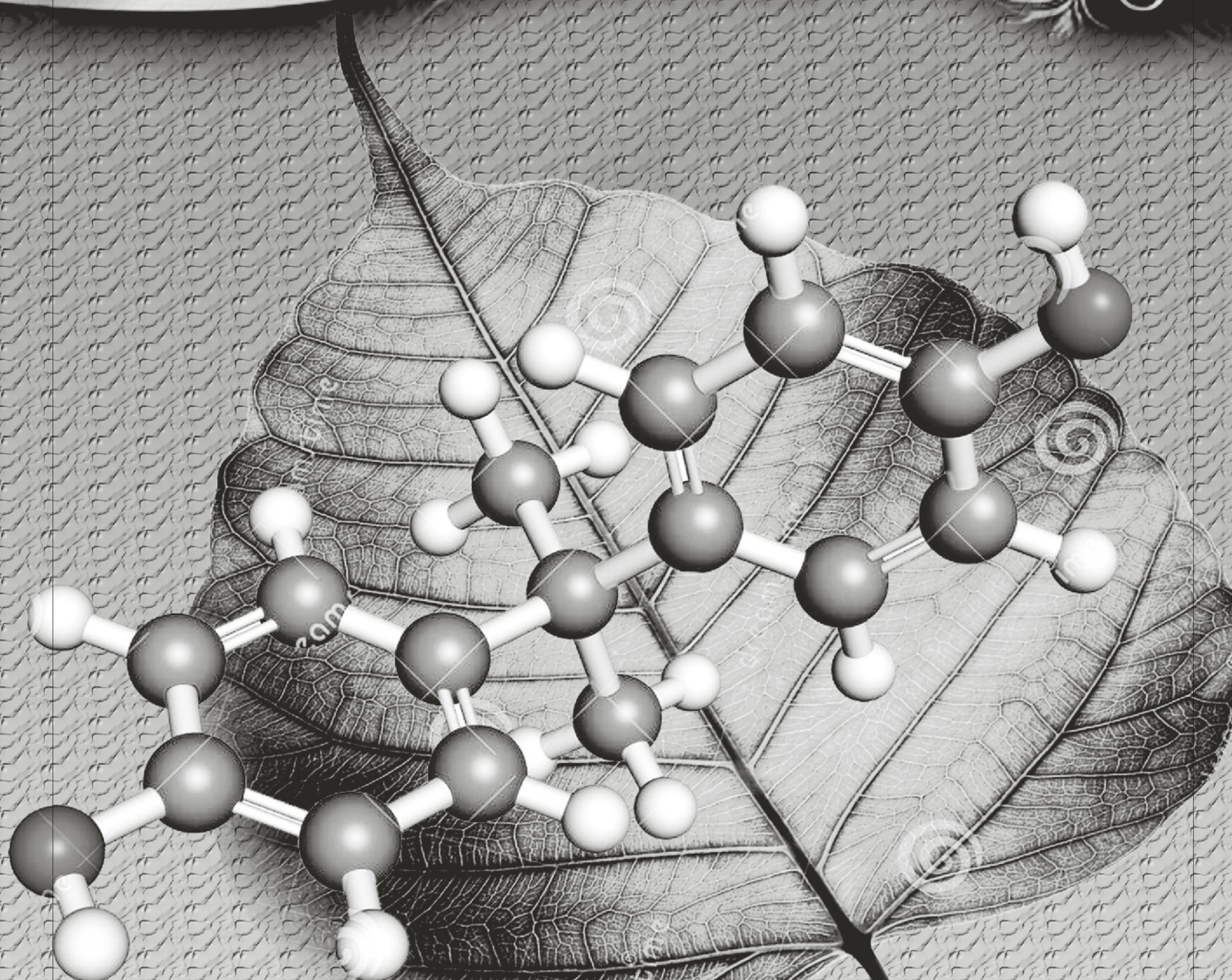
# CHRYSL

## Vol XVI - 2020



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# The Editorial

Dear Reader,

Greetings to you!!

It gives me immense pleasure in bringing out the Volume XVI of the Yearly Periodical CHRYSL (Chemistry Resonating in Young Students' Lives) successfully for the year 2019-2020. Extracting talents, ideas and skills from our chemistry students was a difficult task but we finally made it possible.

Fostering creativity and inspiring innovation are two of the key elements of a successful education, and the periodical CHRYSL is the perfect amalgamation of both. It harnesses the creative energy of the academic community, and distils the essence of their inspired imagination in the most brilliant way possible.

Students acquire skills and knowledge easily if we make the surrounding stimulating and purposeful. It is such an opportunity given to our young chemists to unleash their creativity and put forth an excellent blend of knowledge, ideas and talents. When work and effort is valued, the student's self-esteem is heightened, which in turn leads to self-motivation.

I congratulate and extend my sincere thanks to the people who have contributed to this issue and enhanced its perfection and beautification through their articles.

We have for you, from the chemistry students, a wide range of puzzles, riddles, jokes, poetry and some informational and inspirational articles.

Happy reading!

***Dr. (Mrs.) J. Rosaline Ezhilarasi***
***Associate Professor of Chemistry***

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# NANOPARTICLES: BOON OR BANE

***Sr. Athisa Roselyn Maheo***
*(Research Scholar)*

Nanoparticles are of great scientific interest as they are a bridge between bulk materials and atomic or molecular structures. They can be defined as materials whose size range in between 1nm-100nm. Though there have been reports and evidences of the use of nanoparticles in the ancient times, the studies and research on nanoparticles has gained momentum only in modern science. As early as the fourth century, nanoparticles were used by artisans and potters to give a glittering effect on their work. Nanoparticles have many possible applications in medicine, cosmetics, physics, optics, agriculture, solar cells, industrial sectors and as catalysts.

The synthesis of nanoparticles can follow two approaches: top-down or bottom-up approaches. When the approach is top-down, nanoparticles are synthesized from bulk materials. On the other hand bottom-up approaches involve synthesis of nanoparticles from atomic level. Nanoparticles can be fabricated either through conventional methods or green methods which involve using different plant parts or microbes. Of the two, the latter is preferred due to its low cost, environment friendly, simple and safe nature. In the green synthesis the plant parts or the microbes act both as reducing and capping agents, thereby eliminating the use of toxic reducing agents.

The advantages and the disadvantages of using nanoparticles can be debatable, given the fact that though they are beneficial in many ways, they can stealthily be harmful too. The reason for both can be attributed to their small size and extremely high ratio of surface area to volume.

The nanoparticles are boon to the society by their indispensable applications in various aspects such as medicine (diagnostics, drug delivery), environment (filtration, degradation), energy (increasing energy efficiency, reducing energy consumption), technology (optoelectronic devices, semiconductor devices, quantum computers), heavy industry (aerospace, automobile, construction) and consumer goods (textile, food, cosmetics, agriculture).

Nanomedicines have the capacity to diagnose diseases and deliver treatment in numerous ways, which was not possible earlier. They can reach the specific target in drug delivery, avoiding harmful side effects. The antimicrobial property of various nanoparticles can be used to curb the growth of microbes including those that have grown resistant to antibiotics. Mass storage devices with capacity of storing billions of bytes in a small device can be manufactured. Solar cells involving nanoparticles can help to tap solar energy much more efficiently. Because of their ability to penetrate skins and also absorb ultraviolet light, nanoparticles particularly ZnO and $TiO_2$ are used in nanocosmetics. Nanotechnology can revolutionise farming systems and help in increasing the crop yield. Taking advantage of the high surface area of nanoparticles, catalysts are being manufactured that improve chemical reactions which in turn can help to remove toxins from the environment. Nanomembranes filtration devices that can clean polluted water, shift out microorganisms and organic wastes could be used to provide clean, safe and affordable drinking water. They are also very good gas and chemo sensors. Low-cost fuel cells and super capacitors can be built with the help of nanomaterials.

A major setback of nanoparticles is that their chemical and physical interactions vary with their shape, size and surrounding environment, leading to toxicity. According to nanotoxicology research, large-scale industrial manufacturing and use of nanomaterials can have adverse effects on human health and environment too. Nanoparticles can gain access to the body via different routes. They can be inhaled, swallowed, absorbed through skin or be deliberately injected during medical treatment. When inhaled, they can cause damage to the lungs, giving rise to pulmonary inflammations. Nanoparticles can pass from the lungs into the bloodstream and cause extensive damage. Nanoparticles, if not excreted can get accumulated in the organs of the animals causing blood coagulation and platelets aggregation. The application of nanoparticles in cosmetics too can be harmful as they can provoke the release of reactive oxygen species. When released into the environment, they can even kill beneficial microorganisms as most of them are highly antimicrobial in nature. With nanomaterials, untraceable weapons of mass destruction can be created which can wreak havoc to the entire world. The use of nanotechnology becomes too expensive and unaffordable.

Nanoparticles have immense potential to revolutionise the world either for good or for bad. While nanotechnology offers wide areas of taking the world forward with many new advances and developments in all fields ranging from human health to saving environment, it itself poses a threat with the possibilities of doing immense harm. The use of nanomaterials is undeniably a boon when trod upon with wisdom and caution and can be a bane too due to their injudicious use coupled by their long term effect.

## SCAFFOLDS FOR TISSUE ENGINEERING: STATE OF THE ART AND FUTURE DIRECTIONS

***R Narmatha Christy***
*(Research Scholar)*

In the modern scientific discipline, tissue engineering plays an important role in chemical, biological and engineering domains especially in understanding the structure and functionality of normal and pathological mammalian tissues. Every day thousands of surgical procedures are performed to replace or repair tissue that has been damaged through disease or trauma. Disease, injury and trauma can lead to damage and degeneration of tissues in the human body, which necessitates treatments to facilitate their repair, replacement or regeneration. Treatments typically focus on transplanting tissue from one site to another in the same patient (an auto graft) or from one individual to another (a transplant or allograft). While these treatments have been revolutionary and lifesaving, major problems exist with both techniques. A variety of strategies are being adopted in tissue engineering towards implantation of cells, delivery of tissues with growth factor and cell placement.

The developing field of tissue engineering (TE) aims to regenerate damaged tissues instead of replacing them. It combines cells from the body with highly porous scaffold biomaterials, which act as templates for tissue regeneration, to guide the growth of new tissue. This combination of cells, signals and scaffold is often referred to as a tissue engineering triad. The field relies extensively on the use of porous 3D scaffolds to provide the appropriate environment and imitate native extracellular matrix for the regeneration of tissues and organs. The term scaffold refers to the 3D biomaterial before cells have been added (*in vitro* or *in vivo*). The very first criterion of any scaffold for tissue engineering is that it must be biocompatible; cells must adhere, function normally, and migrate onto the surface and eventually through the scaffold and begin to proliferate. Scaffolds and constructs, are not intended as permanent implants. The scaffold must therefore be biodegradable so as to allow cells to produce their own extracellular matrix. The by-products of this degradation should also be non-toxic and able to exit the body without interference with other organs. The scaffold should have mechanical properties consistent with the anatomical site into which it is to be implanted.

From a practical perspective, it must be strong enough to allow surgical handling during implantation. Producing scaffolds with adequate mechanical properties is one of the great challenges in attempting to engineer bone or cartilage. Therefore, increasing research is now being directed at utilizing the mechanosensitive capacity of cells to develop scaffolds with specific mechanical properties that can be used to direct the behaviour of the cells with which they interact. In addition to biomechanical signals, cellular behaviour is strongly influenced by biological and biochemical signals from the extracellular matrix. Therefore, the use of scaffolds as delivery systems for growth factors, adhesion peptides and cytokines is receiving considerable attention in the field. The challenge of tissue engineering is to mimic what happens in nature. Work is proceeding in creating tissue- engineered liver, nerve, kidney, intestine, pancreas and even heart muscle and valves. To date the highest rates of success have been achieved in the areas of skin, bladder, airway and bone, where tissue-engineered constructs have been used successfully in patients. A further challenge is that healing rates vary with age; for example, in young individuals, fractures normally heal in about six weeks but in the elderly the rate of repair slows down. This too must be taken into account when designing scaffolds for orthopaedic applications. However, the lack of vascularity in scaffolds and tissue engineered constructs is a major challenge, and improving vascularisation strategies is considered one of the areas requiring the most extensive research in the field of tissue engineering.

For many more disease states, tissue engineering remains a flourishing research area with potential new treatment. It offers the potential for regeneration of almost every tissue and organ in the human body.

# BIOMATERIALS IN TISSUE ENGINEERING

***Sr. D. Switha***
*(Research Scholar)*

Life expectancy among people increases along technology progression level. The future ahead of such technological advances in various fields underlines the need for new and innovative tools in accordance to people's comfort. Health is the most important issue worldwide and scientists endeavour to enhance the level of people's health, so various strategies have been developed so far to meet health requirements. Nowadays polymers are known as the building blocks of both commodity and modern stuff ranging from general purpose to sophisticated applications. In particular, polymers have been vital elements of advanced materials and systems in medical landscapes. Polymers used in biomedical engineering can be categorized into two main groups including synthetic and natural polymers. Biomedical engineering can bridge between engineering and biology, seeking new methods and materials to enhance the health level of life, and then getting prepared for advanced health-care treatment such as therapy, diagnosis, and monitoring. The tuneable microstructure of polymers paves the way for targeted design of biomedical materials and systems.

Biomaterials play an important, in fact indispensible, role in the field of TE. A number of biomaterials for TE are available for various clinical applications. The use of biomaterials should be used in an application-specific nature. Biomaterials have been used for centuries for applications such as intraocular lens replacement and dental fillings, but advancements in cell and molecular biology, chemistry, materials science, and engineering have provided much broader opportunities for clinical use. The definition of the ideal biomaterial has changed considerably during the past 50 years and, in fact, will vary between given applications. In early biomaterial design, the goal was to match mechanical and material properties and to achieve a level of functional outcome that adequately matched the native tissue without invoking tissue damage or a deleterious host response. For example, bone cement, stainless steel, and Dacron were used extensively in early biomaterials because they were considered to be relatively inert and incited a predictable but tolerable foreign body response.

Decades ago, scientists and engineers sought for materials that mechanically match human tissue, remain stable in contact with the human tissue and do not induce severe immunological responses. However, with no materials being inert, the long term presence of biomaterials in the body raises the concern of their safety profile. Now the burgeoning concept of tissue engineering raises more stringent standards, in addition to minimal foreign body responses and safety profile, those materials should be able to degrade or be absorbed and concurrently guide tissue regeneration. This ambitious goal also requires high-degree convergence and integration of medicine, bioengineering and material science.

On increasing number of people each year with increasing demands on these materials with higher expectations related to quality of life arising from an aging population. Now a day there is an ever-increasing search for novel biomaterials as the material requirements for complex biomedical devices increases with time. Many materials such as metals, ceramics, polymers, and glasses are being investigated as biomaterials. They are very useful in various fields due to their excellent bioactivity and biocompatibility. The smart design of synthetic polymeric biomaterials can overcome the barriers for future efficient and safe regeneration of damaged tissues in the routine clinic.

## 3D PRINTING: THE NEW INDUSTRIAL REVOLUTION

***Julia Sebastian***
*(Research Scholar)*

The concept of 3D printing was first proposed by Charles W. Hull in the 1980s. 3D Printing is an additive manufacturing technique whereas conventional technologies focus on subtractive manufacturing. Accurate and precise patterning can be performed using 3D printing to achieve minute details. The various types of 3D printing include material extrusion, material jetting, binder jetting, powder bed fusion, direct energy deposition, vat photo-polymerization, and sheet lamination and bio printing. 3D printing has drawn increasing attention globally and is a growing technology that makes a revolutionary impact on the fabrication of products for applications in areas like healthcare and medicine, aeronautics and space, automotive, food industry, art, textile and fashion, architecture and construction.

3D printing employs an additive manufacturing process whereby products are built on a layer-by-layer basis, through a series of cross-sectional slices. While 3D printers work in a manner similar to traditional laser or inkjet printers, rather than using multi-colour inks, the 3D printer uses powder/polymer wires (e.g. PLA wires) that is slowly built into an template/mode on a layer-by-layer basis. All 3D printers use 3D Computer-Aided Design (CAD) or a blueprint (MicroCT image (.stl file)) that measures thousands of cross-sections of each product to determine exactly how each layer is to be constructed. In the case of laser printing, the 3D machine dispenses a thin layer of liquid resin and uses a computer-controlled ultraviolet laser to harden each layer in the specified cross-section pattern. At the end of the process, the excess soft resin is cleaned away through the use of a chemical bath.

3D printing uses raw materials such as plastics, resins, super alloys such as nickel-based chromium and cobalt-chromium, stainless steel, titanium, polymers, ceramics, wax, paper, sandstones, plastics, nylon, metal and wood. 3D printing is a versatile method and is capable of integrating many distinct classes of materials such as digital and smart materials, electronic materials, ceramic materials, biomaterials and composite materials.

Modern desktop 3D printers are small, cheap, and easy to operate. The following ways are used to create an object using a 3D printer.

1. 3D printers require digital design files of 3D objects (STL files are the most common)

2. Once the digital design is saved, the computer will process the file and get ready for printing. Settings can be changed just like in a normal inkjet printer.

3. The material for the 3D object is chosen and the 3D printer is loaded with enough material. In a normal inkjet printer, ink cartridges are used. In a 3D printer, filaments made of different materials serve as the ink for 3D printers.

4. *A 3D printer creates a physical object by depositing many layers of materials on a print bed.* When the 3D printer is loaded with materials, we need to feed the computer with instructions like layer thickness, deposition rate, extrusion temperature to control the 3D printer about how to deposit the material layer by layer to recreate a physical copy of the digital design.

**Advantages of 3D printing in comparison to other technologies**

- Accurate and precise patterning
- High resolution with high throughput
- The porosity of the product can be controlled
- Can economically build custom products in small quantities

**Sources of cost-effectiveness include**

- No need for costly tools, moulds, or punches
- No scrap, milling, or sanding requirements
- Automated manufacturing
- Use of readily available supplies
- Ability to recycle waste material
- Improved working capital management as goods are paid for before being manufactured
- Ability to easily share designs and outsource manufacturing
- Speed and ease of designing and modifying products

**3D printing applications of novel materials**

- 3D printing of human tissue and organs can revolutionize the healthcare industry by extending the average life expectancy and greatly improving the quality of life for millions of people.
- 3D printing of dentures, orthodontics, implants, crown and bridges has been proved to be a cheaper and faster alternative to conventional techniques in the dental industry.
- The technology of 3D printing can be used for a variety of housing projects with applications in custom luxury designer homes, large scale development projects to temporary housing projects. This technology could also enable engineers to design and build stiffer and safer geometries for houses.
- 3D printing is becoming popular in the customizable gifts industry with products such as personalized models of art and dolls in many shapes and also used to manufacture moulds for making jewellery and even the jewellery itself.
- 3D printing is also being utilized by the automotive industry. Urbee is the name of the first car in the world car mounted using the technology of 3D printing and air forces make use of this technology to print spare parts for planes.
- 3D printing of food is produced by pressing food into three-dimensional objects layer by layer.

**Limitations of 3D Printing**

- Higher costs for large production runs relative to injection moulding and other technologies
- The reduced choice for materials, colours and surface finishes
- Lower precision relative to other technologies
- Limited strength resistance to heat and moisture and colour stability.
- Requires a lot of optimization like extrusion temperature, pressure, flow rate, layer thickness, bed height, infill density etc.

3D Printing technology could revolutionize and reshape the world. Advances in 3D printing technology can significantly change and improve the way we manufacture products and produce goods worldwide. If the last industrial revolution brought us mass production and the advent of economies of scale - the digital 3D printing revolution could bring mass manufacturing back a full circle - to an era of mass personalization, and a return to individual craftsmanship.

## BORON CHEMISTRY AND ITS APPLICATION IN CANCER TREATMENT

Boron is a chemical element, semimetal of main group 13 of the periodic table, essential for plant growth and of wide industrial application. Pure crystalline boron is a black, lustrous semiconductor and it is too brittle for use in tools.

There are two isotopes of boron - Boron-10 and Boron-11. Boron-10 is having the tendency to absorb neutrons, so it is used in the treatment of cancer. The technique that is used to treat the cancer using boron is known as Boron Neuron Capture Therapy (BNCT).

BNCT is a two-step treatment. First, the patient is given a drug that contains Boron-10 and preferentially targets the cancer cells. The drug is non-toxic and has no effect on its own. The most prevalent targeting drug is Boro Phenyl Alanine (BPA) / polyhedral borane anion/ sodiumborocaptate (BSH), which is taken up by highly metabolic cells and accumulates roughly 3.5 times more in cancer cells than in normal cells. Next, the tumor region is irradiated with a low-energy neutron beam, which also causes little impact on tissue by itself. When the neutrons impact the boron atoms, however this causes a fission reaction that creates two alpha particles and recoiling lithium ions with the emission of gamma rays.

By using BNCT technique more than 2000 patients around the world are rescued. BNCT represents a joining together of nuclear technology, chemistry, biology and medicine to treat malignant recurrent head and neck cancers.

The concept of BNCT though had evolved in 1936, there has been a steady improvement in knowing and understanding the science behind it, working out with clinical trials and putting it to clinical use.

***R. Ramya***
***II M.Sc. Chemistry***

## NANO SILICON SAMURAI: OIL ENGINEERED SPONGES

Oil spills in oceans are one of the reasons that cause natural disasters such as volcano eruption, increasing the temperature of the ocean (earth), etc. So it is very essential to clean up oil spills in ocean. There are various methods of cleaning up oil spills such as sorbents, bacteria, etc. By using these various methods only 85% efficiency has been obtained. At early times, only polyester-polyurethane sponges are used up as it showed more efficiency than other methods. But it worked well only between the pH 5 to 6. In more acidic or more basic condition, the activity of these sponges becomes least or almost inactive. By changing the surface properties of these sponges using nanosilicones, the efficiency of these sponges becomes more than 90% and also found out that they work at all pH. Thus nanosilicones - polyester polyurethane sponges are found to be a samurai of oceans in cleaning up oil spills.

***M. Shahada***
***I M.Sc. Chemistry***

## MICROPLASTICS

Microplastics are tiny plastic particles typically with a diameter of less than unity. Microplastics are of two types - Primary microplastics and secondary microplastics. They are obtained from consumer goods like tooth brush, water bottle, food packaging, face products, clothes and cotton swabs. Micro plastics are mainly made of Polyethylene, Polypropylene, Polyethylene terephthalate, Polymethyl methacrylate and Nylon.

Microplastics are found everywhere in the sea. Microplastics accumulated in the sea water endanger all marine life, from top to bottom predator. They are also harmful to human health. Scientists from the University of Cantabria in Spain have discovered that wax worms can eat plastics. It takes about a month for 100 wax worms to break down an average of 5g plastic bags. Enzyme which is present in the worms is able to convert polyethylene into ethylene glycol.

Disposal of plastics and plastic debris in to the ocean is not only an alarming threat to the marine animals but it could also be a threat to the human food chain. Recently WHO reported that more intensive studies are required to draw firm conclusion about the toxicity of the microplastics, but answering to this question is urgent.

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The concept of BNCT though had evolved in 1936, there has been a steady improvement in knowing and understanding the science behind it, working out with clinical trials and putting it to clinical use.

***M. Saranya***
***II M.Sc. Chemistry***

## PAPER BATTERY

We are using the electronic gadgets for many years, for example, mobile phone, television, car and remote etc. Without these electronic gadgets, the present modern world couldn't exist and the most significant part of those electronic gadgets is batteries. We know that the typical electro chemical batteries or cells convert chemical energy into electrical energy. The chemical reactions in a battery involve the flow of electrons from one electrode to another. This flow of electrons through the external circuit provides an electric current that can be used to work. Based on charging abilities, batteries are classified into two types, primary and secondary cells. Out of these two, secondary cells are widely used, because, of their rechargeable ability. These batteries occupy lot of space in electronic gadgets and also it contributes maximum weight of the electronic device. To overcome this, we need a battery which should be light in weight, flexible, thin and have a capacity to store the energy. Such an amazing battery had recently come into existence and is known as PAPER

BATTERY. These Paper Batteries could fulfill the energy demands of the next generation gadgets. A paper battery is a combination of carbon nanotubes and conventional sheets of cellulose paper. This Paper Battery can act as both high energy battery and super capacitor, whereas our traditional electronic gadgets could act as either high energy battery or super capacitor. The combined action of this paper battery allows it to provide long term, steady power production. Nontoxic, flexible, biodegradable paper batteries would have lot of applications in the fields of medicine, space station, auto mobile, etc.

**"This eco-friendly paper battery would be the substitute of existing battery and which could bring a great change in the future technology"**

*R. Subraja*
*I M.Sc. Chemistry*

## FUEL FROM PLASTIC WASTE

Federal and state environment ministers certified an ambitious aim to make all Australian packaging recyclable, compostable or reusable by 2025. All packaging were made of paper or wood-based materials. But realistically, plastic will continue to dominate our packaging, especially for food, because it is moisture-proof, airtight, and hygienic.

Most rigid plastic products can only be recycled a few times before they lose their original properties and become non-recyclable. We need to expand our range of options for keeping this plastic waste out of landfill. One potential approach is "plastic to energy", which unlocks the chemical energy stored in waste plastic and uses it to create fuel.

**WORKING OF PLASTIC AS ENERGY:**

Plastic is made from refined crude oil. Its price and production are dictated by the petrochemical industry and the availability of oil. As oil is a finite natural resource, the most sustainable option would be to reduce crude-oil consumption by recycling the plastic and recovering as much of the raw material as possible.

There are two types of recycling: mechanical and chemical. Mechanical recycling involves sorting, cleaning and shredding plastic to make pellets, which can be fashioned into other products. This approach works very well if plastic wastes are sorted according to their chemical composition.

Chemical recycling turns the plastic into an energy carrier or feedstock for fuel. There are two different processes by which this can be done: gasification and pyrolysis. ***Gasification*** involves heating the waste plastic with air or steam, to produce valuable industrial gas mixtures called "synthesis gas", or syngas. This can be used to produce diesel and petrol, or burned directly in boilers to generate electricity. In ***pyrolysis***, plastic waste is heated in the absence of oxygen, which produces mixture of oil similar to crude oil. This can be further refined into transportation fuels.

*"Pollution is nothing But the resources we are not harvesting. We allow them to disperse because we've been ignorant of their value".* - R. Buckminster Fuller.

*K. Swetha*
*I M.Sc.Chemistry*

# FAST FACTS: CHEMISTRY MOLECULES

**Q :** I have a convoluted connection to the winter holidays.

What molecule am I?

**A :** *Potassium Chlorate*

Potassium chlorate ($KClO_3$) is a strong oxidizing agent that has a wide variety of uses. It has been a component of explosives, fireworks, safety matches, and disinfectants. It is used to generate oxygen in the lab. Because it is a strong oxidizer, $KClO_3$ must be kept away from contacting organic matter; reduced inorganic materials such as elemental sulphur, phosphorus; and iodine; and concentrated acids.

**Q:** You might smell me during your Thanksgiving preparations.

What molecule am I?

**A :** *Furfural*

Furfural or furan-2-carbaldehyde is an oily liquid formed when sugars from lignocellulosic biomasses such as corncobs, sawdust, and oat hulls dehydrate. This is one of the earliest sustainable chemical feed stocks and is used to synthesize a wide range of industrial chemicals including solvents, resins, plastics, and furan derivatives. It must be handled with an abundance of caution.

**Q :** I can kill you or save your life.

What molecule am I?

**A :** *Nitroglycerin*

Nitroglycerin or 1, 2, 3-propanetriol trinitrate is a venerable explosive and it is also a life-saving drug in small doses. It was first prepared in 1846 by chemist Ascanio Sobrero at the University of Turin, who was reluctant to publish his work because of the compound's extreme explosiveness. After numerous accidents, the manufacture and distribution of the pure liquid was soon banned in many jurisdictions.

**Q :** I'm an old, but still widely used, antibiotic.

What molecule am I?

**A:** *Nitrofurantoin*

Nitrofurantoin is an antibacterial medication used primarily to treat urinary tract and bladder infections. It has been sold under more than two dozen trade names, including Macrobid; but it is now supplied as a generic.

**Q :** I'm a "ghost" compound.

What molecule am I?

**A :** *Dioxanetetraketone*

Dioxanetetraketone ($C_4O_6$) is a chemical curiosity. It is also known as dimeric oxalic anhydride. It is an oxide of carbon; but unlike carbon monoxide and carbon dioxide, it is difficult to make and impossible to isolate. $C_4O_6$ is stable in ether solution at 30 ºC. When the solution is warmed to 0ºC, the compound decomposes to CO and $CO_2$. The mono- and dimethyl esters of oxalic acid are obtained by treating $C_4O_6$ with methanol. With diazo- methane, the products obtained are dimethyl oxalate and mono- and bis (diazo) derivatives.

***Kafula Linda***
***I M.Sc. Chemistry***

# NANO CATALYSTS

Nano catalysts have combined advantages of both the homogenous and heterogeneous catalytic systems. Nano catalytic system allows the rapid selective chemical transformations with major product yield which is coupled with ease of catalyst separation and recovery. Recovery of catalysts from the system is more important characteristics of any catalyst before being acceptable for green chemical manufacturing processes in industry. Because of the nano size and high surface area of nano catalyst, the contact between reactant and catalyst increases considerably. Insolubility in the reaction solvent makes the catalyst in different medium and hence can be separated out easily from the reaction mixture.

**APPLICATIONS OF NANO CATALYSTS:**

- Biomass gasification to produce high synthetic gas and in biomass pyrolysis for production of bio-oil.
- Production of biodiesel from waste cooking oil.
- Green diesel production using Fischer-Tropsch Synthesis (FTS).
- Hydrogen production by steam reforming of ethanol over nano structured indium oxide catalysts.
- Adsorptive desulfurization, hydro desulfurization and bio desulfurization of fossil oils.
- To improve economic catalytic combustion of JP-10 aviation fuel.
- In-situ hydrogen production by the reaction of ammonia with nano catalysts.

***K. Swetha***
***I M.Sc. Chemistry***

# CHEMISTRY JOKES

1. Two chemists walk into a bar, one says, I'll have $H_2O$, the other says, "I'll have $H_2O$ too". The second chemist dies.

   $H_2O_2$ is the chemical formula for hydrogen peroxide, which you can't drink at a bar without grievous consequence.

2. What's a chemist's favourite type of dog?

   LABrador dog.

3. Why did the attacking army use acid?

   To neutralize the enemy's base.

4. What did the thermometer say to the measuring cylinder?

   "You may be graduated, but I have several degrees".

5. Why did the bear dissolve in water?

   It was a polar bear.

6. Which is the dullest element?

   Bohrium.

7. What do you call a tooth in a glass of water?

   One molar solution.

8. Why chemists are so great at solving problems?

   Because, they have all the solutions.

9. $H_2O$ is the formula for water, what is the formula for ice?

   $H_2O$ cubed

10. I would tell many Chemistry jokes but... all the good ones Argon.

***P. Lalithapriya***

***II B.Sc. Chemistry***

## INTERESTING FACTS IN CHEMISTRY

1. Mars is red because its surface contains lot of iron oxide or rust.
2. Approximately 20% of the oxygen in the atmosphere was produced by the amazon rainforest.
3. Hot water freezes more quickly than cold water. A high school student documented the effect, which bears his name (the Mpemba effect).

4. Hydrofluoric acid is so corrosive that it will dissolve glass. Although it is corrosive, hydrofluoric acid is considered to be a weak acid.
5. Human body contains enough carbon to provide "lead" (which is really graphite) for 9,000 pencils.
6. Lightning strikes produce ozone ($O_3$) and strengthen the ozone layer of the atmosphere.
7. Although oxygen is colorless, the liquid and solid forms of oxygen are blue.
8. Car's air bags are packed with salt sodium azide, which is very toxic. When collision takes place, the car's sensors trigger an electrical impulse which in fraction of a second dramatically raises the temperature of the salts. These then decompose into harmless nitrogen gas, rapidly expanding the air bag.
9. Sound travels through helium, a lighter gas, much faster than it does through air, a heavier gas. Sound travels around 2-3 times faster through helium, making high frequencies sound louder than low frequencies, making your voice sound higher in a funny way.
10. Mosquitoes get to you following the heat that our bodies emit. Higher emission of carbon dioxide correlates with a mosquito wanting to bite you more. Pregnant women, exhale more carbon dioxide and usually show higher body temperatures, can be easily detected by mosquitoes.

**K. Yogalakshmi**

I M.Sc. Chemistry

## METALS AND METAL COMPOUNDS IN CANCER TREATMENT

1. Arsenic:

Arsenic trioxide is used for the treatment of acutepromyelocytic leukemia and lung, prostate bladder, renal and skin cancers.

Side effects: Long term exposure of arsenic compound can lead to diabetes, hyper-tension, cardiovascular disease, vascular changes and neuropathy.

2. Antimony :

Antimony (III) compounds with polydentate carboxylic acids have shown anti-tumor activity in mice inoculated with S 180 solid tumors.

Sides effects: Over exposure of antimony (III) displayed some cytotoxicity against several cell lines.

3. Bismuth:Bismuth can be used for the treatment of gastric lymphoma. Bismuth increases the

production of metallothionein, a property which may be used to reduce the toxic side effects of cisplatin. Bismuth complexes offer advantages over other radiopharmaceuticals.

Side effects: It causes some allergies.

4. Gold:

It has been used as bacteriostatic and subsequently for the treatment of rheumatic arthritis. Gold (I) compounds have anti-tumor and anti-HIV activity.

Side effects: It exhibits significant cytotoxicity.

5. Vanadium:

Vanadium is an inhibitor of murine erythroleukemia cells. Vanadium compounds have been used for an insulin-like action. Vanadium has a good therapeutic potential.

Side effects: The most common side-effect of vanadium is a mild gastrointestinal disturbance. It may induce DNA stand breaks.

6. Iron:

The anti-tumour effect of an anticancer drug beleomycin is mediated by chelation of iron or copper, to form a complex which degrades DNA.

Side effects: There can be little effect on normal tissue.

7. Rhodium:

Rhodium(III) complexes have shown anti neoplastic activity. Cationic complexes of Rhodium(III) can be used as antimalarial drugs.

Side effect: The most common side effect of Rhodium is nephrotoxicity.

8. Titanium:

Titanium complexes are active against both homografts and xenografts. They also showed anti-tumour activity in ovarian carcinoma cells resistant to both doxorubicin and cisplatin.

Side effects: The dose limiting toxicity affects the liver and kidneys.

9. Platinum:

Diaquo-platinum compound has used for the treatment of cancer.
It has an anti-bacterial property.
Side effects: Platinum compounds inhibit DNA synthesis.

*G. Srimathi*
*II B.Sc. Chemistry*

# CHEMICAL WEAPONS

**Chemical weapons used in World War I:**

Chlorine, Phosgene, and Mustard gas

**Chlorine gas:**

- It produces greenish yellow cloud that smells of bleach and immediately irritates the eyes, nose, lungs and throat.
- It reacts chemically with water as it dissolves to form HCl and Hypochlorous acid(HOCl).
- Chlorine itself is very reactive with the human body and toxic. High levels of chlorine cause pulmonary oedema-fluid build-up in the lungs.

**Phosgene:**

- It smells like moldy hay and it is six times more deadly than chlorine gas.
- Phosgene was responsible for 85% of chemical weapons fatalities during world war I.
- Phosgene is a major industrial chemical used to make plastics and pesticides.
- Phosgene is used in the manufacture of other chemicals such as dyestuffs, isocyanates, polycarbonates and acid chlorides.
- It is also used in the manufacture of pesticides and pharmaceuticals.
- It is also used to separate ores.

**Mustard gas:**

- Sulfur mustard is commonly known as mustard gas.
- Mustard gas will react with water to form a breakdown product called **hemi mustard**, which is equally toxic. It releases HCl as part of this reaction.
- Mustard gas has always been seen as a nasty poison, resulting in a painful and often slow death.
- Nitrogen mustard (differing from mustard gas only due to the presence of a nitrogen atom, not a sulphur atom) reduced tumour growth in mice.

Sulphur mustard

$(CH_2\text{-}CH_2\text{-}Cl)_2\text{-} S$

Nitrogen mustard

$(CH_2\text{-}CH_2\text{-}Cl)_2\text{-}N$

**Five most deadly chemical weapons of warfare**

Most toxic: VX

Most recently used: Sarin

Most popular: Mustard gas

Most dangerous: Phosgene

Most attainable: Chlorine

***R. Taslim Unnisa***
***II B.Sc. Chemistry***

## EDIBLE WATER BOTTLE (BUBBLES)

The edible water is a blob-like water container made from sodium alginate gel. The biodegradable blob was created by Skipping Rocks Lab in an attempt to make a more environmental friendly alternative to single-serving plastics bottles. The container, named “OOHO” by its creators, enclose a small volume of water in a membrane made from brown algae and calcium chloride.

**MATERIALS:**

The key ingredient for this project is sodium alginate, a natural gelling powder derived from algae. The sodium alginate gels or polymerizes when reacted with Ca. It's a common alternative to gelatine used in candies and other foods. We have suggested calcium lactate as the calcium source, but you could also use calcium gluconate or food-grade calcium chloride. These ingredients are readily available online. You can also find them in grocery stores that provide ingredients for molecular gastronomy.

**REQUIREMENTS:**

- Water
- 1g of sodium alginate
- 5g of calcium lactate
- Large bowl, Small bowl
- Hand mixer, Spoon with a rounded bottom

The size of the spoon determines the size of your water bottle.

**MAKE AN EDIBLE WATER BOTTLE:**

1. In a small bowl add 1g of sodium alginate to 1 cup of water.
2. In a large bowl, stir 5g of calcium lactate into 4 cups of water.
3. Gently drop the sodium alginate solution into the bowl containing the calcium lactate solution. It will immediately form a ball of water in the bowl. Use less time for a thinning coat and more time for thicker coating.
4. Use a slotted spoon to gently remove each water ball. Place each ball in a bowl of water to stop any further reaction. The bottle is edible too. It's an algae-based polymer.

**SODIUM ALGINATE:**

Sodium alginate $NaC_6H_7O_6$ is a linear polysaccharide derivative of alginic acid comprised of 1,4-β-d-mannuronic(M) and α-1-guluronic(G) acids. Sodium alginate is a cell wall component of marine brown algae, and contains approximately 30% to 60% alginic acid. The biggest advantage of alginate is its liquid-gel behaviour in aqueous solutions. When monovalent ions (eg, sodium in sodium alginate) are exchanged for divalent ions (especially calcium), the reaction proceeds almost immediately, changing from a low viscosity solution to a gel structure. The gelled mass is a copolymer composed of two kinds of monomer units.

Alginic acid is used as a hydrocolloid in various applications such as food manufacturing, pharmaceuticals and in textiles and cosmetics, particularly as an emulsifier, and is also used in dentistry to make moulds.

**SAFETY AND BIODEGRADABILITY:**

The biocompatibility of alginate gels has been studied extensively and their safety for consumption is well established. As natural polysaccharides, resistant to breakdown by human digestive enzymes, alginates are classified as dietary fibres. Although undigested if eaten, the OOHO capsule will gradually decompose as the calcium diffuses out of the gel matrix in reverse of the reaction.

$$CaCl_2 + 2NaCl \longrightarrow 2NaAlg + CaCl_2$$

Because it is a single-strand polymer, Alginate can be depolymerized (broken into smaller units) by a variety of chemical reaction. Both acid and alkaline mechanisms can break down the linkages between the mucronate and guluronate monomers. Free radicals' oxidation is another way the alginate can be degraded in the environment. Many bacterial species produce an enzyme (alginate lyase) which can break the molecule down into single super components, which can act as an energy source for the organism.

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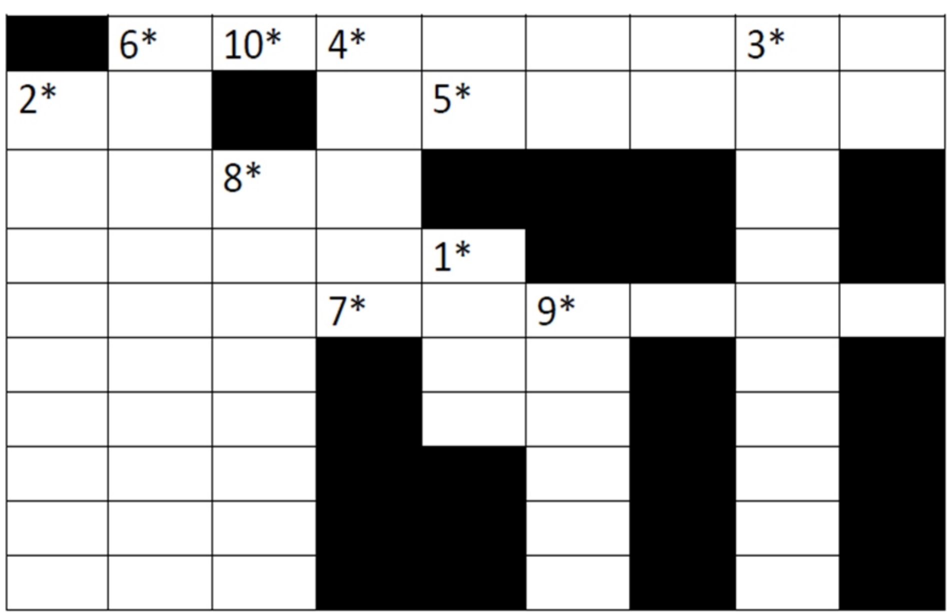
***S. Sneha***
***II B.Sc. Chemistry***

# PERIODICA




**DOWN**

1. Gun metal is an alloy of copper, tin and______________
2. This metal is known as “green metal” for its high rate of recycling and reusing without deteriorating its quality.

3. These elements were not discovered by the time when Mendeleev published his periodic table.
4. This element is the densest of all the noble gases.
6. The first man made element in the lab was ___________
8. The last discovered naturally occurring element is___________
9. This element forms a coordinate complex with chlorine, what is known as 'Invisible ink'. Identify the element.

**ACROSS**

5. In Greek, the name of this element means 'stranger'. Identify the element.
7. This is one among the elements that show ferromagnetism at room temperature.
10. The only halogen that exists as liquid at room temperature.

**ANSWERS**

| | | | |
|---|---|---|---|
| 1. | Zinc | 6. | Technetium |
| 2. | Aluminium | 7. | Nickel |
| 3. | Noble Gases | 8. | Francium |
| 4. | Radon | 9. | Cobalt |
| 5. | Xenon | 10. | Bromine |

*B. Poonguzhali*
*II B.Sc. Chemistry*

## 10 TOXIC INGREDIENTS THAT MIGHT BE IN YOUR MAKEUP

**1. Phthalates**

Phthalates are present in deodorants, nail polishes and scented lip balms. These chemicals can be grouped under "Fragrance".

Phthalates are a group of chemicals that may be disruptive to the endocrine system.

They cause reproductive abnormalities and endometriosis in women.

**2. Lead**

Lead is used in Foundations, Lipsticks and even in whitening toothpastes.

It is a proven neurotoxin linked to miscarriage, reduced fertility and delays in the onset of puberty for females.

3. **PEG Compounds**

Polyethylene glycols or PEGs are petroleum based compounds that are used to thicken, soften and gelatinize cosmetics, making them a common ingredient in cream based products. PEGs are often contaminated with ethylene oxide and 1,4-dioxane.

Ethylene oxide is a human carcinogen and is potentially harmful to the nervous system.

4. **Siloxanes:**

These silicone-based compounds are used in **cosmetics** to soften, smooth, and moisten. They make hair products dry more quickly and deodorant creams slide on more easily. They ar also used extensively in moisturizers and facial treatments.

They disrupt the endocrine system.

5. **Quaternium -15 and other formaldehyde releasing preservatives**:

They are used in Mascara, eyeliners and pressed powders.

When some chemicals break down, they release harmful formaldehyde gas, aknown human carcinogen.

6. **Octinoxate:**

Found in Foundations. This is an unstable chemical linked with endocrine disruption and thyroid disorder.

7. **Parabens:**

**Parabens** are a group of chemicals widely used as artificial preservatives in **cosmetic** and body care products. Since **cosmetics** contain ingredients that can biodegrade, these chemicals are added to prevent and reduce the growth of harmful bacteria and mold, increasing the shelf life of the product.

Parabens can mimic estrogen and have been detected in human breast cancer tissue.

8. **p-phenylenediamine:**

It is present in hair dyes, tattoos and black henna.

It causes swelling in the upper respiratory tract and larynx which causes respiratory distress.

9. **Carbon black:**

Found in Eyeliners.

It is linked to cancer and organ toxicity.

10. **Butylated hydroxyanisole (BHA) and butylated hydroxyl toluene (BHT):**

In Food: Chips, baked goods, butter, meats, chewing gum.

In makeup and skin care products: Eyeliners, eye shadows, lipsticks, lip glosses, foundations, perfumes and blushes.

These chemicals are linked to several health concerns including endocrine disruption and organ-system toxicity.

***R. Taslim Unnisa***
***II B.Sc. Chemistry***

# SCIENCE IS A GOOD SERVANT BUT A BAD MASTER

Science is a great blessing to mankind. Nothing better has happened in the history of man than the advent of science in his life. It has transformed human life beyond all imagination. Man is no longer a helpless toy in the hands of nature, but the proud master of the three worlds of land, air and water. Science has changed our outlook, our mental makeup, our thoughts and ideas, our dreams and hopes. We live and have our being in Science.

The triumph of science is seen everywhere in life. It is a faithful servant of man. It has served us in all walks of life. It is our servant in the home, in the field, in the factory. Never was there a more helping servant.

Scientists have made traveling a pleasure. Communication was almost non-existent, except for those who could afford to send special messengers. It is our most faithful medical attendant. It shows every care for our health. Small-pox reaped a good harvest, cholera and plague held their terror for man, and with the advent of science they have vanished.

Science has spanned the sky, measured the ocean and wrested from nature many of her hidden treasures. It has relieved human suffering by discovering secrets of health and disease. It has extended the frontiers of our knowledge in various directions. Indeed, when we think of triumph of science, we gape in wonder and admiration.

But one should not outlook the fact that science has also done great disservice to man- kind in the fields of armaments and destructive engines of war. The invention of gun powder was hailed as a great achievement, but gun powder has been used and perfected into a hundred, new more destructive weapons, so that today artillery, gun-fire, shells and bombs have become hellish terror to everybody

Now the question arises, "Is science a boon or a bane". Science is not the beast in man. Alfred Nobel invented dynamite to help workers in mines and to construct roads in hilly places, but not to blow up man and their properties. It is certainly not the fault of science, if we go on multiplying engines of destruction. Thus, against gas, there is the gas mask; against tank, anti-tank gun and against aerial bombing, anti-craft gun. It is reported that some effective weapons have been made to tame the fury of the Nuclear bomb.

Before us now lies a new era in which the power of atomic energy has been unleashed. It is for us to decide whether we will destroy the world with atomic bomb or rebuild it with atomic energy. Thus, science is a good servant but a bad master.

*Fathima Ramsha*
*I B.Sc. Chemistry*

# WHO AM I?

1. I can be sparkling but I'm not a star,
   I can run but I don't have legs,
   I can fall but I don't get hurt,
   I'm found in a bath but I'm not a rubber duck,
   I can help you clean but I'm not a soap.

   Who am I?

2. I have a slide but I'm not a playground,
   I have lens but I'm not a camera,
   I can help you see cells, but I'm not a prison guard,
   I can be found in labs but I'm not a test tube,
   I have your eye pressed to me but I'm not a peephole

   Who am I?

3. I'm sometimes found in a pot but I'm not stew,
   I can be a bar but I'm not a soap,
   I've been known to cause a rush but I'm not a Black Friday sale,
   I'm a type of metal, but I'm not a tin,
   I can be a medal but I'm not silver.

   Who am I?

**Answers**

1.Water

2.Microscope

3. Gold

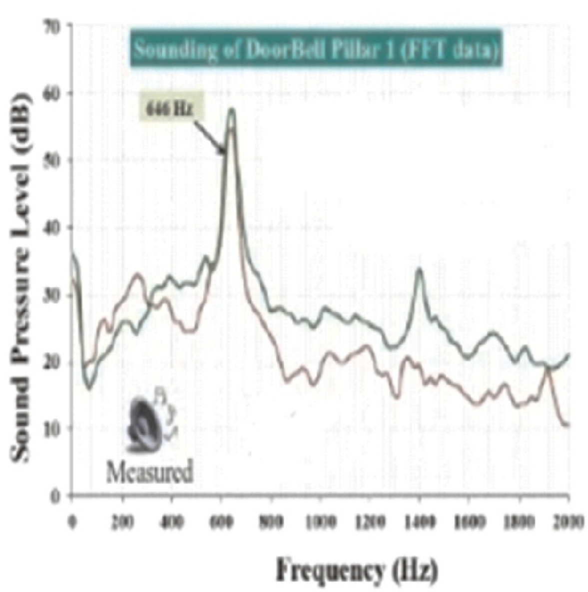
*1.Fathima Ramsha*
*I B.Sc. Chemistry*

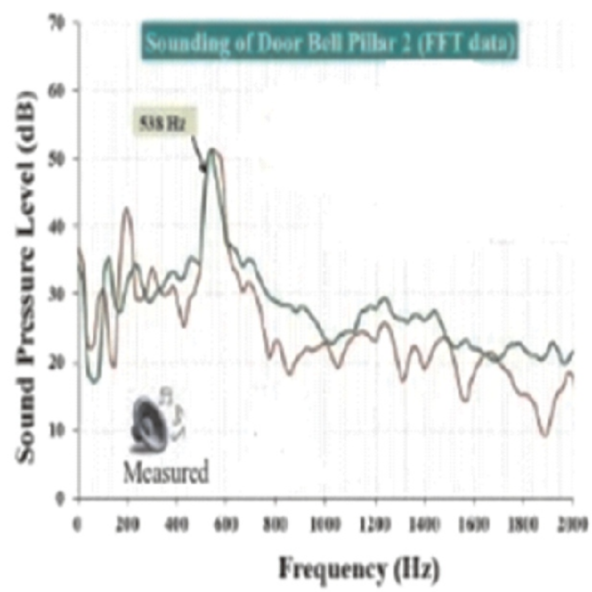
# MUSICAL PILLARS AND THE SPECTRAL ANALYSIS

India, the land of millions of god and goddesses has an incredible heritage. Especially in South India, some ancient Hindu temples have some interesting architectural elements known as "MUSICAL PILLARS" which are made up of solid granite. Even today, tourists are awe-struck by the sound of these tapping and blowing pillars.

For example: The Vittala Temple at Hampi, Karnataka contains 56 musical pillars. From that, one particular pillar is chosen because of its famous doorbell sound like *"ding-dong"*. It can be recorded with audio player and their spectra are analysed.

The fundamental frequency of the column which produces *ding* sound is 646 Hz and the column that would produce the *dong* sound is 538 Hz. Then both the columns are tapped alternatively and the "FFT analysis" are carried out.




The sound spectra (FFT) of the musical pillars which produce doorbell sounds are analysed and the spectral plot of this particular column is shown in (*Figure 1 and Figure 2*)
The fascinating musical pillars of Tamil Nadu are found in these following temples, Meenakshi Amman Temple (Madurai), Nellaiyappar Temple (Thirunelveli), Elephant Temple near Chennai.

**P.B. Aishwaryalakshmi**
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# WORD SEARCH PUZZLE FOR ELEMENTS

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T | E | S | M | A | G | N | E | S | I | U | M | D | A | I | T |
| N | T | E | A | P | O | T | A | S | S | I | U | M | E | R | P |
| S | C | P | I | N | O | I | P | O | T | A | S | S | I | U | M |
| E | V | O | M | E | B | A | R | I | U | M | B | W | I | V | D |
| E | L | I | U | O | I | I | R | A | D | I | U | M | V | A | T |
| W | V | E | I | U | S | A | L | U | M | I | N | I | U | M | F |
| L | N | I | S | G | K | P | A | M | E | R | I | C | I | U | M |
| O | L | N | E | K | I | K | H | A | O | R | E | H | T | H | I |
| L | L | S | N | R | L | O | O | O | T | V | E | X | G | C | G |
| H | S | T | G | R | I | D | U | E | R | H | E | O | D | O | O |
| A | I | E | A | S | U | O | R | O | H | P | S | O | H | P | L |
| H | H | I | M | N | O | O | N | I | N | A | S | A | E | P | D |
| O | N | N | K | R | Y | P | T | O | N | E | E | E | I | E | O |
| M | U | I | C | N | E | R | W | A | L | N | F | M | I | R | I |
| O | N | U | A | O | C | A | L | I | F | O | R | N | I | U | M |
| O | A | M | A | T | I | N | E | S | D | I | E | Q | R | E | T |

Questions:

1. Which metal is highly found in earth's crust?
2. Which element is produced by bombarding plutonium with neutrons in a nuclear reaction?
3. Which element is mostly used in drilling fluids for oil and gas?
4. Which element is used as a neutron source to detect gold and silver ores through a technique called neutron activation?
5. Chile is the world's largest producer of-----------------
6. Which element is used to create heavier elements including Mendelevium?
7. Which element stimulates skin cells and increases the skin elasticity?
8. Which element is widely used in medical field in heart shunt studies?
9. Which element is very large and has an atomic mass of 262amu?
10. Which element is used as laxative for constipation and for preparation of the bowel for surgical or diagnostic procedures?
11. Which element is highly found in milk products and meat?
12. Which element helps to regulate fluid balance and muscle contraction?
13. Which element has half-life of 1600 years and decay in radon gas?
14. Which element exists in the form of igneous rock of earth crust at about a concentration of 0.001 percent?

**Answers:**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T | E | S | M | A | G | N | E | S | I | U | M | D | A | I | T |
| N | T | E | A | P | Q | T | A | S | R | I | U | M | E | R | P |
| S | C | P | I | N | O | I | P | O | T | A | S | S | I | U | M |
| E | V | O | M | E | B | A | R | I | U | M | B | W | I | V | D |
| E | L | I | U | O | I | I | R | A | D | I | U | M | V | A | T |
| W | V | E | I | U | S | A | L | U | M | I | N | I | U | M | F |
| L | N | I | S | G | K | P | A | M | E | R | I | C | I | U | M |
| O | L | N | E | K | I | K | H | A | O | R | E | H | T | H | I |
| L | L | S | N | R | L | O | O | O | T | V | E | X | G | C | G |
| H | S | T | G | R | I | D | U | E | R | H | E | O | D | O | O |
| A | I | E | A | S | U | O | R | O | H | P | S | O | H | P | L |
| H | H | I | M | N | O | O | N | I | N | A | S | A | E | P | D |
| O | N | N | K | R | Y | P | T | O | N | E | E | E | I | E | O |
| M | U | I | C | N | E | R | W | A | L | N | F | M | I | R | I |
| O | N | U | A | O | C | A | L | I | F | O | R | N | I | U | M |
| O | A | M | A | T | I | N | E | S | D | I | E | Q | R | E | T |

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# CHEMISTRY OF PERFUMES

**Olfactory structure:**

Majority of perfumes composes a three-part structure. The "head," also known as the "top" note is the first olfactory impression the perfume conveys. The second is the "heart" note, which is the main fragrance which lasts for several hours. The last one is the "base" note, which is the fragrance that underpins the full perfume and it comprises of the minimum volatile chemicals. These parts or structure makes the fragrances lasts the whole day.

**Chemicals used in perfumes:**

***Perfume/Fragrant oils:*** Perfume oil can be divided into two types: synthetic oil or a fragrance taken out of specific sources by methods such as headspace. Headspace vacuums the smell directly from the object and recreates the smell by getting a print out of its chemical equation. Oils are extracted from flowers, plants, animals or other natural resources. The chemical equations for perfume oil are dependent completely upon what the oil was taken from.

***Water and Alcohol:*** There are many types of alcohol that can be used in perfume making, but Ethyl Alcohol ($C_2H_6O$) is most commonly used as it helps the fragrance to spread out. Distilled water ($H_2O$) is also used in the fragrance for spreading out the smell of the fragrance. Based on the amount of dilution added, there is a much different strength of perfumes.

**Role of Chemistry:**

A smell is a molecule that floats in the air as it is very light. Materials used in the fragrances are generally semi volatile organic compounds and molecular weight of these organic compounds hardly exceeds 260amu. However, the very molecule that floats in the air does not have a smell or does not have enough smell to be perceived by the human nose, e.g., Carbon Monoxide.

Chemical reactions resulted by light can alter your perfume smell, as the energy present in light can break down the bonds present in molecules of the fragrance. Bright sunlight can damage your perfume and air can also corrode perfume fragrance because of oxidation, the same process that turns uncorked wine into vinegar. With this being informed the best place to keep the perfume is in a dark place and at a room temperature in a spray bottle and the best place to apply perfume is on the pulse points because the pulse will warm the perfume and cause consistent spreading of its scent.

***S.M. Keerthanaa***
***S. Suganya***
***II M.Sc. Chemistry***

## APPLICATIONS OF VOLUMETRIC TITRATIONS

1. Wastewater Analysis:

The safety of water is based on its chemical ingredients. By analysing wastewater, the extent of contamination and requirements for filtering and cleaning can be determined. Titration is the key mechanism in this analysis. More titration specialised equipment is used in this application that can measure ammonia levels in combination with other chemicals present.

2. Pharmacology:

The development of medication is a precise science that relies on specific measurement of chemical quantities. Titration is an important part of pharmaceutical industry to ensure quality control. Many variations of the titrations are used, and often specialised equipment for pharmaceutical titration is developed to make the process more efficient.

3. Preparation of Wine:

The flavour of wine is a delicate balance often affected by its degree of acidity. This quality also affects how the wine responds to age. It is possible to improve wine production by measuring acidity using titration. Simple inexpensive titration kits are available to winemakers for this purpose. The test on wine can suggest if additional ingredients are necessary to maintain its quality.

4. Cleaning Materials Industry:

The production of effective cleaning materials and sanitizers relies on titration. This is especially important in food manufacturing factories because all machines and equipment should be pathogen and bacteria free. Titration kits are used to define the appropriate concentration of chemicals in sanitizers or cleaning agents.

5. Cosmetic Industry:

In cosmetics definitely some amount of chemicals are included as ingredients. The cosmetic production industries must come up with appropriate concentration and amount of chemicals to use in their products. The titration determines the kind of base for a suitable cosmetic.

6. Medical Labs:

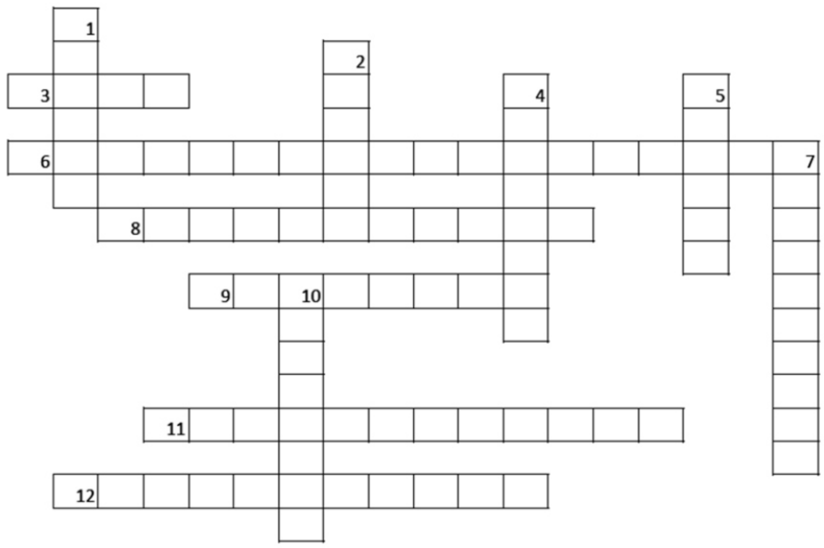
Titrations are often used in dealing with blood and urine sample from patients. It can be used in determining glucose level in those diagnosed with diabetes.  Blood samples are taken and a titration test is conducted to define the amount of HCG hormone that is present in blood.

7. Automotive Industry:

The automotive industry uses titration in production of biodiesel fuel. The manufacturers must ensure the pH of the fuel. It also helps to know the amount of base to be used to make sure the resulting solution has a correct pH and also determines the concentration of base required for the production of the biodiesel.

*M.P. Riya*
*II B.Sc. Chemistry*

# SCIENCE PUZZLE




**ACROSS**

3. The energy needed to move an object against a force.
6. KOH
8. Process of transition from solid to gas phase without passing through an liquid phase.
9. It is the measure of the force applied over a unit area.
11. Method of separating mixtures based on differences in their boiling points.
12. Device that measures temperature.

**DOWN**

1. Basic unit of light and all other electromagnetic radiation.
2. Volume that encloses little or no matter.
4. It is the name of the element and is represented by the symbol H.
5. Negative ions are called
7. It is a physical property where the material returns to its original shape after being deformed.
10. Elementary subatomic particle with a negative charge.

**ANSWER**

| | | | |
|---|---|---|---|
| 1. | Photon | 7. | Elasticity |
| 2. | Vacuum | 8. | Sublimation |
| 3. | Work | 9. | Pressure |
| 4. | Hydrogen | 10. | Electron |
| 5. | Anions | 11. | Distillation |
| 6. | Potassium hydroxide | 12. | Thermometer |

***P. Keerthana***
***II B.Sc. Chemistry***

# LIST OF CHEMICALS IN EVERYDAY HOUSEHOLD ITEMS

**Baking Powder**
Sodium bicarbonate - $NaHCO_3$
Used in baking where it reacts with other ingredients, releasing carbon dioxide ($CO_2$).

**Battery acid**
Sulphuric acid - $H_2SO_4$
Used in lead-acid batteries for cars and other vehicles.

**Vinegar**
Acetic acid or Ethanoic acid - $C_2H_4O_2$
Food seasoning and various household cleaning uses.

**Sugar (Table Sugar)**
Sucrose - $C_{12}H_{22}O_{11}$
Used as a sweetener.

**Salt (Table Salt)**
Sodium chloride NaCl
Used to season food (during food preparation and at the table), and also as a food preservative.

**Lime**
Calcium oxide CaO

Less common in modern homes than in the past. Glows when heated; was used in theatres before invention of electric lighting. Health risks on skin contact or inhalation.

**Caustic soda**
Sodium hydroxide NaOH
Used in products for cleaning, unblocking sinks, drains and even toilets. It's a highly corrosive alkali.

- **Egg shell**
  Calcium carbonate - $CaCO_3$
  Natural product; Part of hens' eggs not usually eaten or used in cooking.

**Bronze**
Alloy of copper and tin - Cu and Sn
Used mainly for making ornaments and weapons in the past.

**Brass**
Alloy of copper and zinc - Cu and Zn
Used to make fixtures, fittings and ornaments.

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# FOOD CHEMISTRY

**What is Food Chemistry?**

As the name implies, food chemistry is the branch of chemistry that deals with the chemistry behind the biochemical nature of food, their properties and how they are processed in the body. It involves the study of chemical components from proteins to carbohydrates and more. In food chemistry, we learn how different processing techniques affect a certain type of food and also for ways to enhance the quality of food.

Components of the Food we eat

**1. Water**

Water is a major component of almost every type of food we eat. But water also provides a place for bacterial growth which leads to food spoilage. Thus measuring the amount of water in a food item can be used to measure the shell life of an object.

The shelf life can be altered by different methods such as:

Refrigeration\Freezing
Dehydration

**2. Carbohydrates**

A carbohydrate is a biomolecule which is responsible for providing energy for most organisms. They are also known as saccharides. They are found in white bread, sugars, candies, fruits, vegetables, pulses, wheat, rice etc.

Some examples of Carbohydrates are:

Glucose, galactose, fructose, glucose

**3. Lipids**

The term lipids refer to non -polar compounds or water-insoluble compounds of biological origin. The main functions of lipids are:

- Storing energy
- Signalling

As structural components of cell membranes, lipids are classified as

- Fatty acids
- Glycerolipids
- Glycerophospholipids
- Sphingolipids
- Sterol lipids
- Prenol lipids
- Saccharolipids
- Polyketides

**4. Proteins**

Proteins play a fundamental role in the structure and functioning of a cell. Proteins in food are important for the survival and growth of a human being. They are essential building blocks of human tissue and in extreme cases serve as a fuel source. Some of the common sources of proteins through food are

- Meat
- Milk
- Eggs
- Pulse

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## INTERESTING FACTS

**Does human body produce free radicals?**

Human body produces free radicals when it is exposed to X-rays, cigarette smoke, industrial chemicals and air pollutants. Free radicals can disrupt cell membranes, increase the risk of many forms of cancer, damage the interior lining of blood vessels and lead to a high risk of heart disease and stroke. Body uses vitamins and minerals to counter the effects of free radicals. Fruit contains antioxidants which decrease the effects of free radicals.

**Apple:**

Apples contain an enzyme called polyphenol oxidase (PPO), also known as tryosinase. Cutting an apple exposes its cells to the atmospheric oxygen and oxidizes the phenolic compounds present in apples. This is called enzymatic browning that turns a cut apple brown. In addition to apples, enzymatic browning is also evident in bananas, pears, avocados and even potatoes.

**Methane:**

Methane is the major component of the atmosphere of Jupiter, Saturn, Uranus and Neptune but only minor component of earth's atmosphere.

**Flammable Ice:**

This catchy phrase describes a frozen mixture of water and methane gas chemically known as methane clathrates. The methane molecule which is produced by biological process under the deep-ocean, at $4^{0}$C and 50atm doesn't simply reach the surface, instead each molecule is trapped inside clusters of 6 to 18 water molecules forming methane clathrates. Many countries are working on how to tap out these vast resources of natural gas but mining and extracting are very difficult.

**Wax in Apple:**

Apples produce its own wax which contains long unbranched alkanes ($C_{27}H_{56}$ and $C_{29}H_{60}$). This natural wax helps the apple to resist moisture lost, enhances the fruit firmness and slowdowns its natural degradation. The consumption of apple with artificial wax coating is harmful to digestive system.

**Do you know about London smog?**

The great smog of London was first observed in December 1952 and hence it is also known as London smog or classical smog. It consists of coal smoke and fog. It occurs in cool humid climate. This is mainly due to induced oxidation of $SO_2$ to $SO_3$, which reacts with water yielding sulphuric acid aerosol. Chemically it is reducing in nature because of high concentration of $SO_2$ and so it is also called as reducing smog. It caused major disruption by reducing visibility and even penetrating indoor areas. Government medical reports estimated that 4000 people had died as a direct result of the smog and 100,000 more were made ill by the smog's effects on the human respiratory tract.

**How does oxygen exchange between maternal and foetal blood in a pregnant woman?**

In a pregnant woman, the oxygen supply for foetus is provided by the maternal blood in the placenta where the blood vessels of both mother and foetus are in proximity. Both foetal and maternal haemoglobin bind to oxygen reversibly as follows:

$$Hb_{(mother)} + O_2 \rightleftharpoons HbO_{2\,(mother)}$$

$$Hb_{(foetus)} + O_2 \rightleftharpoons HbO_{2\,(foetus)}$$

The equilibrium constant value for the oxygenation of foetal haemoglobin is higher due to its higher affinity for oxygen compared to the adult haemoglobin. Hence the oxygen from the mother's blood is effectively transferred to the foetal haemoglobin.

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# DO YOU KNOW?

**Snake cells grown in the lab produce venom, which we could use as medicine:**

Snake glands have for the first time been grown in the lab as tiny balls of cells called organoids that become filled with venom. It might mean the end of “milking” snakes for their venom by hand to produce treatments for bites. As well as becoming a new source of venom for the makers of snakebite antidotes, the clumps of cells, just 1 millimeter across, could also be used for turning the biochemicals in snake venom into medicines, because they have powerful effects on the body.

Scientist created the venom organoids by taking tiny clumps of gland tissue either from snake embryos inside eggs or in one case from a pet snake that had to be put down due to illness. Antivenom is currently made by keeping snakes in captivity and extracting their venom. This is injected in low doses into horses, which make antidotes that can be taken from their blood. Being able to make venom in the lab would cut out the snake farming part of the process. It is labour intensive, so only a few kinds of snakes are kept in this way, but there are an estimated 600 species that are venomous, meaning we don't have antidotes for many snake bites.

In the longer term, antidotes in lab produced venom could be made by immune cells grown in a dish, avoiding all use of animals. The snake gland organoids could also be a source of new medicine. Several existing drugs are based on compounds found in snake venom, such as a major class of drugs that lower blood pressure, based on a toxin made by the Brazilian pit viper. Any one species venom typically has more than 20 compounds that have biological effects. They may work by affecting the heart, the nervous system or paralyzing muscles, for instance.

**Ribose, a sugar needed for life has been detected in meteorites:**

Space rocks that fell to Earth contain ribose, an essential molecule for life's genetic machinery, and other related sugars. Many of life's ingredients were delivered to Earth by interplanetary debris. Many organic molecules have been found in space. For example, carts around sugar and alcohol, the base ingredients for a decent interplanetary cocktail. But until now, no one had confirmed an extraterrestrial source for ribose. This molecule forms part of the sugar-phosphate backbone of RNA, molecular workhorses within cells responsible for reading and carrying out instructions encoded in DNA.

A geochemist at Tohoku University, Japan found the ribose, along with several chemically similar sugars, in samples from two meteorites, one collected from Morocco, the other from Australia. By measuring the amount of carbon-13 in the sugars a variant of carbon with an extra neutron, which appears more often in organic molecules from space than in their terrestrial counterparts, the team found that the components likely originated in space and weren't picked up on Earth.

The team suspects that the sugars formed from chemical reaction between water and formaldehyde in the meteorites long ago. Previous lab work in a simulated space environment where ultraviolet light irradiated chilled water, ammonia and methanol has also shown that ribose could form an interstellar ice grains. Other similar experiments have done the same for ribose's chemical cousin deoxy ribose, which helps for the backbone of DNA.

**Tiny bites of iron may explain why some icebergs are green:**

Icebergs often appear mostly white because light bounces off air bubbles trapped inside the ice. But pure ice, ice without air bubbles that often forms on a berg's underside, appears blue because it absorbs longer light wavelengths (warm colors like red and orange) and reflects shorter ones (the cooler colors).

Since the 1930s, though mysterious capsized icebergs with green undersides, nicknamed “jade bergs”, have been spotted around Antarctica. In the early 1990s, glaciologist of Washington proposed that the green came from microscopic carbon particles from dead organisms. When integrated into ice, these yellow carbon particles would absorb blue light leaving green to be reflected. Later experiments, though, found that the amount of carbon in green icebergs was too low to create the emerald.

Then in 2016, researchers discovered iron oxides in decades-old preserved green ice sample taken from the Amery ice shelf in Antarctica. Iron oxides such as rust reflect reds and oranges but absorb blue light. If these particles, possibly picked up from rocks crushed by the weight and friction of glaciers flowing toward the ocean, get incorporated into ice forming underwater, the result would be vibrant green.

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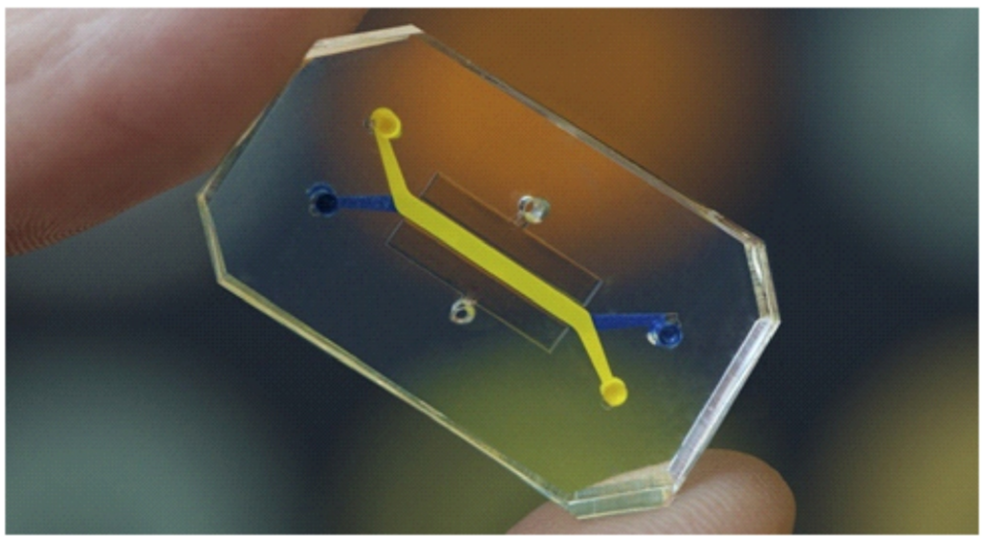
## HUMAN ORGANS-ON-CHIPS

**Microfluidic devices lined with living human cells for drug development, disease modeling, and personalized medicine**

Clinical studies take years to complete and testing a single compound can cost more than $2 billion. Meanwhile, innumerable animal lives are lost, and the process often fails to predict human responses because traditional animal models often do not accurately mimic human pathophysiology. For these reasons, there is a broad need for alternative ways to model human diseases *in vitro* in order to accelerate the development of new drugs and advance personalized medicine.

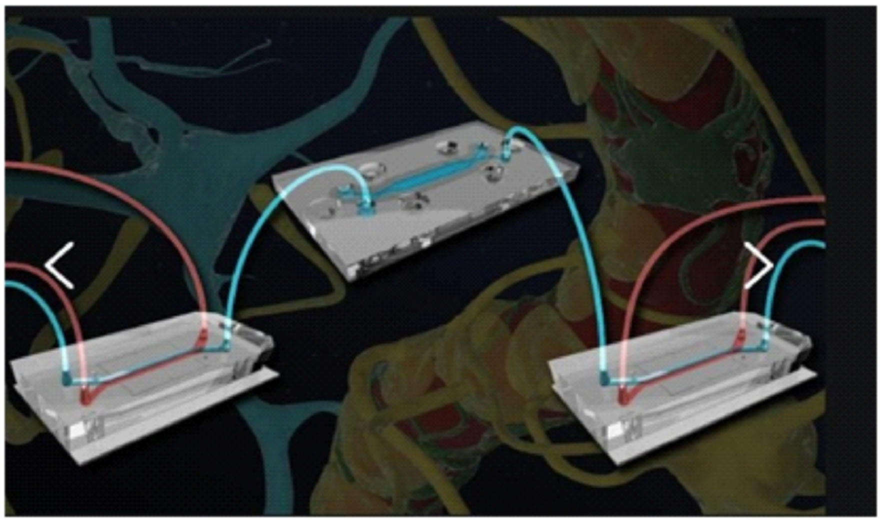
Wyss Institute researchers and a multidisciplinary team of collaborators have adapted computer microchip manufacturing methods to engineer micro fluidic culture devices that recapitulate the micro architecture and functions of living human organs, including the lung, intestine, kidney, skin, bone marrow and blood-brain barrier, among others. These micro devices, called 'Organs-on-Chips' (Organ Chips), offer a potential alternative to traditional animal testing. Each Organ Chip is composed of a clear flexible polymer about the size of a computer memory stick that contains hollow micro fluidic channels lined by living human organ-specific cells interfaced with a human endothelial cell-lined artificial vasculature, and mechanical forces can be applied to mimic the physical microenvironment of living organs, including breathing motions in lung and peristalsis-like deformations in the intestine. They are essentially living, three-dimensional cross-sections of major functional units of whole living organs. Because they are translucent, they provide a window into the inner workings of human cells in living tissues within an organ-relevant context.



With their ability to host and combine the different cell and tissue types making up human organs, Organ Chips present an ideal microenvironment to study molecular- and cellular-scale activities that underlie human organ function and mimic human-specific disease states, as well as identify new therapeutic targets *in vitro*. They recreate therapeutically relevant interfaces, like the alveolar-capillary interface and blood-brain-barrier, to investigate drug delivery as well as discover new therapeutics. Organ Chips also can be used to culture a living microbiome for extended times in direct contact with living human intestinal cells to enable insights into how these microbes influence health and disease, or to model lung infections with influenza virus to identify its vulnerabilities. They also open up new possibilities to investigate how environmental factors like cigarette smoke affect tissue health and physiology in individual patients, as shown with a smoking machine that precisely mimics human smoking behavior and its impact on human lung airway functions by breathing cigarette smoke directly into the airspace of a human Lung Airway Chip.

To mimic the interconnectedness of organs within the human body, Wyss researchers also have developed an automated instrument to link multiple Organ Chips together by transferring fluid between their common vascular channels. This instrument, designed to mimic whole-body physiology, controls fluid flow and cell viability while permitting real-time observation of the cultured tissues and the ability to analyze complex interconnected biochemical and physiological responses across ten different organs. This holistic "human Body-on-Chips" approach is being used to predict human pharmacokinetic and pharmacodynamics (PK/PD) responses of drugs *in vitro*.

A Wyss Institute-launched startup company, Emulate, Inc. has licensed the technology and is now further developing and commercializing the Institute's Organ Chip technology and automated instruments to bring these important research tools to biotechnology, pharmaceutical, cosmetics and chemical companies as well as academic institutions and hospitals for personalized medicine. Organ Chips are now being explored worldwide as tools for accurately predicting drug efficacies and toxicities, with the goal of dramatically improving the accuracy and efficiency of preclinical drug testing.



**1/7 A system that links two Blood-Brain Barrier (BBB) Chipsto a Brain Chip allows scientists to study how the brain andit's blood vessels influence each other**

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## CHEMICALS IN COSMETICS

A cosmetic may be a substance or preparation that's designed to be used on any external part of the human body in order to enhance the odours of the body, to alter its look, cleanse it, keep it in condition, fragrance it or shield it. The type of cosmetics includes all products like shampoo, soap, hair dye, face cream, moisturizer, concealer, perfume, lipstick and many more. There are many chemical combinations used for the preparation of these cosmetics. The chemicals added is what gives the texture and feel for these kinds of beauty products. Cosmetics are made from a range of ingredients which are the so called industrial chemicals. Industrial chemicals may be either synthetic chemicals or naturally occurring processed chemicals. Few of the chemicals and their use in cosmetics are listed below.

**ALS-Ammonium lauryl sulphate:** Ammonium lauryl sulfate (ALS) acts as an anionic surfactant by avoiding surface tension in liquids. Due to this property it is used in cosmetics like cleansing agents, hair shampoos and bathing agents. ALS is an irritant to eyes and has very low acute toxicity.

**Talc:** Talc is a major component in many cosmetics like face powders, concealers etc. The chemical formulation in talc is hydrated magnesium silicate.

**Formaldehyde:** Formaldehyde is present in many cosmetics and personal care products like shampoos, conditioners, shower gels, hair straightening solutions, liquid hand soaps, cream cleansers, skin moisturisers and toothpastes. It is the most common ingredient in nail polish, nail polish remover etc.

**Alcohols:** Alcohols are common ingredients in perfumes. The fatty alcohols(less dense alcohol after the removal of fats and oils) are ingredients in detergent and act as cleansing agents. The glycols are used as substances to avoid loss of moisture. Isopropanol is the common alcohol ingredient in many cosmetics and cleansing products. Alcohols are usually used to reduce the thickness of liquid.

**Lanolin:** Lanolin is a thick substance derived from the sebaceous gland of sheep. It is a thick moisturizing agent. It is a common additive in cosmetic products for moisturizing skin, hair and nails. This acts as an emulsion by blending with any other cosmetic product.

**Mineral oil/waxes:** Mineral waxes are common ingredient in cosmetics. They are main ingredients in products such as paraffin oil, paraffin wax, petrolatum (known as Vaseline).

**Phthalates:** Phthalates are used as plasticisers and solvents, and can be found in fragrances, hair products, skin lotions, nail polish and nail hardeners.

**Parabens:** Parabens are preservatives used in many cosmetic and personal care products, with methyl paraben being the most commonly used.

**Lead acetate:** Hair colour restorers may contain lead acetate.

**Coal tar: Som**e colouring dyes are derived from coal tar.

**Retinoids:** Dermatologists love retinol and other retinoids, which are forms of vitamin A that encourage your skin to speed up its natural turnover (the process wherein old skin cells are sloughed away and replaced by fresh new ones.) Faster cell turnover leads to more collagen, the springy framework that keeps young skin plump and glowing.

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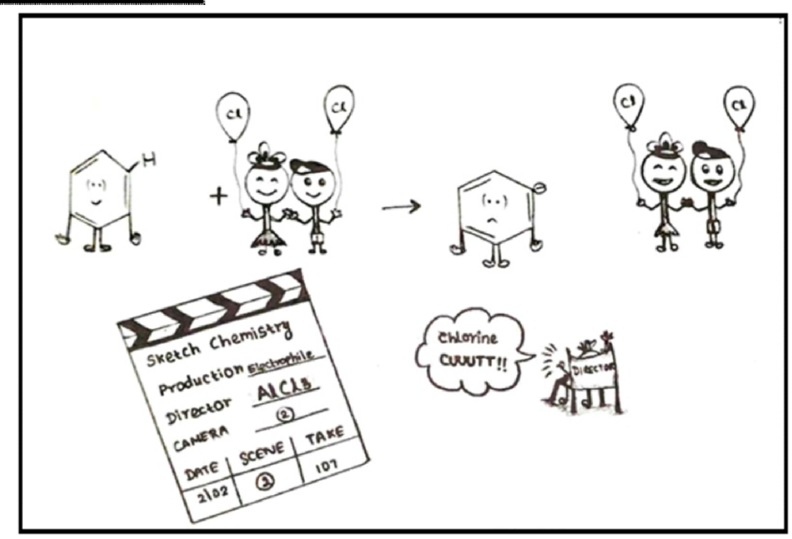


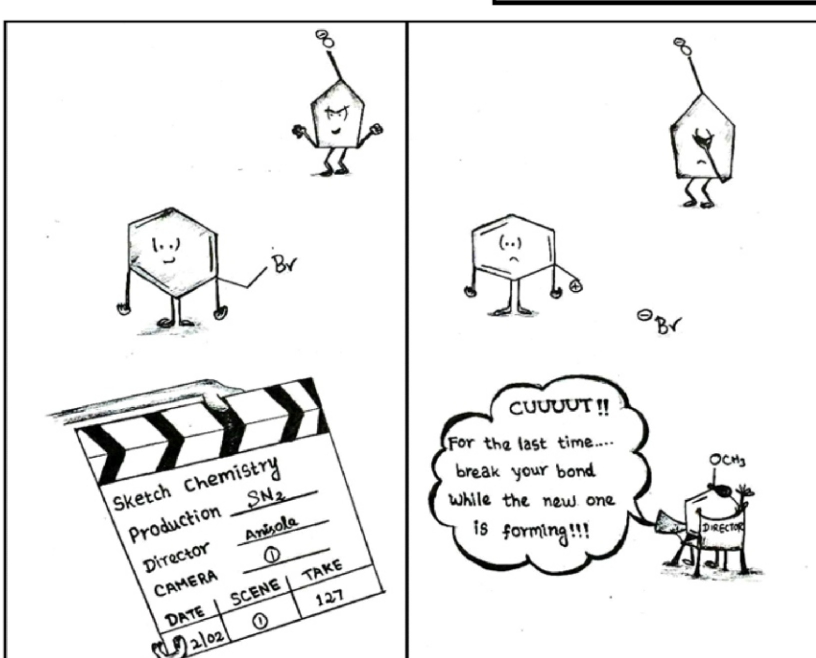


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