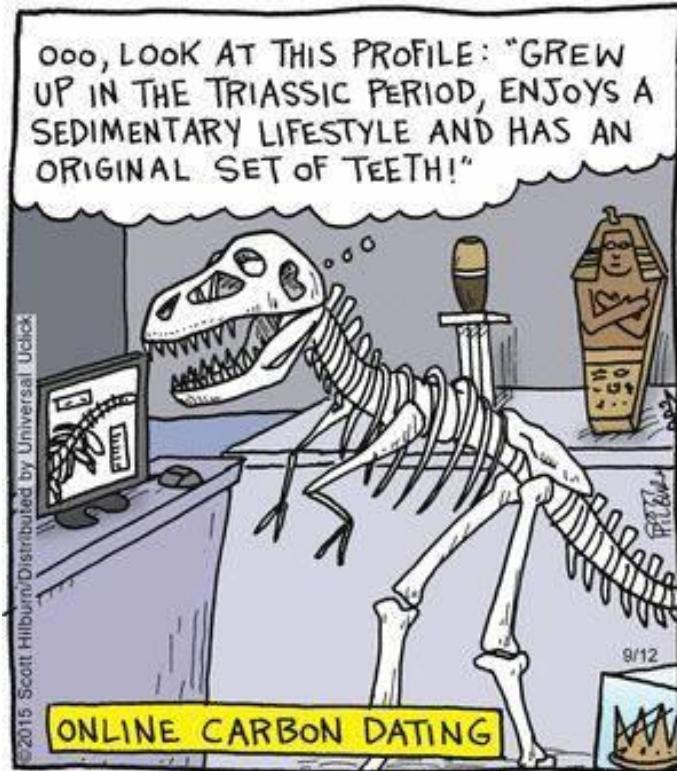
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## HINTS:

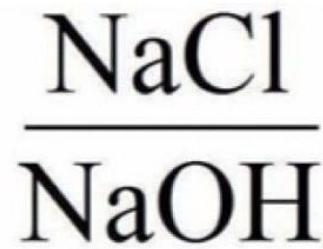
1. Fire refining process is employed in case of?
2. Auto collimator is used to check?
3. For separating small pieces of metal from engine oil of a car, the best separating technique is?
4. Which bond is strongly directional in solids?
5. Enzymes belong to the category of?
6. What is the order of chemical reaction, whose rate is determined by the variation of one concentration term only?
7. Extensive property of thermodynamic system depend upon the ---- of the system?
8. Fundamental principle of refrigeration is based on which law of thermodynamics?
9. Heating of water under atmospheric pressure is process called?
10. Siderosis is a disease caused by the inhalation of ---- dust
11. Exposure to small amount of this element results in high blood pressure and heart disease in humans.

Send us your answers at [pathwaysteam16@gmail.com](mailto:pathwaysteam16@gmail.com). The winner will be announced in the next edition.

# WHY SO SERIOUS?

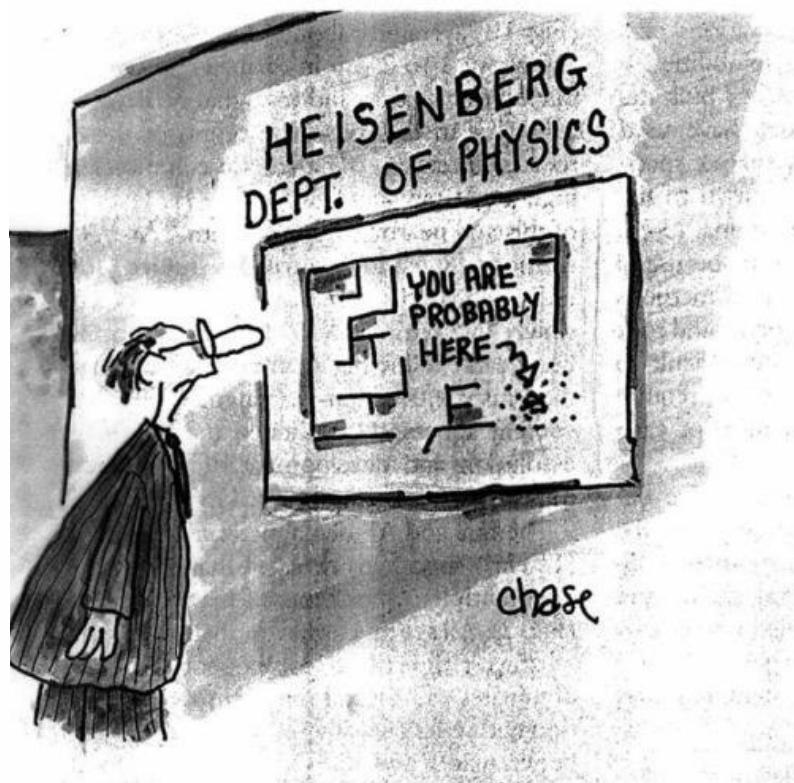
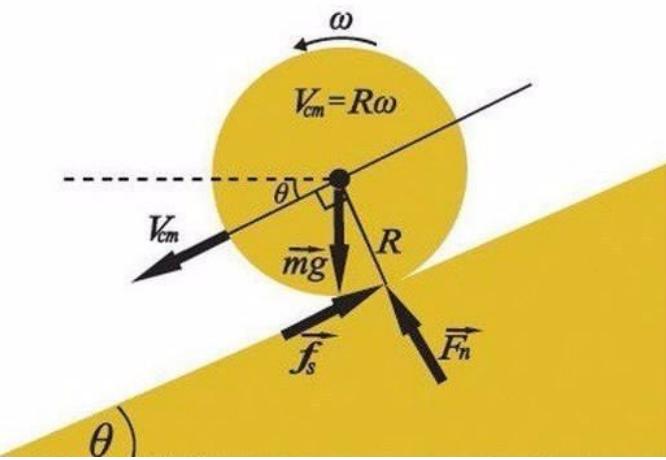


Red alert! Red alert!



The base is under a salt!

that's how i roll



# SENIOR EDITORS AND DESIGNERS



SANJANA



ASHWIN



MAHISHA



SOURABH



PRIYADARSHI



DURGA



ABHINAV

Tours

# JUNIOR EDITORS AND DESIGNERS



ANURADHA



SUCHARITA



LAKSHNIA



NEEL



SEHAJ



ARPAN



SUPRAJA



MARK

Tapis

# JUNIOR EDITORS



GAYATRI



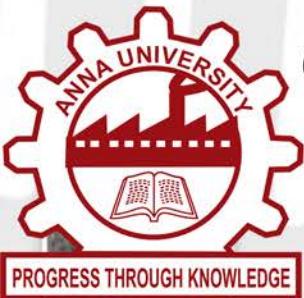
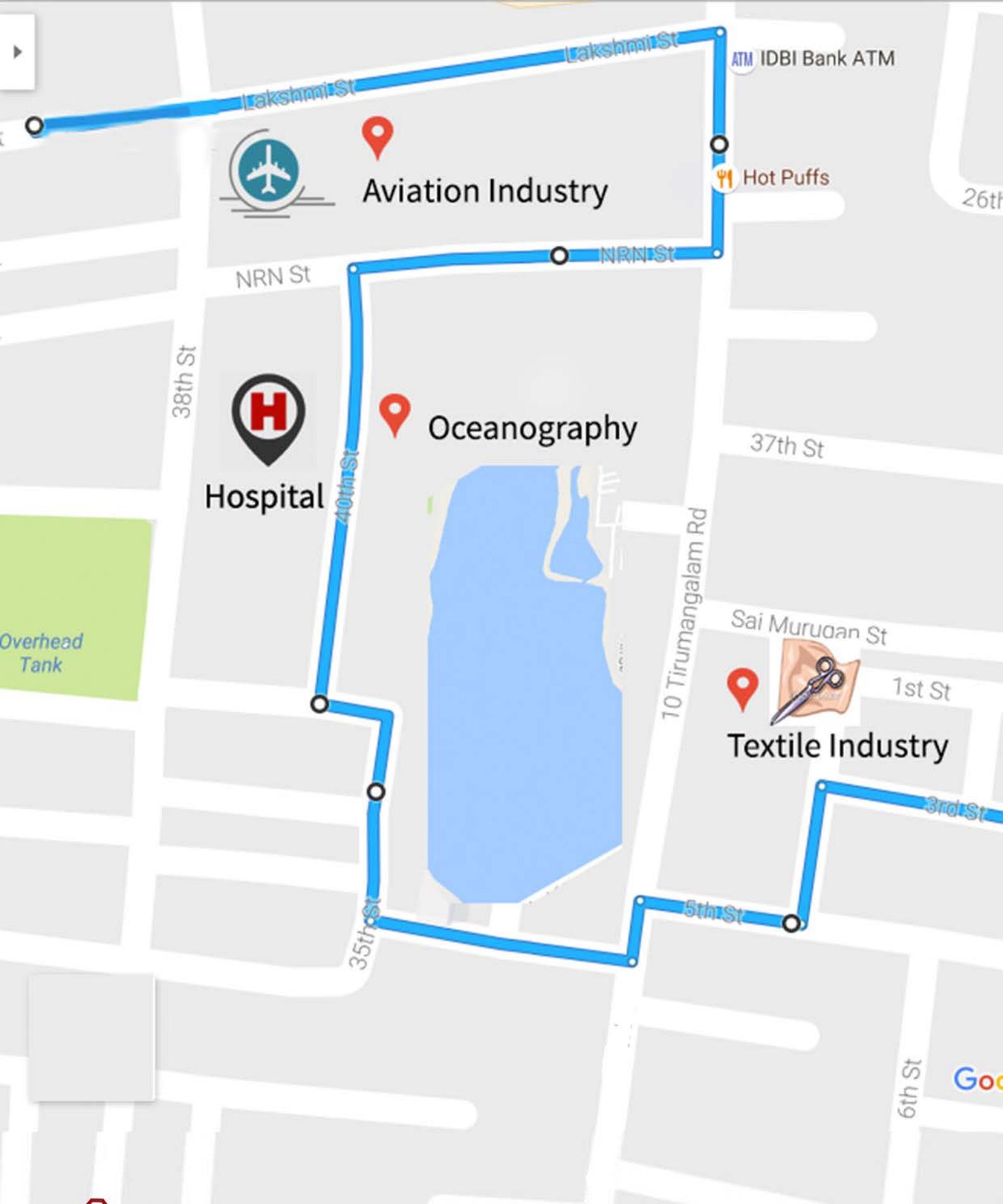
JEBIN



REESHMA



SRIKAR



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