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Contents

HOD'S Note

2015 has been a happening and fulfilling year for AS&H Department as we recreated the vision and mission to become a living document. One quality objective of our mission was to create research minded youngsters/faculty members who could find solution to the world's problem through research developments. Our intention and hope is that our work and effort will enable students and faculty member's to develop skill knowledge and values that will allow them to participate and contribute positively in an ever changing world.

We are very fortunate to be received all possible support from the Sreepathy Management and Principal to accomplish this endeavor successfully. I would like to take the opportunity to thank all staff of AS & H department supportive community for working so hard to materialize this venture. By working together we will ensure positive and productive learning environment for all stake holders.

With best regards

Dr. George C.T, MA, PhD, MBA
HOD AS & H DEPARTMENT

PROSPER THE LEADER IN YOU

Hithes P (Asst Prof in Physics)

Here I take this opportunity to list out types of leaders, I could write this only because of my interactions with varieties of people I have met in my 37 years of life, the different people I have worked with in my 17 years of experience in teaching physics, computer science and science. Please use this to introspect yourself and improve (if needed) thereafter.

Competencies	Type I	Type II	Type III	Type IV
Leader for	It's a part of life	Standing for values	Getting benefits	Controlling others
Accept people	Unconditionally with love	thinking is in line with that of others	they get benefit from others	only if they are accepted great by others
Main aim in life is to	Live with happiness and love	to be being righteous	get benefitted, noticed in whatever they do	Thrust their ideas, views on others
Inner Personality type	Guide	Combatant	Tycoon	Trapper
Live for	Ideals	Views	Benefit	Power
Stand with	Eternal good values	Good vision	Good for majority	Good only for themselves
Want to	Use love as means to live.	Implement correct among people	Use people for personal profit	Control others
Intervention of others	Pursue in their own path	Takes only what's needed	Welcomes only to their benefit	Resisted
Idea of being a leader	Anybody can be best leader	Anyone among their list of inspired people can be the best	One who benefits them is the best	They themselves is unquestionably best
They address by	doing the required	doing right	pleasing others	weakness in others
Interactions with subordinates	Prosper subordinates to develop according to their own pace	Like to improve the standards of subordinates aligned with a vision	Like to improve the standards of their subordinates as far as subordinates are with them.	Never like to improve the standards of subordinates
Strategies in life	Make others strategic	Develops good strategies and follows	Uses only beneficial strategies	Strategic disagreement
Execution of ideas	Motivates others to implement genuine ideas	Supports implementing the correct ides	Mutual consensus to bring out their plans alone	Compulsory execution of ideas

Competencies	Type I	Type II	Type III	Type IV
Self esteem	Always in high self esteem. Learns from failure too.	Mostly with self esteem but in identity crisis when all plans fail	Mostly in identity crisis (if failed), no crisis otherwise	Always in identity crisis, poor self esteem
when challenged	accepts challenges as a part of normal life	accepts challenges only righteous	accepts challenges only beneficial	they cannot be challenged
work from	enthusiasm	righteousness	profit	helplessness
friendship	open to all	strategy based	profit based	fewest friends
method of working	thinks about the welfare of all concerned	thinks about the welfare of good people	thinks about few close friends at work	thinks only about themselves
Freedom	Freedom with love so that work is done smoothly	Freedom is given until their core values remain same.	Restricted freedom for few till they are with them	No freedom to anybody working under them
working in a group	work with considering interest of all	right work	least work with maximum profit	all gains
Critics	accepts critics as a part of life	accepts those which are in line with their thought	fearful to hear the critics	shouts at critics
They	Create leaders	aim to be a good leader	let others to lead the show	never allows anyone to be a leader
Speech pattern	We did it	You must do this	Let us do this	Why didn't you do this?
Attitude towards duty	Duty is a part of life	Duty first , beauty next	Beauty first, duty next	Accept my beauty, I shall reduce your duty

Since all the above types are present in almost all types of leaders in different amount. It's better to focus steps to become "Type I leader". This exhaustive list is given exclusively for introspection of each individual and change leadership pattern if needed. On close observation it's seen that each types can again be minutely sub-divided into sixteen further groups and it's not needed at this point here. **This tool will be a great failure if it is used to evaluate others since our subjective mind comes into play while observing others.**

GREEN CHEMISTRY

Amrutha K (Asst.Prof in Chemistry)

Green chemistry, also called sustainable chemistry, is a philosophy of chemical research and engineering that encourages the design of products and processes that minimize the use and generation of hazardous substances.

- The design of processes to maximize the amount of raw material that ends up in the product;
- The use of safe, environment-benign substances, including solvents, whenever possible;
- The design of energy efficient processes;
- The best form of waste disposal: not to create it in the first place.

The 12 principles are:

1. It is better to prevent waste than to treat or clean up waste after it is formed.
2. Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.
3. Wherever practicable, synthetic methodologies should be designed to use and generate substances that possess little or no toxicity to human health and the environment.
4. Chemical products should be designed to preserve efficacy of function while reducing toxicity.
5. The use of auxiliary substances (e.g. solvents, separation agents, etc.) should be made unnecessary wherever possible and innocuous when used.
6. Energy requirements should be recognized for their environmental and economic impacts and should be minimized. Synthetic methods should be conducted at ambient temperature and pressure.
7. A raw material or feedstock should be renewable rather than depleting wherever technically and economically practicable.
8. Reduce derivatives – Unnecessary derivatization (blocking group, protection/deprotection, and temporary modification) should be avoided whenever possible.
9. Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.
10. Chemical products should be designed so that at the end of their function they do not persist in the environment and break down into innocuous degradation products.
11. Analytical methodologies need to be further developed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substances.
12. Substances and the form of a substance used in a chemical process should be chosen to minimize potential for chemical accidents, including releases, explosions, and fires.

Examples

Hydrazine

Hydrazine is traditionally produced by the Olin Raschig process from sodium hypochlorite (the active ingredient in many types of bleach) and ammonia. The net reaction produces one equivalent of sodium chloride for every equivalent of the targeted product hydrazine:

$$NaOCl + 2\ NH_3 \rightarrow H_2N\text{-}NH_2 + NaCl + H_2O$$

In the greener Peroxide process hydrogen peroxide is employed as the oxidant, the side product being water. The net conversion follows:

$$2\ NH_3 + H_2O_2 \rightarrow H_2N\text{-}NH_2 + 2\ H_2O$$

Methyl ethyl ketone is used as a carrier for the hydrazine; the intermediate ketazide phase separates from the reaction mixture, facilitating workup without the need of an extracting solvent.

1,3-Propanediol

Green route to 1,3-propanediol, which is traditionally generated from petrochemical precursors. It can be produced from renewable precursors via the bioseparation of 1,3-propanediol using a genetically modified strain of *E. coli*. This diol is used to make new polyesters for the manufacture of carpets.

Carbon dioxide as blowing agent

Polystyrene foam is a common material used in packing and food transportation. Seven hundred million pounds are produced each year in the United States alone. Traditionally, CFC and other ozone-depleting chemicals were used in the production process of the foam sheets, presenting a serious environmental hazard. Flammable, explosive, and, in some cases toxic hydrocarbons have also been used as CFC replacements, but they present their own problems. Dow Chemical discovered that supercritical carbon dioxide works equally as well as a blowing agent, without the need for hazardous substances, allowing the polystyrene to be more easily recycled. The CO_2 used in the process is reused from other industries, so the net carbon released from the process is zero.

Green Chemistry is here placed as a part of Chemistry for the Environment, concerning the still non-existent pollutants. Indeed, the object of Green Chemistry is the reduction of pollution and risks by chemicals by avoiding their generation or their introduction into the biosphere. The distinction between pollutant chemicals and dangerous chemicals, along with the consideration of the exhaustion of fossil resources and the acknowledgement of the harmful effects of the chemicals employed in a great variety of activities, leads to the recognition of four general objectives for Green Chemistry. In order to accomplish these general objectives, a number of strategies, or secondary objectives and some fundamental concepts, namely, atomic economy, selectivity, potential harm or historical harm can be visualized. A connection is finally established between the strategies and current and future research areas of Green Chemistry.

The ultimate aim of green chemistry is to entirely cut down the stream of chemicals pouring into the environment. This aim seems unattainable at present, but progress in the green chemical research areas and their application through successive approaches will certainly provide safer specialty chemicals and much more satisfactory processes for the chemical industry

AN INTRODUCTION TO FRACTALS

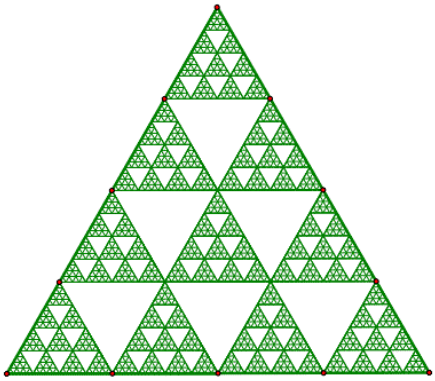
Deepthy P V (Asst Prof in Mathematics)

Fractals - modern branch of mathematics and art. Benoit Mandelbrot is generally considered to be the father of fractals. Although the study of fractals have existed as early as the 17th century, but the term fractal was only coined in 1975 by Benoit Mandelbrot. It is derived from the Latin word fractus, which means broken or fractured. While a fractal is strictly a mathematical construct, it is found in various non-mathematical models such as natural systems and artworks.

To create a fractal, you can start with a simple pattern and repeat it at smaller scales, again and again, forever. In real life, of course, it is impossible to draw fractals with "infinitely small" patterns. However we can draw shapes which *look* just like fractals.

. Two of the most important properties of fractals are self-similarity and non-integer dimension.

The Sierpinski triangle (also with the original orthography *Sierpiński*), also called the Sierpinski gasket or the Sierpinski Sieve, is a fractal and attractive fixed set with the overall shape of an equilateral triangle, subdivided recursively into smaller equilateral triangles.



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The peculiarity about fractals is that they have *fractional dimensions*! A fractal curve could have a dimensionality of 1.4332, for example, rather than 1. Fractals are not just a mathematical curiosity. The dimension of fractals depending on how much space it takes up as it twists and curves

If you look carefully at a fern leaf, you will notice that every little leaf part of the bigger one has the same shape as the whole fern leaf. You can say that the fern leaf is self-similar. The same is with fractals: you can magnify them many times and after every step you w ill see the same shape, which is characteristic of that particular fractal

Fractals in Nature

Most natural objects are fractal by nature, and can be best described using fractal mathematics. Clouds, leaves, the blood vessel system, coastlines, particles of lint, etc. have fractal shapes. . Extending beyond the typical perception of mathematics as a body of complicated, boring formulas, fractal geometry mixes art with mathematics to demonstrate that equations are more than just a collection of numbers. What makes fractals even more interesting is that they are the best existing mathematical descriptions of many natural forms, such as coastlines, mountains or parts of living organisms.

Fractals in vegetables

ADVANTAGES :

Fractals are considered to be important because they define images that are otherwise cannot be defined by Euclidean geometry.

Fractals are described using algorithms and deals with objects that don't have integer dimensions.

Some of the more prominent examples of fractals are the Cantor set, the Koch curve, the Sierpinski triangle, the Mandelbrot set, and the Lorenz model.

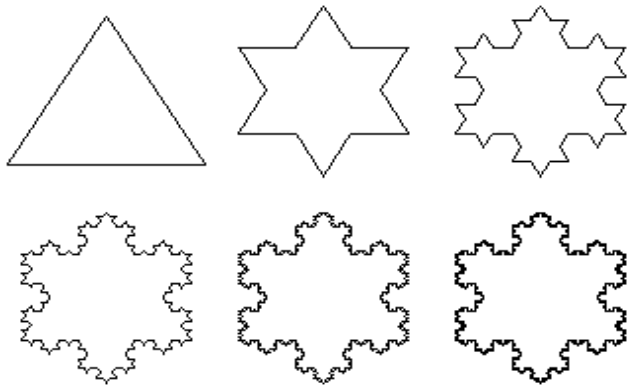
Contrary to its complicated nature, fractals do have a lot of uses in real life applications. First, we start with art. The image created by a fractal is complex yet striking, and has intrigued artists for a long time already. In fact, fractal art is considered to be true art.. Even in African art and architecture fractal shapes and images are prevalent.

In addition, some artists are inspired by fractal images when creating their own art forms. Not only that: fractal images are actually being used nowadays to create special effects. Utilized in shows such as Star Trek and Star Wars, fractals are used to create landscapes that are otherwise impossible with conventional technology. On a related note, fractals are also used in creating some computer graphics.

In addition, fractals are a very important part in biological studies. For example, a lot of objects in nature are composed of complex figures that are otherwise not possible to be defined by Euclidean shapes. Most natural objects, such as clouds and organic structures, resemble fractals. As such, fractals can be used to capture images of these complex structures. In addition, fractals are used to predict or analyze various biological processes or phenomena such as the growth pattern of bacteria, the pattern of situations such as nerve dendrites, etc.

And speaking of imaging, one of the most important uses of fractals is with regards to image compressing. A pretty controversial process, it takes an image and expresses it into an iterated system of functions. This image is displayed quickly and is expressed in detail in any magnification.

Reproducing Realistic Images A very important application of fractal is to reproduce the natural images such as clouds, trees, mountains and etc. This is because many natural things, such as plants, are very complex and exhibit some self-similarity. The complexity of fractals and the property of self-similarity allow fractals to reproduce a large set of real-world images. In fact, the Koch Snowflake is a possible starting point for the design complex natural curves. The Koch Snowflake itself is already very similar to the snowflake in the natural world. However, everyone can tell that the Koch Snowflake does not look like a natural curve. It is too regular in shape. This regularity comes from the strictness of its construction process. Thus, the first step to loosen the regularity is to introduce some random fluctuations during the construction process. The final curve can be strongly modified when the iteration process is changed.



Koch Snowflake

The fractals have more and more applications in the science. The main reason is that they describe very often better the real world than traditional mathematics and physics.

Some examples are presented in this page.

Astronomy
Computer science
Fluid mechanics
Telecommunications
Surface physics
Medicine

Astronomy

Fractals will maybe revolutionize the way to see the universe (ref.1 and ref.3). Cosmologists usually assume that matter is spread uniformly across space. But observation shows this is not true. Astronomers agree with that fact on "small" scales, but most of them think that the universe is smooth at very large scales. However, a dissident group of scientists claims that the structure of the universe is fractal at all scales. If this new theory is proved to be correct, even the big bang models should be adapted. But at present, cosmologists need more data about the matter distribution in the universe to prove (or not) that we are living in a fractal universe. More on the debate is here.

Computer science

Actually, the most useful use of fractals in computer science is the fractal image compression. This kind of compression uses the fact that the real world is well described by fractal geometry. By this way, images are compressed much more than by usual ways (eg: JPEG or GIF file formats). Another advantage of fractal compression is that when the picture is enlarged, there is no pixelisation. The picture seems very often better when its size is increased.

Fluid mechanics

The study of turbulence in flows is very adapted to fractals. Turbulent flows are chaotic and very difficult to model correctly. A fractal representation of them helps engineers and physicists to better understand complex flows.

Flames can also be simulated.

Porous media have a very complex geometry and are well represented by fractal. This is actually used in petroleum science.

Telecommunications

A new application is fractal-shaped antennae that reduce greatly the size and the weight of the antena

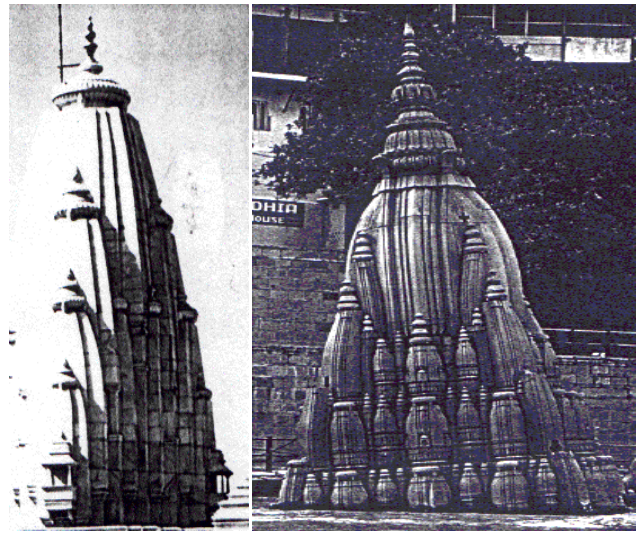
Surface physics

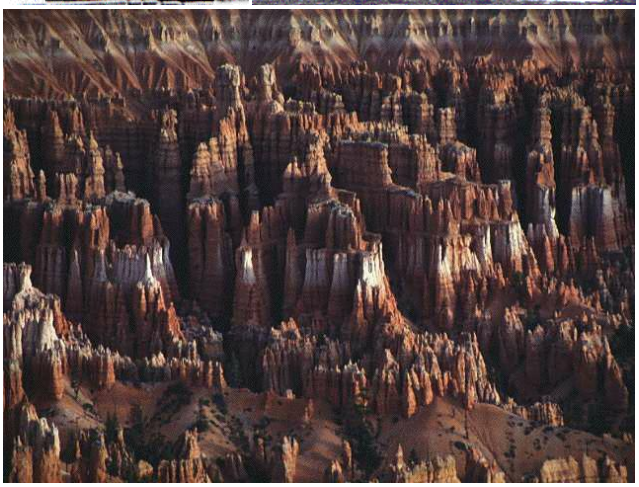
Fractals are used to describe the roughness of surfaces. A rough surface is characterized by a combination of two different fractals.

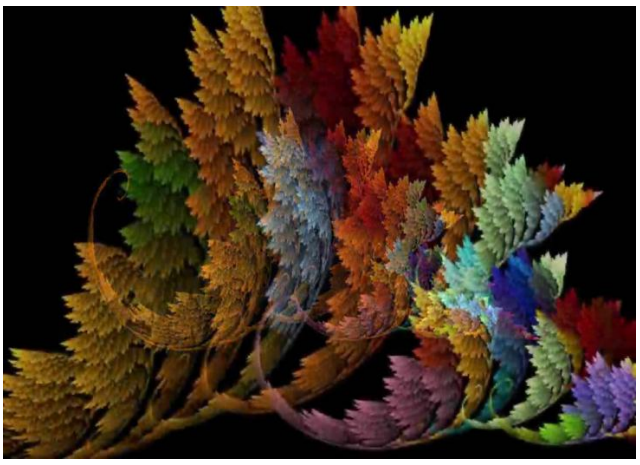
Medicine

Biosensor interactions can be studied by using fractals.

RECONSTRUCTED IMAGES OF NATURE USING FRACTAL THEORY







Stunning and Intricate Fractal Arabesque on a ceiling panel (4’ x 4’) at Delware Jain Temple, Mt. Abu, India, 1031AD.

VEDIC MATHEMATICS

Bagyasree P G (ASST.PROF in MATHEMATICS)

Vedic Mathematics introduces the wonderful applications to Arithmetical computations, theory of numbers, compound multiplications, algebraic operations, factorisations, simple quadratic and higher order equations, simultaneous quadratic equations, partial fractions, calculus, squaring, cubing, square root, cube root and coordinate geometry etc.

Uses of Vedic Mathematics:

- It helps a person to solve mathematical problems 10-15 times faster
- It helps m Intelligent Guessing
- It reduces burden (need to learn tables up to 9 only)
- It is a magical tool to reduce scratch work and finger counting
- It increases concentration.
- It helps in reducing silly mistakes

"Vedic Mathematics" is a system of reasoning and mathematical working based on ancient Indian teachings called Veda. It is fast, efficient and easy to learn and use. Vedic mathematics, which simplifies arithmetic and algebraic operations, has increasingly found acceptance the world over. Experts suggest that it could be a handy tool for those who need to solve mathematical problems faster by the day. Vedic Mathematics provides answer in one line where as conventional method requires several steps.

It is an ancient technique, which simplifies multiplication, divisibility, complex numbers, squaring, cubing, and square and cube roots. Even recurring decimals and auxiliary fractions can be handled by Vedic Mathematics. Vedic Mathematics forms part of Jyotish Shastra which is one of the six parts of Vedangas. The Jyotish Shastra or Astronomy is made up of three parts called Skandas. A Skanda means the big branch of a tree shooting out of the trunk. The basis of Vedic mathematics, are the 16 sutras, which attribute a set of qualities to a number or a group of numbers. The ancient Hindu scientists (Rishis) of Bharat in 16 Sutras (Phrases) and 120 words laid down simple steps for solving all mathematical problems in easy to follow 2 or 3 steps. Vedic Mathematics or one or two line methods can be used effectively for solving divisions, reciprocals, factorisation, HCF, squares and square roots, cubes and cube roots, algebraic equations, multiple simultaneous equations, quadratic equations, cubic equations, biquadratic equations, higher degree equations, differential calculus, Partial fractions, Integrations, Pythogorus theoram, Apollonius Theorem, Analytical Conics and so on.

How fast you can solve a problem is very important. In Vedic System a manual approach is preferred. The simplicity of Vedic Mathematics encourages most calculations to be carried out without the use of paper and pen. A method like Shudh Method is applicable in statistics. This mental approach sharpens the mind, improves memory and concentration and also encourages innovation. Since the Vedic Mathematics approach encourages flexibility, the mathematics teachers encourage their students to device his/her own method and not remain limited to the same rigid approach, which is boring as well as tedious. Once the mind of the student develops an understanding of system of mental mathematics it begins to work more closely with the numbers and become more creative. The students understand the numbers better. Vedic Mathematics is very flexible and creative and appeals to all group of people. It is very easy to understand and practice expert advice in developing this manual which lead to qualitative and quantitative improvement in mathematics education and may this subject an interesting, joyful and effective.

PULMONARY EMBOLISM

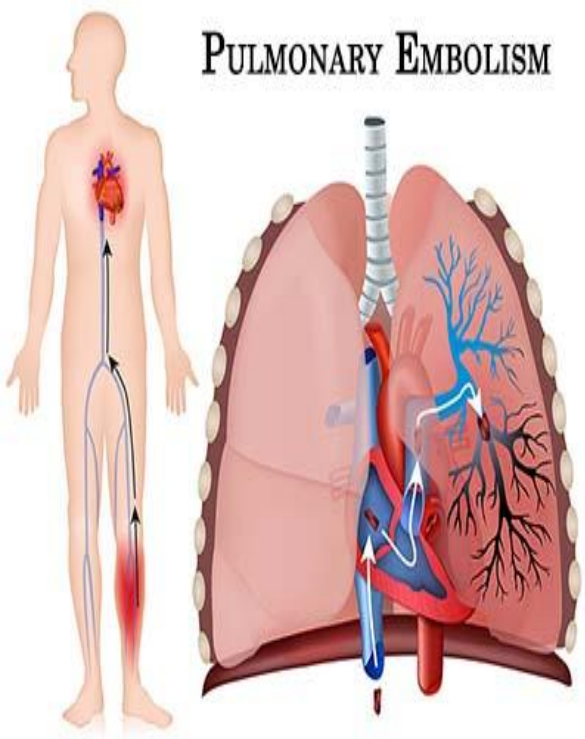
Jyothi K K (Asst. Prof in Chemistry)

A pulmonary embolism is a sudden blockage in a lung artery. The cause is usually a blood clot in the leg called a deep vein thrombosis that breaks loose and travels through the bloodstream to the lung. Pulmonary embolism is a serious condition that can cause

- Permanent damage to the affected lung
- Low oxygen levels in your blood
- Damage to other organs in your body from not getting enough oxygen

If a clot is large, or if there are many clots, pulmonary embolism can cause death but immediate emergency treatment greatly increases your chances of avoiding permanent lung damage.

Half the people who have pulmonary embolism have no



symptoms. If you do have symptoms, they can include shortness of breath, chest pain or coughing up blood. Symptoms of a blood clot include warmth, swelling, pain, tenderness and redness of the leg. The goal of treatment is to break up clots and help keep other clots from forming.

1. What Causes a Pulmonary Embolism?

Blood clots can form for a variety of reasons. Pulmonary embolisms are most often caused by deep vein thrombosis, a condition in which blood clots form in veins deep in the body. The blood clots that most often cause pulmonary embolisms typically begin in the legs or arms.

Factors that increase a person's risks of deep vein thrombosis and pulmonary embolism include:

- Cancer
- A close family member with a history of embolisms
- Fractures of the leg or hip
- Genetic blood clotting disorders (hypercoagulable states), including Factor V Leiden, prothrombin gene mutation, and elevated levels of homocysteine
- A history of heart attack or stroke
- Major surgery
- Obesity
- A sedentary lifestyle

2. Symptoms of a Pulmonary Embolism

Symptoms of a pulmonary embolism depend on the size of the clot and the location in your lung where it becomes lodged. The most common symptom of a pulmonary embolism is shortness of breath. This may be gradual or sudden. If you experience sudden shortness of breath, you should seek medical attention immediately.

Other symptoms of a pulmonary embolism include:

- Anxiety
- Clammy or bluish skin
- Coughing
- Chest pain that may extend into your arm, jaw, neck, and shoulder

- Fainting
- Irregular heartbeat
- Lightheadedness
- Rapid breathing
- Rapid heartbeat
- Restlessness
- Spitting up blood
- Weak pulse

The most common sources of embolism are proximal leg deep vein thromboses (dvts) or pelvic vein thromboses. Any risk factor for DVT also increases the risk that the venous clot will dislodge and migrate to the lung circulation, which may happen in as many as 15% of all dvts.[*citation needed*] The conditions are generally regarded as a continuum termed *venous thromboembolism* (VTE).

If you notice one or more of these symptoms, especially shortness of breath, you should seek medical attention immediately.

3. How Is a Pulmonary Embolism Diagnosed?

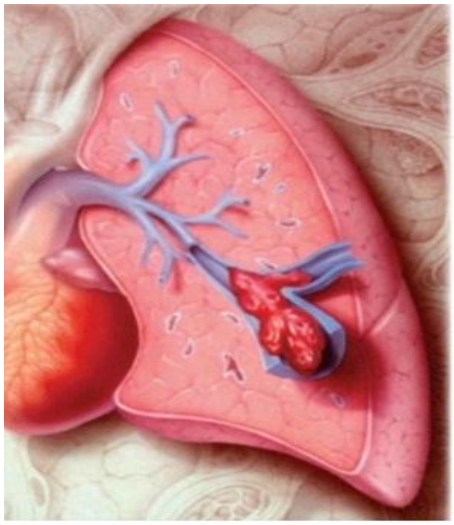
In some cases, a pulmonary embolism can be difficult to diagnose. This is especially true if you have an underlying lung or heart condition, such as lung disease or high blood pressure.

When you first see your doctor about your symptoms, he or she will ask about your overall health and any pre-existing conditions you may have as part of a complete health profile.

Your doctor will typically perform one or more of the following tests to discover the cause of your symptoms:

- Chest X-ray: this standard, noninvasive test allows doctors to see your heart and lungs in detail, as well as any problems with the bones around your lungs.
- Electrocardiography (ECG): this test measures your heart's electrical activity.
- Magnetic resonance imaging (MRI): this scan uses radio waves and magnetic field to produce detailed images
- Computed tomography (CT) scan: This scan gives your doctor the ability to see cross-sectional images of your lungs
- Pulmonary angiography: this test involves making a small incision so your doctor can guide specialized tools through your veins. A special dye is injected so that the vessels of the lung can be seen.
- Duplex venous ultrasound: this test uses radio waves to visualize the flow of blood and to check for blood clots in your legs.
- Venography: this is a specialized X-ray of the veins of your legs.

4.



A blood Clot in the Pulmonary Artery

4.Treating a Pulmonary Embolism

Your treatment for a pulmonary embolism depends on the size and location of the blood clot. If the problem is small and caught early, your doctor may opt for medication as the primary treatment. Some drugs can break up small clots.

Drugs your doctor may use include:

- Anticoagulants: also called blood thinners, the drugs heparin and warfarin prevent new clots from forming in your blood. These can save your life in an emergency situation.
- Clot Dissolvers (Thrombolytics): these drugs speed up the breakdown of a clot. These are typically reserved for emergency situations because side effects may include dangerous bleeding problems.

Surgery may be required to remove problematic clots, especially those that restrict the blood flow to the lungs or heart. Some surgical procedures your doctor may use in the case of a pulmonary embolism include:

- Vein filter: a small incision is made to use a thin wire to install a small filter in your inferior vena cava—the main vein that leads from your legs to the right side

of your heart. The filter prevents blood clots from traveling from your legs to your lungs.

- Clot removal: large clots may need to be suctioned out of your artery using a thin tube called a catheter. It isn't an entirely effective method because of the difficulty involved, so it's not always a preferred method of treatment.

- Open surgery: open surgery is used only in emergency situations when a person is in shock or medications aren't working to break up the clot.

Emergency Treatment

When PE is life threatening, a doctor may use treatments that remove or break up the blood clot. These treatments are given in an emergency room or hospital.

Thrombolytics (THROM-bo-LIT-iks) are medicines that can quickly dissolve a blood clot. They're used to treat large clots that cause severe symptoms. Because thrombolytics can cause sudden bleeding, they're used only in life-threatening situations.

Sometimes a doctor may use a catheter (a flexible tube) to reach the blood clot. The catheter is inserted into a vein in the groin (upper thigh) or arm and threaded to the clot in the lung. The doctor may use the catheter to remove the clot or deliver medicine to dissolve it.

Rarely, surgery may be needed to remove the blood clot.

Other Types of Treatment

If you can't take medicines to thin your blood, or if the medicines don't work, your doctor may suggest a vena cava filter. This device keeps blood clots from traveling to your lungs.

The filter is inserted inside a large vein called the inferior vena cava. (This vein carries blood from the body back to the heart). The filter catches clots before they travel to the lungs. This type of treatment can prevent PE, but it won't stop other blood clots from forming.

Graduated compression stockings can reduce the chronic (ongoing) swelling that a blood clot in the leg may cause.

Graduated compression stockings are worn on the legs from the arch of the foot to just above or below the knee. These stockings are tight at the ankle and become looser as they go up the leg. This causes gentle compression (pressure) up the leg. The pressure keeps blood from pooling and clotting.

5. Future Care

After you've been properly treated for a pulmonary embolism at the hospital, you'll be advised to treat the underlying cause. This is typically deep vein thrombosis.

You'll most likely be put on anticoagulant medications, such as heparin and warfarin to prevent blood clots from returning. You may also be given compression stockings—similar to really tight socks—or another device to prevent clots from forming in your legs.

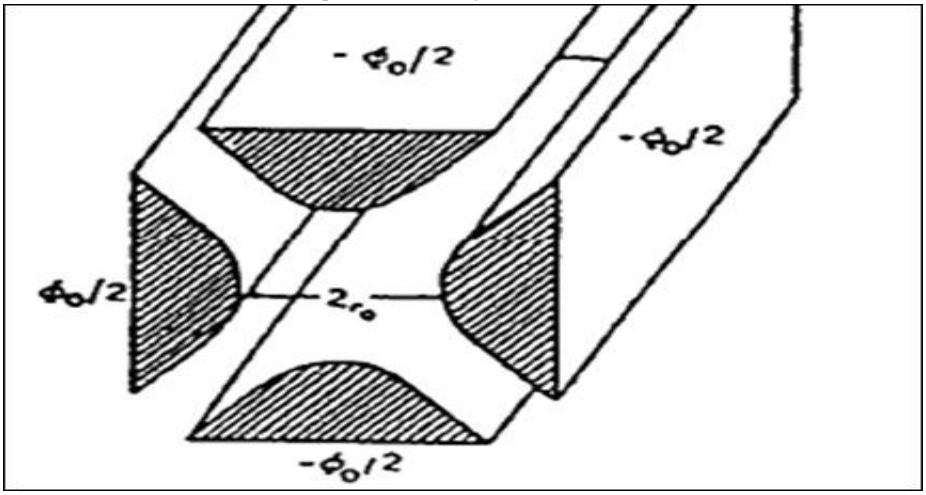
Regularly exercising your legs will also be a key component of therapy after a pulmonary embolism. Your doctor will give you complete instructions on how to care for yourself to prevent future blood clots.

QUADRUPOLE MASS ANALYZERS

Remitha V P (Asst. Prof in Physics)

QMAs are also known as Mass filters or Residual gas Analyzers. They are compact, easy to handle instruments and can be very readily integrated to experimental systems. QMAs are extensively used in residual gas analysis of the interaction products where chemical, photochemical or charged particle interactions with matter are studied. QMAs conjugated with gas chromatographs offer an excellent method for pollution monitoring in environmental sciences. Perhaps the most important area where QMAs find extensive application is isotope separation and enrichment of nuclear fuels. The MIP payload of Chandrayan-1 carried a QMA for the mass spectrometry of Lunar atmosphere.

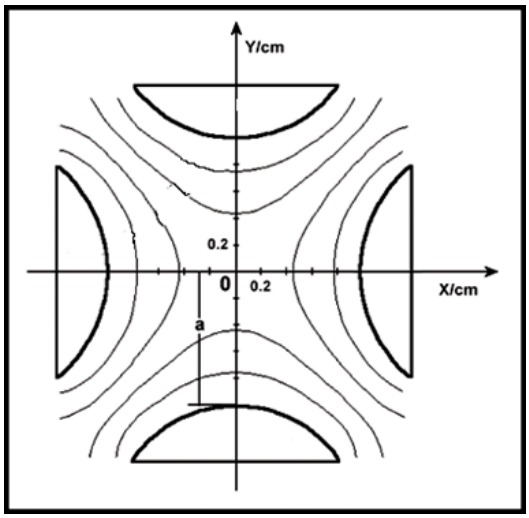
A commercial Quadrupole Mass Analyzer



The geometry of the field is shown in the figure.

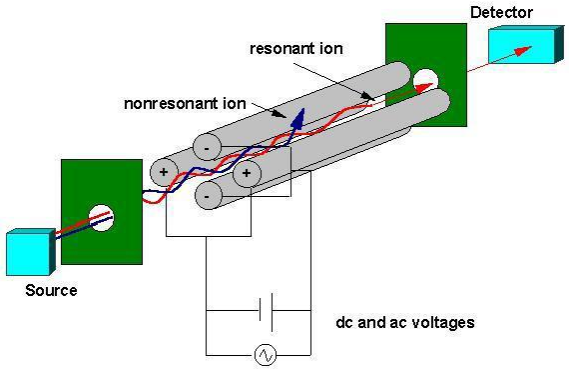
There are a set of four cylindrical electrodes symmetrically placed along the axis. The surfaces of the rods are hyperbolic. They are constructed in such a way that the field radius bears a relation to the radius of hyperbola. For any pair of electrodes the horizontal axis offers trapping whereas the vertical direction is unstable. That is, all points are saddle points. A combination of DC and radio frequency voltages are applied to one set of electrodes and

the same combination with a reversed polarity on another set of electrodes. If a +ve ion is placed inside the electrode structure it will experience a repulsive force due to +ve electrodes and an attractive force due to -ve electrodes. Then the ion will start acceleration towards -ve electrodes. However if we switch the potentials on the electrodes before the ion reached the electrode, the polarities are now reversed and the ion will start the acceleration towards the new -ve potentials. Then if the potential is again switched before the ion reached the new –ve potential the polarities are again reversed. Thus by cheating the particle in this way we can trap it. Paul analyzed the trajectories of the ions inside the electrode structure and found that only certain trajectories characterized by their e/m values would have sustained non-divergent oscillations in the field. All other ions with differing e/m values would pick up oscillations with exponentially increasing amplitude while they drift through the filter and thus would get lost on the electrodes.



Structure Inside a QMA

Consider the figure given below. The structure consists of a source, and an Ionizer. The particles to be mass analyzed are subjected to electron bombardment at the entrance side of the filter with a relatively high density electron beam produced using a thermal source. After Ionizer then comes the electrode structure. After mass filtering the residual ions are focused onto a charged particle detector using an electrostatic lens. The signals are then amplified using a pre-amplifier and are further processed to suit the required function. The whole components are housed in ultra high vacuum.



A PALINDROME IS A SYMMETRIC WORD

Sarmishta C (Asst Prof in Mathematics)

A palindrome is a symmetric word, phrase, number or other sequence of units that reads the same forward and backward. It originates from the combination of two Greek words palin (means backward, again) and dromos (means running). The Greek word palindromos means "running back again."

Commonly used palindrome words include dad, mom, eye, pup, wow, deed, noon, civic, kayak, level, madam, radar, refer, rotor, solos, rotator and racecar. There are also palindrome names such as Bob, Eve, Anna, and Hannah. Some examples of palindrome phrases that are constructed for amusement are "A man, a plan, a canal-Panama," "A Toyota," "Madam, in Eden I'm Adam!" "Never odd or even," "No, it can assess an action," "No, it is opposition," "No lemons, no melon," "Rats live on no evil star," "Rise to vote, Sir," and "Step on no pets!"

Assuming each calendar date in all four-digit years is assigned a single eight-digit full date number as MMDDYYYY (where the first-two digits MM is the month, DD is the date, and YYYY is the year number), some of these dates are palindrome numbers and these dates are referred to as palindrome dates. For example, the first palindrome date of the 21st century occurred on Oct. 2, 2001 since the full date number of that day is 10022001.

A **palindromic number** or **numeral palindrome** is a number that remains the same when its digits are reversed. for example 16461.

The term *palindromic* is derived from palindrome, which refers to a word (such as *rotor* or *racecar*,*malayalam*) whose spelling is unchanged when its letters are reversed. The first 30 palindromic numbers (in decimal) are:

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 22, 33, 44, 55, 66, 77, 88, 99, 101, 111, 121, 131, 141, 151, 161, 171, 181, 191, 202, …

Decimal palindromic numbers

All numbers in base 10 with one digit are palindromic. The number of palindromic numbers with two digits is 9:

{11, 22, 33, 44, 55, 66, 77, 88, 99}.

There are 90 palindromic numbers with three digits

{101, 111, 121, 131, 141, 151, 161, 171, 181, 191, …, 909, 919, 929, 939, 949, 959, 969, 979, 989, 999}

and also 90 palindromic numbers with four digits

{1001, 1111, 1221, 1331, 1441, 1551, 1661, 1771, 1881, 1991, …, 9009, 9119, 9229, 9339, 9449, 9559, 9669, 9779, 9889, 9999},

so there are 199 palindromic numbers below 10^4. Below 10^5 there are 1099 palindromic numbers and for other exponents of 10^n we have: 1999, 10999, 19999, 109999, 199999, 1099999,

Perfect powers

There are many palindromic perfect powers n^k, where n is a natural number and k is 2, 3 or 4.

- Palindromic squares: 0, 1, 4, 9, 121, 484, 676, 10201, 12321, 14641, 40804, 44944, ... (sequence A002779 in OEIS)
- Palindromic cubes: 0, 1, 8, 343, 1331, 1030301, 1367631, 1003003001, ... (sequence A002781 in OEIS)
- Palindromic fourth powers: 0, 1, 14641, 104060401, 1004006004001, ... (sequence A186080 in OEIS)

The only known non-palindromic number whose cube is a palindrome is 2201, and it is a conjecture the fourth root of all the palindrome fourth powers are a palindrome with 100000...000001 ($10^n + 1$).

Other bases

Palindromic numbers can be considered in other numeral systems than decimal. For example, the binary palindromic numbers are:

0, 1, 11, 101, 111, 1001, 1111, 10001, 10101, 11011, 11111, 100001,

or in decimal: 0, 1, 3, 5, 7, 9, 15, 17, 21, 27, 31, 33, …

The Fermat primes and the Mersenne primes form a subset of the binary palindromic primes.

All numbers are palindromic in an infinite number of bases. But, it's more interesting to consider bases smaller than the number itself - in which case most numbers are palindromic in more than one base, for example, ,

In base 18, some powers of seven are palindromic:

$7^0 = 1$

$7^1 = 7$

$7^3 = 111$

$7^4 = 777$

$7^6 = 12321$

$7^9 = 1367631$

HUBBLE SPACE TELESCOPE (HST)

Sindhu Narayanan (Asst Prof in Physics)

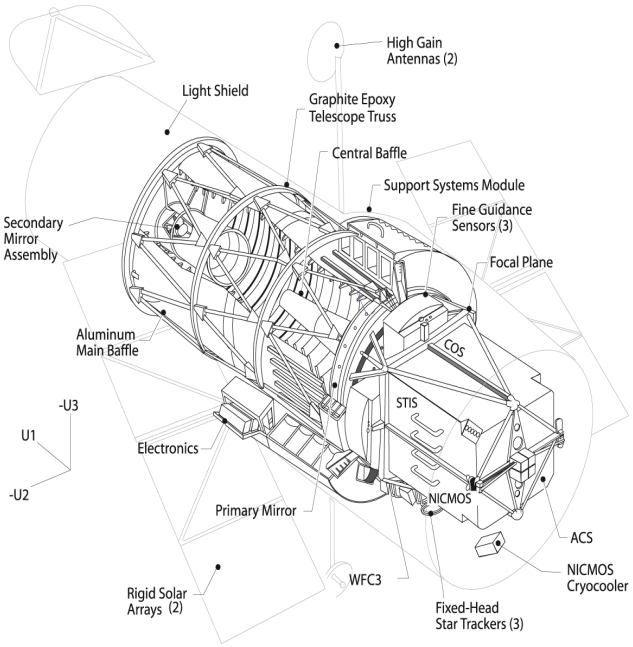
The **Hubble Space Telescope** (**HST**) is a space telescope that was launched into low Earth orbit in 1990, and remains in operation. With a 2.4-meter (7.9 ft) mirror, Hubble's four main instruments observe in the near ultraviolet, visible, and near infrared spectra. The telescope is named after the astronomer Edwin Hubble.

Hubble's orbit outside the distortion of Earth's atmosphere allows it to take extremely high-resolution images with negligible background light. Hubble has recorded some of the most detailed visible-light images ever, allowing a deep view into space and time. Many Hubble observations have led to breakthroughs in astrophysics, such as accurately determining the rate of expansion of the universe.

Although not the first space telescope, Hubble is one of the largest and most versatile, and is well known as both a vital research tool and a public relations boon for astronomy. The HST was built by the United States space agency NASA, with contributions from the European Space Agency, and is operated by the Space Telescope Science Institute. The HST is one of NASA's Great Observatories, along with the Compton Gamma Ray Observatory, the Chandra X-ray Observatory, and theSpitzer Space Telescope.[6]

Configuration of Hubble Space Telescope

The spacecraft has three interacting systems: The Support System Module (SSM), an outer structure that houses the other systems and provides services such as power, communication, and control; The Optical Telescope Assembly (OTA), which collects and concentrates the incoming light in the focal plane for use by the Scientific Instruments (SI); and five SIs. The SI Control and Data Handling (CDH) unit controls the five SI's, four that are housed in an aft section focal plane structure and one that is placed along the circumference of the spacecraft. The purpose of the HST, the most complex and sensitive optical telescope ever made, is to study the cosmos from a low-Earth orbit. By placing the telescope in space, astronomers are able to collect data that is free of the Earth's atmosphere. The HST detects objects 25 times fainter than the dimmest objects seen from Earth and provides astronomers with an observable universe 250 times larger than visible from ground-based telescopes, perhaps as far away as 14 billion light-years. The HST views galaxies, stars, planets, comets, possibly other solar systems, and even unusual phenomena such as quasars, with 10 times the clarity of ground-based telescopes. The HST was deployed from the Space Shuttle Discovery (STS-31 mission) into Earth orbit in April 1990. The Marshall Space Flight Center had responsibility for design, development, and construction of the HST. The Perkin-Elmer Corporation, in Danbury, Cornecticut, developed the optical system and guidance sensors. The Lockheed Missile and Space Company of Sunnyvale, California produced the protective outer shroud and spacecraft systems, and assembled and tested the finished telescope.



Ten Amazing Facts about Hubble Space Telescope

1. The HST's history is longer than you might have thought, going back to just after World War II. In 1946, the astronomer Lyman Spitzer (1914-97) identified the main advantages that a space-based observatory would have over ground-based telescopes. Spitzer spent much of his career to pushing for the building of a space telescope.
2. Originally he HST was to have been bigger. NASA began seriously planning it in the mid-1970s. It was originally proposed to have a mirror diameter of 3m, but this was reduced to 2.4 m to save money.
3. The HST is still bigger than you might think. It weighs 11 tonnes and is 15.9 m long. That's nearly as long as a couple of Routemaster doubledecker buses (each 8.4m long).

4. The HST doesn't use as much power as you think. It uses about 2800 watts, while a typical kitchen kettle is rated at 2200 watts. Hubble gets its power from a couple of solar panels (each 2.6 x 7.1 m).
5. Hubble is pretty fast for a telescope, speeding around the world at 28 000 km/h. This is twelve times as fast as the cruising speed of the Concorde supersonic airliner (2270 km/h).
6. The HST can observe the furthest away galaxies ever seen but there are a couple of nearby objects it cannot look at. These are the Sun (so bright it would damage its sensors) and the planet Mercury, which is too close to the sun.
7. Hubble is essentially a giant camera but it doesn't use film. Its instruments capture the light from the Universe with electronic detectors (CCD's) so it is basically a giant digital camera.
8. Hubble's images of the wonders of the cosmos are recorded in shades of black and white, not colour.
9. The final colour images we all love are actually combinations of two or more black-and-white exposures made through coloured filters. During image processing the colours matching the filters are added to the picture.
10. The Hubble telescope is in the final phase of its life. Sometime after 2014 failure of its vital systems will render it useless. Unless some kind of rescue is made, which is pretty unlikely, it will re-enter the Earth's atmosphere and burn up sometime between 2019 and 2030. Goodbye Hubble, we'll miss you. But don't be sad, it will be replaced by the even larger James Webb Space Telescope.

Images captured by HST

THE BUTTERFLY NEBULA

Chosen by: Jason Kalirai, project scientist, James Webb Space Telescope, Space Telescope Science Institute

STAR CLUSTER NGC 602

Chosen by: Antonella Nota, astronomer, Space Telescope Science Institute

THE EAGLE NEBULA—PILLARS OF CREATION

Chosen by: Jennifer Wiseman, senior project scientist, Hubble, NASA Goddard Space Flight Center