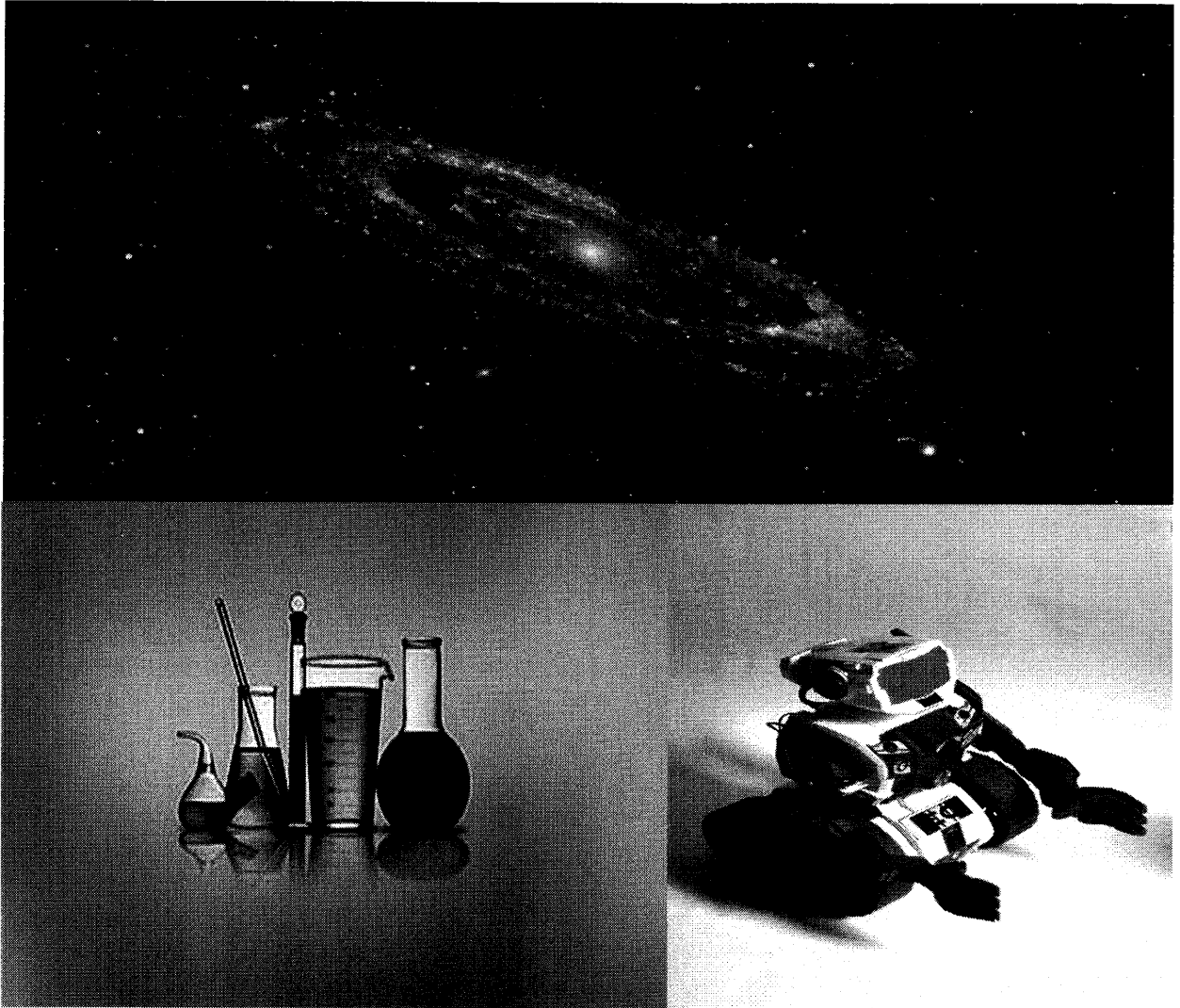


# ENGLISH FOR PHYSICAL SCIENCES



**TAMIL NADU STATE COUNCIL FOR HIGHER EDUCATION  
(TANSCHE)**



## PREFACE

This textbook on Professional English envisioned under the leadership of the Honorable Chief Minister of Tamilnadu, Thiru. Edappadi K.Palaniswami by the Honorable Minister for Higher Education Thiru. K.P. Anbalagan, and Principal Secretary to Government, Department of Higher Education, Selvi. Apoorva, I.A.S., is a pioneering venture and strategic intervention in higher education in Tamil Nadu. It has been prepared with the unstinted support of Thiru. K.Vivekanandan, I.A.S. Member Secretary, TANSCH (Tamil Nadu State Council for Higher Education)

Tamil Nadu has the distinction of having the highest GER (Gross Enrolment Ratio) of 49%, in higher education in the country: this figure attests to the efforts of the government to empower the youth of the state by enhancing access to higher education.

After duly examining the challenges faced by students in learning their subjects and with a vision to equip them to compete in a global scenario, four textbooks, *English for Physical Science*, *English for Life Sciences*, *English for Arts and Social Sciences* and *English for Commerce and Management* have been prepared.

As language is an essential tool with regard to the learning process, a textbook which uses subject/discipline based content to leverage language learning is an ideal approach and fulfills the dual objective language proficiency and professional competence.

This book is bound to fulfill its destiny as teachers and students work in tandem: teachers as facilitators and learners as highly motivated stakeholders.





## PROFESSIONAL ENGLISH FOR PHYSICAL SCIENCES

### OBJECTIVES:

- To develop the language skills of students by offering adequate practice in professional contexts.
- To enhance the lexical, grammatical and socio-linguistic and communicative competence of first year physical sciences students
- To focus on developing students' knowledge of domain specific registers and the required language skills.
- To develop strategic competence that will help in efficient communication
- To sharpen students' critical thinking skills and make students culturally aware of the target situation.

### LEARNING OUTCOMES:

- Recognise their own ability to improve their own competence in using the language
- Use language for speaking with confidence in an intelligible and acceptable manner
- Understand the importance of reading for life
- Read independently unfamiliar texts with comprehension
- Understand the importance of writing in academic life
- Write simple sentences without committing error of spelling or grammar

(Outcomes based on guidelines in UGC LOCF – Generic Elective)

**NB: All four skills are taught based on texts/passages.**

### UNIT 1: COMMUNICATION

**Listening:** Listening to audio text and answering questions

- Listening to Instructions

**Speaking:** Pair work and small group work.

**Reading:** Comprehension passages –Differentiate between facts and opinion

**Writing:** Developing a story with pictures.

**Vocabulary:** Register specific - Incorporated into the LSRW tasks

### UNIT 2: DESCRIPTION

**Listening:** Listening to process description.-Drawing a flow chart.

**Speaking:** Role play (formal context)

**Reading:** Skimming/Scanning-

Reading passages on products, equipment and gadgets.

**Writing:** Process Description –Compare and Contrast

Paragraph-Sentence Definition and Extended definition-  
Free Writing.

**Vocabulary:** Register specific -Incorporated into the LSRW tasks.

### **UNIT 3: NEGOTIATION STRATEGIES**

**Listening:** Listening to interviews of specialists / Inventors in fields  
(Subject specific)

**Speaking:** Brainstorming. (Mind mapping).

Small group discussions (Subject- Specific)

**Reading:** Longer Reading text.

**Writing:** Essay Writing (250 words)

**Vocabulary:** Register specific - Incorporated into the LSRW tasks

### **UNIT 4: PRESENTATION SKILLS**

**Listening:** Listening to lectures.

**Speaking:** Short talks.

**Reading:** Reading Comprehension passages

**Writing:** Writing Recommendations

Interpreting Visuals inputs

**Vocabulary:** Register specific - Incorporated into the LSRW tasks

### **UNIT 5: CRITICAL THINKING SKILLS**

**Listening:** Listening comprehension- Listening for information.

**Speaking:** Making presentations (with PPT- practice).

**Reading:** Comprehension passages –Note making.

Comprehension: Motivational article on Professional Competence,

Professional Ethics and Life Skills)

**Writing:** Problem and Solution essay– Creative writing –Summary writing

**Vocabulary:** Register specific - Incorporated into the LSRW tasks

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# PROFESSIONAL ENGLISH FOR B.SC. PHYSICAL SCIENCES

## UNIT - I- COMMUNICATION

### LEARNING OBJECTIVES

❖ **Aim:** Learning new concepts, new words, expressing and sharing further information, foreign words, the meaning words, and contextual usage of the underlying scientific terms. Learners will develop their skills in comparing, contrasting, skimming, and scanning, predicting will be activated as they are necessary for learning

### **Pre-Task: New Words or Concepts introduced / Vocabulary Enhancement**

Given below are some of the key words that you will come across in the texts in the Unit. Talk to your partner and sort out their meanings. Your teacher will then check the meanings with the class as a whole.

|                                    |                            |
|------------------------------------|----------------------------|
| Raman Effect                       | Spectroscopy               |
| scattering                         | Raman scanner              |
| crystal structure                  | Diffraction                |
| Substances                         | Ultrasonic                 |
| Molecules                          | Hypersonic frequency       |
| Optics                             | Infra-red                  |
| Acoustics                          | Crystal dynamics           |
| Optics of colloids                 | Iridescent substances      |
| Electrical and magnetic anisotropy | Physiology of human vision |
| Radiation effect                   | Vibrations                 |

Water has no colour, then why does the sea look blue?

### **SOURCE PASSAGE 1 :The Indian Scientist who found why the sea is blue?**

A glass of water has no colour. But a deep sea with the same water is a brilliant blue. Why is this so? This was the question that CV Raman asked himself in 1921 on seeing the colour of the Mediterranean Sea from a ship. He immediately began to conduct experiments on board the ship using some simple instruments he had with him. At that time, scientists believed the sea was blue because it reflected the colour of the sky, but Raman found that it was the water itself that caused blue light to scatter more than other colours in light.

Raman returned from his visit to England and Europe and started experiments to study how light behaved when it passed through various substances. On February 28, 1928, one of the experiments gave a clear result. Light of only one colour was

passed through a liquid, but the light that emerged had small traces of another colour. This meant that the molecules in the liquid were changing the colour of some of the light passing through it. The discovery created a sensation around the world and was named the Raman Effect. In 1930, CV Raman became the first person from Asia to be awarded a Nobel prize in any field of science. The date of the discovery, February 28, is now celebrated as National Science Day in India. The Raman Effect has been very useful in many areas of science. It was found that when light was passed through a substance, a series of colours were seen that could be thought of as an fingerprint of the substance. This idea has been used in chemistry, medicine, biology and many other areas of science. It is called Raman Spectroscopy.

Recently, people have used the idea to make a device called Raman Scanner. It can be pointed at a substance to tell what it is. Police have begun to use this scanner to find out if people are carrying banned substances. Simply brilliant, Raman was a man of extraordinary ability. He passed his tenth standard when he was just 11 years old. At 15 he had a degree, with gold medals in Physics and English. By the time he was 19 he had an MA. Professors at college used to allow him to skip science classes because they knew he didn't need them. In addition to being brilliant, Raman was also intensely curious about the world around him. We saw how his curiosity about the colour of the sea led to the discovery of the Raman Effect. Similarly, his curiosity led to a wide range of scientific work. On his 1921 trip to England he was taken to St. Paul's Cathedral. Raman became so excited by the whispering gallery there that he performed some experiments and wrote scientific papers about it. As a child, Raman had seen his father play the violin. Much of his life's research work was about the science behind music. He also investigated the effect of sound on light and the structure of crystals. His collection of crystals is preserved at the Raman Research Institute in Bangalore.

Chandrasekhara Venkata Raman was born at Tiruchirappalli in Southern India on November 7th, 1888. His father was a lecturer in mathematics and physics and so from a very young age Raman was immersed in an academic atmosphere. He joined Presidency College, Madras, in 1902, and in 1904 passed his B.A. examination, winning the first place and the gold medal in physics; in 1907 he completed his graduation with a distinction. His earliest research was in optics and acoustics – the two ends of investigation to which he dedicated his entire career – were carried out while he was a student. At that time a scientific career did not appear to present the best possibilities, CV Raman joined the Indian Finance Department in 1907; though the duties of his office took most of his time, Raman found opportunities for carrying on experimental research in the laboratory of the Indian Association for the Cultivation of Science at Calcutta (of which he became Honorary Secretary in 1919).

In 1917 he was offered the newly endowed Palit Chair of Physics at Calcutta University, and decided to accept it. After 15 years at Calcutta he became Professor at the Indian Institute of Science at Bangalore (1933-1948), and in 1948 he was made the Director of the Raman Institute of Research at Bangalore, established by him. He also founded the Indian Journal of Physics in 1926, of which he was the Editor.

Raman sponsored the establishment of the Indian Academy of Sciences and served as its first President since its inception. He also initiated the Proceedings of that academy, in which much of his work has been published. He was also the President of the Current Science Association, Bangalore, which publishes Current Science (India). Some of Raman's early memoirs appeared as Bulletins of the Indian Association for the Cultivation of Science (Bull. 6 and 11, dealing with the

"Maintenance of Vibrations"; Bull. 15, 1918, dealing with the theory of the musical instruments of the violin family). He contributed an article on the theory of musical instruments to the 8th Volume of the Handbuch der Physik, 1928.

In 1922 he published his work on the "Molecular Diffraction of Light", the first of a series of investigations with his collaborators which ultimately led to his discovery, on the 28th of February, 1928, of the radiation effect which bears his name, the Raman effect ("A new radiation", Indian J. Phys., 2 (1928) 387), and which got him the Nobel Prize in Physics in 1930. Other investigations carried out by CV Raman were: his experimental and theoretical studies on the diffraction of light by acoustic waves of ultrasonic and hypersonic frequencies (published 1934-1942), and those on the effects produced by X-rays on infrared vibrations in crystals exposed to ordinary light.

In 1948 Raman, through studied the spectroscopic behaviour of crystal. His laboratory was dealing with the structure and properties of diamond, the structure and optical behaviour of numerous iridescent substances (labradorite, pearly felspar, agate, opal, and pearls). Among his other interests were the optics of colloids, electrical and magnetic anisotropy, and the physiology of human vision. Raman was honoured with a large number of honorary doctorates and memberships of scientific societies. He was elected a Fellow of the Royal Society early in his career (1924), and was knighted in 1929. Sir Chandrasekhara Venkata Raman – died on November 21, 1970.

**Resource:** <https://www.myindiamyglory.com/2018/07/12/raman-effect-how-indian-scientist-cv-raman-discovered-why-sea-is-blue/>

**TASK 1: Listen to the audio and answer the given questions**

**Classify the following terms as devices, concepts or processes in the table**

Raman Effect, Scattering, Crystal Structure, Acoustics, Optics of colloids, Prism, Diffraction

| Device | Process | Concept |
|--------|---------|---------|
|        |         |         |

**TASK 2: Listen and give specific information on the terms given :**

- 1.Spectroscopy
- 2.Raman effect
- 3.Raman scanner
- 4.Diffraction
- 5.Ultrasonic
- 6.Hypersonic frequency
- 7.Infra-red
- 8.Crystal dynamics
- 9.Iridescent substances
- 10.Diffraction

**Task 3: Match the following:**

- Crystal Dynamics - a frequency above the human ear's audibility limit
- Hypersonic - the vibrational movement of atoms in the solid state
- Ultrasonic - Speed of more than 5 Mach
- Optics - concerned with the properties of sound.
- Acoustics - studies the behaviour and properties of light

**Task 4: Fill in the blanks with suitable words from the choices given in the bracket**

*(Prism, Matter, Radiation, Light, Interaction)*

**Spectroscopy** - is the study of the ----- between ----- and electromagnetic -----  
--via ----- electron **spectroscopy**, ----- atomic **spectroscopy**.  
Historically, **spectroscopy** originated through the study of visible ----- dispersed  
according to its wavelength, by a -----.

**SPEAKING**

**Source Passage 1: Tipu Sultan – The Original Rocket Man of India**

**Pre-Task: Learning New Words and Concepts.**

|   |   |
|---|---|
| <p><b>Weaponise</b> : adapted for use<br/>asa<br/><b>Weapon</b></p> <p><b>Incorporate</b>: to include something<br/>within something else</p> <p><b>Nozzle</b> : a cylindrical<br/>spoutat<br/>the end of a pipe</p> <p><b>Deployed</b> : to move<br/>intoposition<br/>for military action</p> <p><b>Disarray</b> : a stateof<br/><b>Disorganization</b></p> <p><b>Aerospace</b> :operating<br/>aircraft/spacecraft</p> | <p><b>Biographer</b>: a person who writes<br/>an<br/>account of someone'slife</p> <p><b>Craftsmen</b>: a person who is skilled<br/>in<br/>craft</p> <p><b>Armoury</b> : a place where<br/>weapons arekept</p> <p><b>Bursting</b> : break open orapart<br/>suddenly and violently</p> <p><b>Paranoia</b> : a thought<br/>processwhich<br/>is influenced by anxiety</p> |
|---|---|

## Introduction

Mysore rockets developed and deployed by Tipu's army during the Anglo-Mysore wars, were one of the first weaponised metal rockets. The British had heavy losses because of these rockets. Not only did these rockets play a huge role in the Anglo-Mysore wars, they also helped in the defeat of Napoleon in the battle of Waterloo. Rockets developed by the British based on Tipu's designs even find a mention in American national anthem – the Star Spangled Banner.

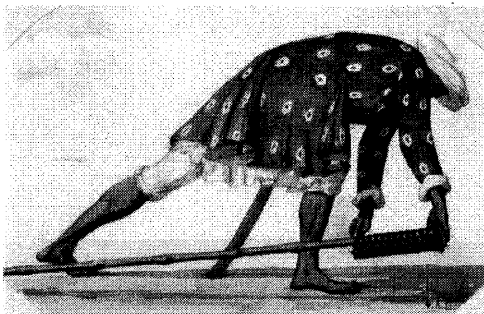
## History

Following the invention of gun powder, the Chinese and Europeans had tested rockets using bamboo tubes. As they lacked the range and stability required for long-range weapons, they were soon replaced by cannons. However, in late the 1700s Tipu experimented by replacing bamboo tubes with iron tubes, because bamboo was a weaker material, the amount of gun powder loaded in the tubes was limited. With the iron tubes, the Mysore army could load more gun powder in the rockets, providing them with more speed and additional range. Tipu's rockets boasted of ranges of upto 2km, because of the introduction of high quality iron.



### **Tipu's designs also incorporated swords in the rockets, which served a dual purpose**

The rockets had a scientific design as well. The metal tubes filled with gun powder were closed on one end, and on the other end a nozzle was provided to propel the rocket using the gases emitted. Tipu's designs also incorporated swords in the rockets, which served a dual purpose. The swords acted as a guidance mechanism, providing the rocket with stability during the flight, and towards the end of the flight, the swords became a weapon. The rockets used to tumble after losing thrust as it came down towards its target, killing or severely injuring the soldiers who came under it.



**Tipu created a designated force to operate the rockets, which was as much as 5,000-men strong.**

### **Use in Battles**

Tipu Sultan's forces used rockets with great effect in the four Anglo-Mysore wars. One of the first mentions of the effective use of metal rockets was during the battle of Pollilur during the first Anglo-Mysore war in 1780. The advancing British East India company forces were repelled by the Mysore army using several rounds of rocket fire. Several officers of the British army were taken prisoners following this defeat.





## **Tipu Sultan confronts his British enemies during the siege of Srirangapattanam**

The records of the third Anglo-Mysore war also mention rockets units being deployed by Tipu Sultan. During the war, Lt Col Knox, a British officer, and his troops came under heavy rocket fire while they were advancing towards the Cauvery River Banks, near Srirangapatana, on 6 February 1792.

## **Battle of Sultanpet Tope**

In the battle of Sultanpet Tope, during the fourth Anglo-Mysore war, Arthur Wellesley, who later became Duke of Wellington and hero of the battle of Waterloo, was ordered to conduct a night raid on the fort in April 1799. The troops moving under the cover of darkness came under heavy rocket fire. Soldiers of the unit and Wellesley, who had not faced rockets before, were shocked and left in disarray. Wellesley, in particular, was humiliated after losing control of his troops.

## **Influence on History**

RottamNarasimha, aerospace scientist and professor, engineering mechanics unit of Jawaharlal Nehru Centre for Advanced Scientific Research, who studied Tipu's rockets and their history, said that the humiliation suffered in Sultanpet changed Wellesley as a military commander. "According to his biographer, he never showed fear again on the battlefield. Wellesley then went to become the commander who defeated Napoleon in the battle of Waterloo. Thus, Mysore rockets influenced the great battle of Waterloo," he said.



### **A soldier of Tipu Sultan's army, using his rocket as a flag staff**

"Even though rockets were used in other parts of the world, Tipu was able to take rocket technology to the next level. India produced one of the best quality irons in the world at that time and Tipu had highly skilled craftsmen at his disposal. Using these two, he made bigger rockets with longer ranges," said Narasimha.

The rockets seized from Tipu's armoury resulted in the development of Congreve rocket, which were used in Anglo-American Wars. They even find a mention in the US National Anthem, the Star-Spangled Banner: "...the rockets' red glare, the bombs bursting in air. According to aerospace scientist Narasimha, the contribution of Tipu towards rocket technology will remain unquestioned. He will remain the original rocket man of India.

#### **TASK 1 :Speaking Activity**

1. Read the passage and describe the two key contributions of Tipu Sultan to India and England. Justify why you consider them as the key contributions. Work in pairs.
2. Discuss in groups and Comment on the Rocket design and craftsmanship of Tipu Sultan, in comparison with the rocket designs that are being used in the present-day context.
3. Suggest two different metals that can be used to increase the efficiency of rocket technology.
4. Describe the "original rocket man" in comparison with the "missile-man of India".

5. On what principle does rocket-science work?

### **TASK 2 :Facts and Opinions**

While reading the passage, you might have noticed that some of the statements are **facts** (which are accurate and proven), whereas some statements are **opinions** (which show the writer's views or attitudes). Opinions may differ from person to person. It is very important to recognize facts and opinions in academic reading and listening for better understanding of a topic.

**Read the following statements and say whether they are facts or opinions. Write F against facts and O against opinions.**

- a) Tipu's rockets boasted of ranges of upto 2km, because of the introduction of high quality iron.
- b) Tipu Sultan is India's original Techninnovator
- c) Tipu established trading houses for Mysore products worldwide
- d) According to aerospace scientist Narasimha, the contribution of Tipu towards rocket technology will remain unquestioned. He will remain the original rocket man of India.

### **TASK 3:Use the Expressions**

Historians and researchers, on the other hand, regard the Tiger of Mysore as a secular, progressive king who was constantly on the lookout for the best global technology. Records suggest that he developed industries, laid the foundation of the silk trade, and encouraged foreign technology. What is your opinion about Tipu's Technical expertise? Give two reasons to support your answer. Try to use the following expressions while speaking

- I think.....
- I believe.....
- It seems to me that.....
- In my opinion.....
- I am convinced that.....
- I feel absolutely certain that.....

### **Source Passage 2: The Invention of Saccharine**

**Pre-Task: Learning New Words and Concepts.**

|   |  |
|---|--|
| <p><b>Non-nutritive</b> : not providing proper nourishment</p> <p><b>Substitutes</b> : a person or thing acting or serving in place of another</p> <p><b>Oxidation</b> : Oxidation is a process in which a chemical substance changes because of the addition of oxygen</p> <p><b>Compensate</b> : give (someone) something, typically money, in recognition of loss, suffering, or injury incurred</p> | <p><b>Aspartame</b>: a very sweet substance used as an artificial sweetener, chiefly in low- calorie products</p> <p><b>Shelflife</b> :the length of time for which an item remains usable, fit for consumption, or saleable.</p> <p><b>Spoilage</b> : the action or process of spoiling, especially the deterioration of food and other perishable goods.</p> |
|---|--|

## Introduction

Saccharin derives its name from the word "saccharine", meaning "sugary". Sodium **saccharin** (benzoic sulfimide) is a non-nutritive or artificial sweetener with effectively no food energy. It is commonly used as sugar substitute because it doesn't contain calories or carbs. It is about 300–400 times as sweet as regular sugar, hence need only small amount to get a sweet taste but has a bitter or metallic after taste, especially at high concentrations. Saccharin is used to sweeten products such as drinks, candies, cookies, and medicines.

## History

Saccharin was discovered by the chemists Ira Remsen and Constantin Fahlberg in 1879, while they were investigating the oxidation of *o*-toluenesulfonamide. Fahlberg noticed an unaccountable sweet taste to his food and found that this sweetness was present on his hands and arms, despite his having washed thoroughly after leaving the laboratory. Checking over his laboratory apparatus by taste tests, Fahlberg was led to the discovery of the source of this sweetness-saccharin. Saccharin became the first commercially available artificial sweetener. It is still made by the oxidation of *o*-toluenesulfonamide, as well as from phthalic anhydride.

Fahlberg and Remsen published articles on benzoic sulfimide in 1879 and 1880. In 1884, then working on his own in New York City, Fahlberg applied

for patents in several countries, describing methods of producing this substance that he named saccharin. Two years later, he began production of the substance in a factory in a suburb of Magdeburg in Germany. Fahlberg would soon grow wealthy, while Remsen merely grew irritated, believing he deserved credit for substances produced in his laboratory. On the matter, Remsen commented, "Fahlberg is a scoundrel. It nauseates me to hear my name mentioned in the same breath with him."

**Uses**

It has no caloric value and does not promote tooth decay. It is not metabolized by the body and is excreted unchanged. Saccharin is widely used in the diets of diabetics and others who must avoid sugar intake. It is also extensively employed in diet soft drinks and other low-calorie foods, and it is useful in foods and pharmaceuticals in which the presence of sugar might lead to spoilage. It does not react chemically with other food ingredients; as such, it stores well. Blends of saccharin with other sweeteners are often used to compensate for each sweetener's weaknesses and faults. A 10:1 cyclamate-saccharin blend is common in countries where both these sweeteners are legal; in this blend, each sweetener masks the other's off taste. Saccharin is often used with aspartame in diet carbonated soft drinks, so some sweetness remains should the fountain syrup be stored beyond aspartame's relatively short shelf life. In its acid form, saccharin is not water-soluble. The form used as an artificial sweetener is usually its sodium salt. The calcium salt is also sometimes used, especially by people restricting their dietary sodium intake.

**Side effects**

People with sulfonamide allergies can experience allergic reactions to saccharin, as it is a sulfonamide derivative and can cross-react. Saccharin in toothpaste can cause burning sensations, swelling, and rashes of the mouth and lips in sensitive individuals.

The current status of saccharin is that it is allowed in most countries, and countries such as Canada have lifted their previous ban of it as a food additive. The claims that it is associated with bladder cancer were shown to be unfounded in experiments on primates.

**TASK 1** Do you know any of the differences between Sugar and Saccharine? Discuss with your partner and write them down.

.....  
.....  
.....  
.....  
.....  
.....

2) How is sugar addictive in humans? Do you have sugar cravings?

.....  
.....

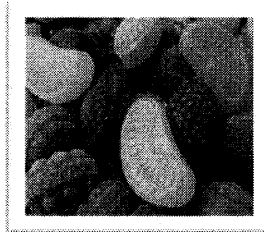
**TASK 2 Revisit the Text and Reflect**

Was the sweetness of Saccharine discovered accidentally?  
Discuss your opinions about accidental discoveries

.....  
.....

**TASK 3**

Here are some of the products that use artificial sweetener. Discuss their pros and cons



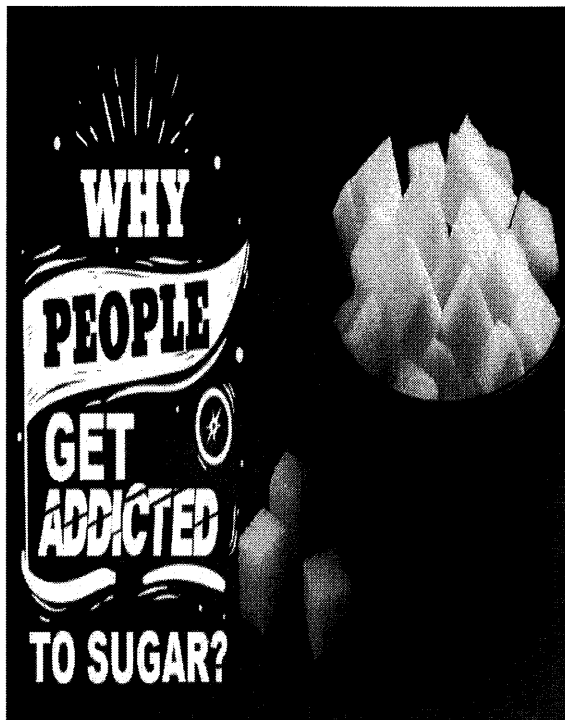
**TASK 4 Group Discussion**

From the History of Saccharine invention, it is found that although Fahlberg and Remsen had worked together, in the later stage, Fahlberg ignored Remsen and applied for Patent. He did not give Remsen any credit of the invention.

Divide the class into groups and begin a discussion on your views and opinion about the given situation with reference to the following questions.

1. Whom do you think deserve the credits of the Saccharine Invention?
2. What do you know about the Patenting of scientific products?
3. How do you associate the issue to the present context?

**TASK 5** Form groups and may short presentations on the topics **ADDICTION**. You may use some of the cues given based on the passage discussed above.



### CUES

-Sugar is also addictive like Drugs –  
Sweet sensation gives sensory pleasures  
- It is habit-forming just like alcohol,  
tobacco, nicotine, tea, coffee and  
chocolate as it triggers the brain- It  
provides comfort and is eaten for  
comfort eating at times of stress and  
distress- sugar consumption should be  
avoided and it is advisable to break the  
habit if you're addicted to it

### TASK 6 Read and Word It – Sweet, Sweeten, Sweetener

A single word can have many meanings. When we change the context/situation of its usage, the meaning also changes. Doesn't it sound interesting? In the Source Passage you learnt about Saccharin, there is one such word.

**SWEET** is a word that can function with many meanings in different sentences. It can do more than one job

Here is a chart detailing the parts of speech. Read it thoroughly and identify the parts of speech indicating the word Sweet in the sentences given in the parallel chart

### READING

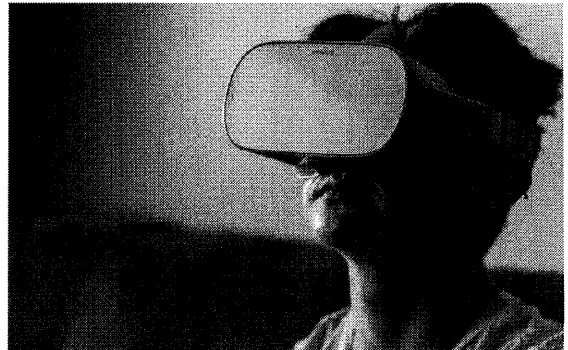
**AIM:** Understanding definitions, use of dictionary to decipher the meanings of words,

## Preparatory

1. Discuss the different images that you see below and what they indicate. How has technology influenced our lives? What is smart technology?



Students watching computer headset



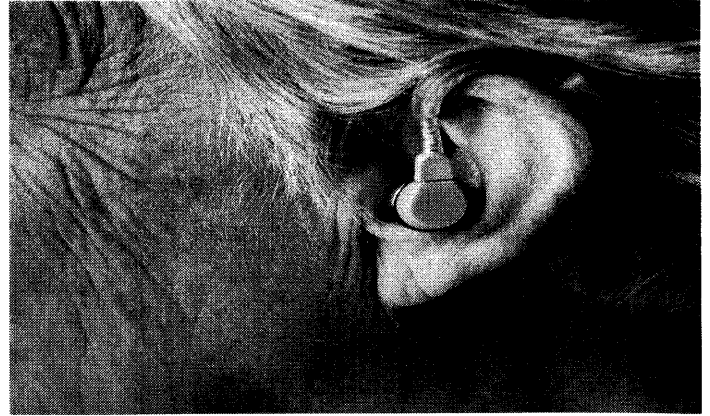
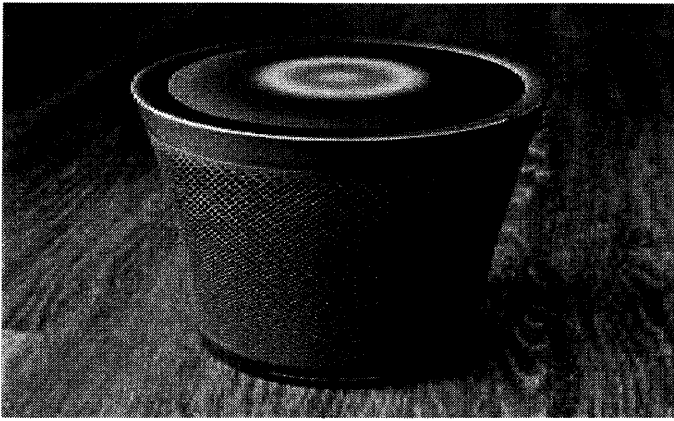
virtual reality



Technology in agriculture

Smart speaker    A person with hearing device





## **SOURCE PASSAGE 1: The Internet of Things**

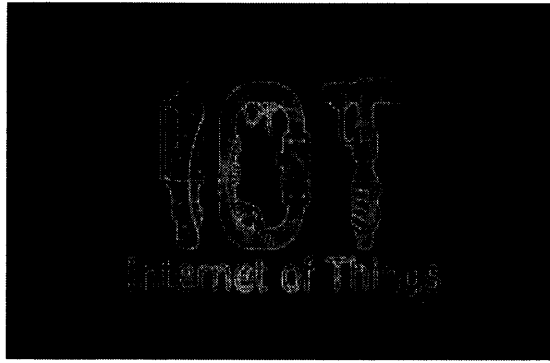
### **Pre-Task : Vocabulary**

|                |  |
|----------------|--|
| Fleet          | A number of vehicles or aircraft operating together or under the same ownership. |
| Framework      | A basic supporting structure   |
| Harm           | Injury   |
| Off peak-hours | Not during the busiest period  |
| Forecast       | Predict or estimate a future event   |
| Vital          | Absolutely necessary   |
| Humanitarian   | Concerned with human welfare   |
| Relief         | Reassurance; financial or practical assistance                                   |
| Hobbyists      | A person who pursues a hobby   |
| Concerns       | Anxiety or worry   |

## What is

### the Internet of Things?

The Internet of Things (IoT) is the vast world of interconnected devices with **embedded sensors** which are capable of providing data, some cases, being controlled, the Internet. Common examples include many home **automation devices**, like smart **thermostats** and remotely controllable lighting fixtures, but there are countless others, from traffic sensors to water quality meters to smart electric grid components to tracking manufactured goods and vehicle **fleets** worldwide.



refers to  
are  
and in  
across

Because of the rapid growth in the IoT space, there are a number of competing standards, tools, projects, policies, **frameworks**, and organizations hoping to define how connected devices communicate in the modern era.

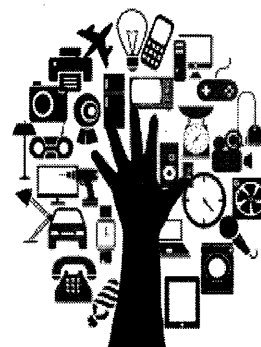
**What are some uses for IoT devices?** How you might make use of IoT connected devices depends a bit on whether you're more interested in collecting data or automating actions, and at what scale you are utilizing them.

- Indoor and outdoor lighting and electrical outlets which can be controlled by sensors, timers, and remote applications.
- Cameras, motion sensors, automatic locks, and other access control devices which can be integrated into advanced security and monitoring systems.
- Water leak sensors, smoke alarms, carbon monoxide sensors, and other devices designed to protect people and property from accidental **harm**.
- Electric car chargers, **battery banks**, and other devices which can intelligently charge at **off-peak hours** to save money and reduce peak energy demands.

For a government, company, or institution, IoT devices are a little different, and generally focus more on collecting data which can be processed and visualized, often in real-time. Some examples include:

- Utility companies are able to more accurately **forecast** energy and water demands, reducing waste.
- Advanced environmental sensors, include water, noise, and air quality monitors, can help understand pollution sources and effects before they negatively impact ecosystem and human health.
- Agencies charged with public safety can develop more advanced early warning systems for natural disasters like earthquakes and floods, and have better data with which to provide **vital** services like fighting fires and providing **humanitarian relief**.

Getting started with creating your own devices and software for the Internet of Things is surprisingly easy. There are numerous hardware



platforms targeted to beginners and **hobbyists** alike which have large communities behind them, including many which are partially or fully open hardware. Security and privacy are major **concerns** while using IoT which are currently being addressed by various industries and governments all over the world.

Source: <https://opensource.com/resources/internet-of-things>

**TASK1: Read the passage and answer the questions**

1. What is the Internet of Things?
2. List some applications of IoT
3. How can governments make use of IoT?
4. What are the two major concerns while using IoT?
5. What would you want to use IoT to make your daily life more comfortable in some way?
6. Here are some terms discussed in the passage on the Internet of Things. Discuss in the class and write the definitions of these terms in the table below:

|                    |  |
|--------------------|--|
| embedded sensors   |  |
| automation devices |  |
| Thermostats        |  |
| battery banks      |  |

**Source Passage 2: Invention of Hydroxychloroquine**

**Pre Task: New Words and Concepts**

|  |  |
|--|--|
| <p><b>Rheumatoid arthritis</b> : a long-term autoimmune disease that affects the body's moisture-producing glands</p> <p><b>Quinine</b> : a bitter crystalline compound present in cinchona bark</p> | <p><b>Speculative</b> : engaged in, expressing, or based on conjecture rather than knowledge</p> <p><b>Toxicity</b> : the quality of being toxic or poisonous.</p> <p><b>Cramps</b> : painful involuntary contraction of a muscle or</p> |
|--|--|

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|--|--|
| <p><b>Qfever</b> : an infectious fever caused by the bacterium <i>Coxiella burnetii</i>, which may be transmitted to humans from cattle, sheep, and other domesticated animals</p> <p><b>Nausea</b> : a feeling of sickness with an inclination to vomit</p> <p><b>Anti-spirochete</b> : any of a group of spiral-shaped bacteria, some of which are serious pathogens for humans, causing diseases such as syphilis, yaws, Lyme disease</p> | <p>muscles, typically caused by fatigue or strain</p> <p><b>Hallucinations</b> : experience involving the apparent perception of something not present.</p> <p><b>Catatonia</b>: abnormality of movement and behaviour arising from a disturbed mental state</p> <p><b>Retinopathy</b> : disease of the retina which results in impairment or loss of vision</p> |
|--|--|

## Introduction

Hydroxychloroquine is a less toxic derivative of chloroquine and was discovered in 1945 as part of the efforts to lessen the toxic effects of chloroquine. It was approved for use in the US in 1955, and since then has been used for the treatment of a wide variety of diseases including arthritis, Systemic Lupus Erythematosus (SLE) etc.

Hydroxychloroquine (HCQ), is a medication used to prevent and treat malaria. It is also used for the treatment of rheumatoid arthritis, lupus, and porphyria cutanea tarda. HCQ is being studied to prevent and treat coronavirus disease 2019 (COVID-19). High-quality evidence of benefit for such use is lacking, with concerns of potential harm from its side effects.

Hydroxychloroquine is on the World Health Organization's list of essential Medicines, which has the most the safest and most effective medicines needed in a health system. In 2017, it was the 128<sup>th</sup> most commonly prescribed medication in the United States, with more than five million prescriptions. The speculative use of hydroxychloroquine for COVID-19 threatens its availability for people with established symptoms.



## History

The HCQ story begins in 1638 when the wife of the Viceroy of Peru, Countess Cinchona, acquired malaria while living in the New World. Rather than getting the "approved" therapy - blood-letting, she was treated by an Incan herbalist with the bark of a tree (eventually, named the countess-Cinchona Tree). Her response was dramatic; when the Viceroy returned to Spain, he brought with him large supplies of the powder for general use, which at the time was controlled by the Church and was thus called "Jesuit's Powder". It took nearly two centuries for the active substance, Quinine, to be isolated from the bark (and was eventually to make a name for itself as a tonic to be added to gin).

Over the next century, quinine would become a common component in folk medicines and patent remedies for the treatment of malaria in the southern states of America, as well as for generic malaise. By the 1940s, quinine, or, rather its derivative chloroquine, was recognized for its anti-malarial properties and found use among troops fighting in the Pacific during WW-II. However, it was noted that this compound had significant toxicities. In 1945, a modification of this compound via hydroxylation led to the development of HCQ, which was found to be less toxic and remains in use, without change, to this day.

## **Uses**

Hydroxychloroquine treats rheumatic disorders such as systemic lupus erythematosus, rheumatoid arthritis, and porphyria cutanea tarda, and certain infections such as Q fever and certain types of malaria. It is considered the first-line treatment for systemic lupus erythematosus. Certain types of malaria, resistant strains, and complicated cases require different or additional medication.

The medicine is widely used to treat primary Sjögren syndrome but does not appear to be effective. Hydroxychloroquine is widely used in the treatment of post-Lyme arthritis. It may have both an anti-spirochete activity and an anti-inflammatory activity, similar to the treatment of rheumatoid arthritis.

## **Adverse effects**

The most common adverse effects of the medicine are nausea, stomach cramps, and diarrhoea. Other common adverse effects include itching and headache. The most serious adverse effects affect the eye, with dose-related retinopathy as a concern even after hydroxychloroquine use is discontinued. Serious reported neuropsychiatric adverse effects of hydroxychloroquine use include agitation, mania, difficulty in sleeping, hallucinations, psychosis, catatonia, paranoia, depression, and suicidal thoughts. In rare situations, hydroxychloroquine has been implicated in cases of serious skin reactions such as Stevens-Johnson syndrome, toxic epidermal necrolysis, and drug reaction with eosinophilia and systemic symptoms. Reported blood abnormalities with its use include lymphopenia, eosinophilia, and atypical

lymphocytosis. Children may be especially vulnerable to developing adverse effects from hydroxychloroquine.

**TASK 1**

1. List the various uses of Hydroxychloroquine given in the passage.

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2. Can Hydroxychloroquine prevent the severity of Covid-19?

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**TASK 2 :Rearrange the given words in the proper order**

1) prevent/treat/and/medication/to/used/a/HCQ/is/Malaria

.....

2) had/toxicities/compound/significant/the

.....

3) additional/malaria/types/certain/of/requires/medication

.....

4) bark/took/it/centuries/two/the/isolated/the  
for/from/bark/be/Quinine

.....

5) include/effects/common/adverse/other/itching/headache/and

.....

**SOURCE PASSAGE 3: Marie Curie (1867-1934)**

**Pre -Task: Elicit students responses on their knowledge about Marie Curie**

Marie Curie was born in Poland she lived till she was twenty- She was the fifth child in her She had a difficult childhood as her parents and one of her died before she was fifteen as graduated from school.

Marie was an excellent student managed to move to Paris to her higher degrees and start scientific work. She had to overcome severe financial difficulties in order to pursue interest in academics and research.



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Curie was married to her colleague Pierre Curie and had two daughters. The couple discovered Radium and Polonium and worked together to study radioactivity for which they received the Nobel prize in Physics. Pierre was an exceptional physicist but died in an accident in 1903.

Curie continued her work in radioactivity and received her second Nobel Prize in Chemistry in 1911 for the isolation of pure Radium. She made contributions to the medical field through her research and applications of X-Radiography, especially during World War I. X-Ray had already been discovered by Rontgen in 1895; and electrons were discovered in 1897 by J.J. Thomson. These discoveries together with the knowledge of radioactivity ushered in the era of modern Physics.



Marie Curie was the first woman to win a Nobel Prize and also the first person to receive two Noble prizes. In 1935, another Nobel Prize would come to the family, as Curie's daughter Irene would win the Noble Prize in Chemistry with her husband for their work on artificial radioactivity.

Curie's contributions to Nuclear Physics is immeasurable. She has also been an inspiration to girls all over the world who want

to pursue a career in Physics and Chemistry.

**References:**

Britannica, T. E. (Ed.). (2020, April 16). *Marie Curie*. Retrieved June 18, 2020, from Encyclopædia Britannica.

Wikipedia, T. E. (Ed.). (16, June 2020). *Marie Curie*. Retrieved June 18, 2020, from Wikipedia.

**TASK 1:** Answer the following questions.

1. Describe Curie's childhood.

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2. Who discovered the electron? Which year was it discovered?

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3. Briefly describe Marie Curie's contributions to the field of Science.

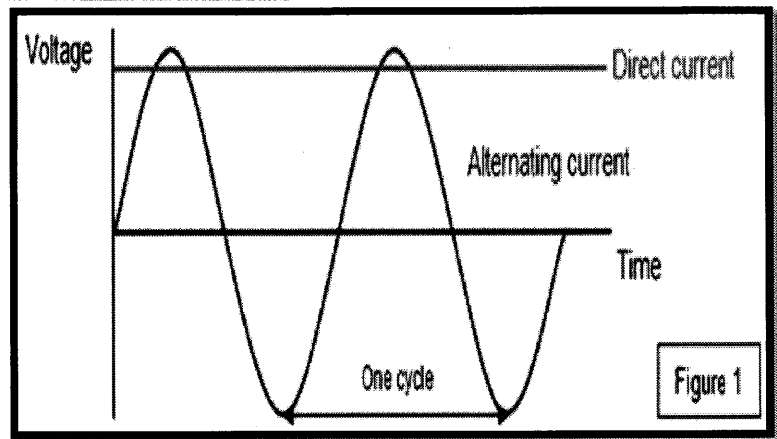
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## WRITING

### The War of Currents

In the late 1800s, businessman and inventor Thomas Edison was developing a practical application of direct (or DC) current to power homes, businesses, and entire cities.



Source: <https://physicsabout.com/difference-between-ac-and-dc/>

However, he was quickly presented with a serious issue--direct current could not be converted to higher or lower voltage, and it could not be transferred reliably over long distances.

Meanwhile, Nikola Tesla, a Serbian **immigrant** with extensive background in physics and engineering, received a **patent** for his alternating current (or AC) induction motor. This motor, in short, posed a solution to many of the issues DC motors presented, and **paved the way** for alternating current.

George Westinghouse, inventor and industrialist, bought Tesla's patents and **implemented** them on a large scale to **rival** Edison's growing business of **monopolizing** the electrical industry. Edison noticed the efforts of the alternating current being used against direct current and decided to campaign against it by spreading misinformation and playing up its dangers. He spent money on public electrocutions of animals and developed the electric chair to **execute** criminals.

Alternating current looked like it might fail thanks to the efforts of Edison-- but this was soon to change.

The Chicago World's Fair of 1893 was the greatest blow to Edison and his direct current monopoly. General Electric, owned by Edison, **petitioned** to electrify the fair for \$544,000. Westinghouse Electric Company however, owned by Westinghouse, proposed a budget of \$399,000 with use of Tesla's alternating current, and received the **privilege** of supplying the light. Alternating current was hailed as being superior to DC and remains to this day the **predominant** current for large-scale power supply.

**Created by: A. Hall, A. Newton, and J. Downey. GitHub.**

**Link: <http://warofcurrents.newtfire.org/>**

### **TASK 1**

Write a short passage comparing and contrasting Alternative Current and Direct Current

### **TASK 2**

Write a short paragraph (10 sentences) based on the passage on the War of Currents describing the main idea discussed in the passage, and the supporting evidence for the main idea.

## **SOURCE PASSAGE 2 THE INVENTION OF VASELINE**

### **Pre Task :The New Words and Concepts**

|   |  |
|---|--|
| <p><b>Petroleum jelly :</b><br/>translucent jelly<br/>consisting of a mixture of<br/>hydrocarbons</p> <p><b>Deodorants :</b> a<br/>substance which<br/>removes or conceals unpleasant<br/>smells</p> <p><b>Cleansers :</b> a substance<br/>to clean<br/>Something</p> <p><b>carcinogenic :</b> having the<br/>potential<br/>to cause cancer</p> | <p><b>Insulator :</b> a substance which<br/>does not<br/>readily allow the passage of heat<br/>or sound</p> <p><b>Tissue dehydration :</b><br/>removal of<br/>water from the aqueous-fixed<br/>tissue</p> <p><b>Refined :</b> with impurities or<br/>unwanted<br/>elements having been removed by<br/>processing</p> <p><b>Characterized :</b> describe the<br/>distinctive nature or features of<br/>something.</p> |
|---|--|

### **Introduction**

Vaseline is a kind of petroleum jelly-based products. The products include plain petroleum jelly and many varieties of skin creams, soaps, lotions, cleansers, and deodorants. Petrolatum, or petroleum jelly, derived from petroleum, is often used in personal care products as a moisturizing agent. In many languages, the word "Vaseline" is used as generic for petroleum jelly; in Portugal it is called as Vaselina, and in Brazil and some Spanish-speaking countries, the products are called as Vasenol.



### **An image from Vaseline company archives**

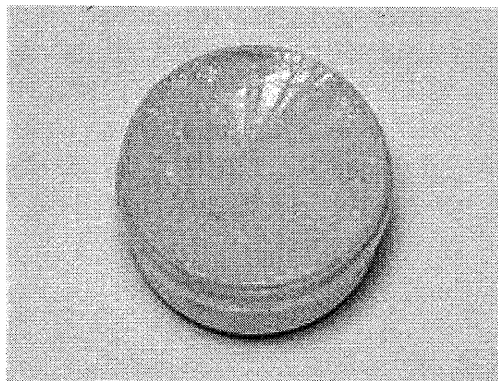
#### **History**

In 1859, Robert Chesebrough went to the oil fields in Titusville, Pennsylvania, and learnt about a residue called "rod wax" that had to be periodically removed from oil rig pumps. The oil workers had been using the substance to heal cuts and burns. Chesebrough took samples of the rod wax back to Brooklyn, extracted the usable petroleum jelly, and began manufacturing a medicinal product called Vaseline.

The name Vaseline was first coined by Chesebrough and filed a U.S. patent (U.S. Patent 127,568) in 1872. The name "vaseline" is said by the manufacturer to be derived from German *Wasser* "water" + Greek (*elaion*) "olive oil". Vaseline was made by the Chesebrough Manufacturing Company until the company was purchased by Unilever in 1987.

#### **Sources**

White petrolatum, the ingredient in petroleum jelly Vaseline, is refined from petroleum.



Vaseline in its container

## Uses

Vaseline can be used as a lubricant, it can also be used as a moisture insulator for local skin conditions characterized by tissue dehydration. Vaseline has been reported to be highly refined, triple-purified and regarded as non-carcinogenic

### **TASK 1: Write two important things you know about Vaseline?**

.....

.....

.....

.....

### **TASK 2: Revisit the Text and Reflect**

- a) Name the generic terms of petroleum jelly in Portugal, Brazil and Spain
- b) Name the personal care products that use Petroleum Jelly
- c) How did Chesebrough manufacture Vaseline?

### **TASK 3: Say whether following sentences are True or False**

- a) Vaseline is a moisturizing agent
- b) The Rod wax is used to heal cuts and burns
- c) Vaseline is a non-medicinal product
- d) The name Vaseline is derived from water and olive oil
- e) Vaseline is carcinogenic

### **TASK 4: Use the Youtube link given below to watch the video and complete the following passage choosing the right word given in brackets**

<https://www.youtube.com/watch?v=ubpsosv7mHM>

Petroleum jelly is easy to find and \_\_\_\_\_  
\_\_\_\_\_ (ineffective/inexpensive). It is chemically

similar to skin \_\_\_\_\_ (protein/vitamin). Dermatologist suggests it for \_\_\_\_\_ (medicinal/non-medicinal) tips and tricks. It is used for the treatment of chapped lips, \_\_\_\_\_ (nails/cuticles), hands and feet.

**TASK 5: Identify the differences between the given set of words taken from the Source passage**

- |    |                  |                     |
|----|------------------|---------------------|
| a) | Petroleum        | c) Residue          |
|    | Petroleum Jelly  | Extract             |
|    | White Petrolatum | Product             |
| b) | Moisturizer      | d) Removed Cleanser |
|    | Refined          |                     |
|    | Lubricant        | Purified            |

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**SOURCE PASSAGE 3 : BOOLEAN ALGEBRA**

**Pre-Task : New Words and Concepts**

|   |  |
|---|--|
| <p><b>Algebra</b> : the part of mathematics in which letters and other general symbols are used to represent numbers and quantities in formulae and equations</p> <p><b>Conjunction</b>: the action or an instance of two or more events or things occurring at the same point in time or space</p> <p><b>Disjunction</b> : the relation of two distinct things</p> | <p><b>Negation</b> : the absence or opposite of something actual or positive</p> <p><b>Logic circuits</b> : a circuit for performing logical operations on input signals</p> <p><b>Binary Decision</b>: <b>binary decision</b> is a choice between two alternatives, for instance between taking some specific action or not taking it</p> |
|---|--|

## INTRODUCTION

In mathematics and mathematical logic, **Boolean algebra** is the branch of algebra in which the values of the variables are the truth values true and false, usually denoted 1 and 0, respectively. Instead of elementary algebra where the values of the variables are numbers, and the prime operations are addition and multiplication, the main

operations of Boolean algebra are the conjunction (and) denoted as  $\wedge$ , the disjunction (or) denoted as  $\vee$ , and the negation (not) denoted as  $\neg$ . It is thus formalism for describing logical operations in the same way

that elementary algebra describes numerical operations.

## History

Boolean algebra was introduced by George Boole in his first book "The Mathematical Analysis of Logic" (1847), and set forth more fully in his "An Investigation of the Laws of Thought" (1854). According to Huntington, the term "Boolean algebra" was first suggested by Sheffer in 1913, although Charles Sanders Peirce in 1880 gave the title "A Boolean Algebra with One Constant" to the first chapter of his "The Simplest Mathematics". Boolean algebra has been fundamental in the development of digital electronics, and is provided for in all modern programming languages. For example, the empirical observation that one can manipulate expressions in the algebra of sets by translating them into expressions in Boole's algebra is explained in modern terms by saying that the algebra of sets is a Boolean algebra. In fact, M. H. Stone proved in 1936 that every Boolean algebra is isomorphic to a field of sets. It is also used in set theory and statistics.

In the 1930s, while studying switching circuits, Claude Shannon observed that one could also apply the rules of Boole's algebra in this



setting, and he introduced switching algebra as a way to analyze and design circuits by algebraic means in terms of logic gates. Shannon already had at his disposal the abstract mathematical apparatus, thus he cast his switching algebra as the two-element Boolean algebra. In circuit engineering settings today, there is little need to consider other Boolean algebras, thus "switching algebra" and "Boolean algebra" is often used interchangeably. Efficient implementation of Boolean functions is a fundamental problem in the design of combinational logic circuits. Modern electronic design automation tools for Very large-scale integration (VLSI) circuits often rely on an efficient representation of Boolean functions known as (reduced ordered) binary decision diagrams (BDD) for logic synthesis and formal verification.

### **Applications**

Boolean algebra as the calculus of two values is fundamental to computer circuits, computer programming, and mathematical logic, and is also used in other areas of mathematics such as set theory and statistics.

Recent days, all modern general purpose computers perform their functions using two-value Boolean logic; that is, their electrical circuits are a physical manifestation of two-value Boolean logic. They achieve this in various ways: as voltages on wires in high-speed circuits and capacitive storage devices, as orientations of a magnetic domain in ferromagnetic storage devices, as holes in punched cards or paper tape, and soon.

### **TASK 1**

a. Whom do you consider as the creator of Boolean Algebra? Discuss its origin and evolution

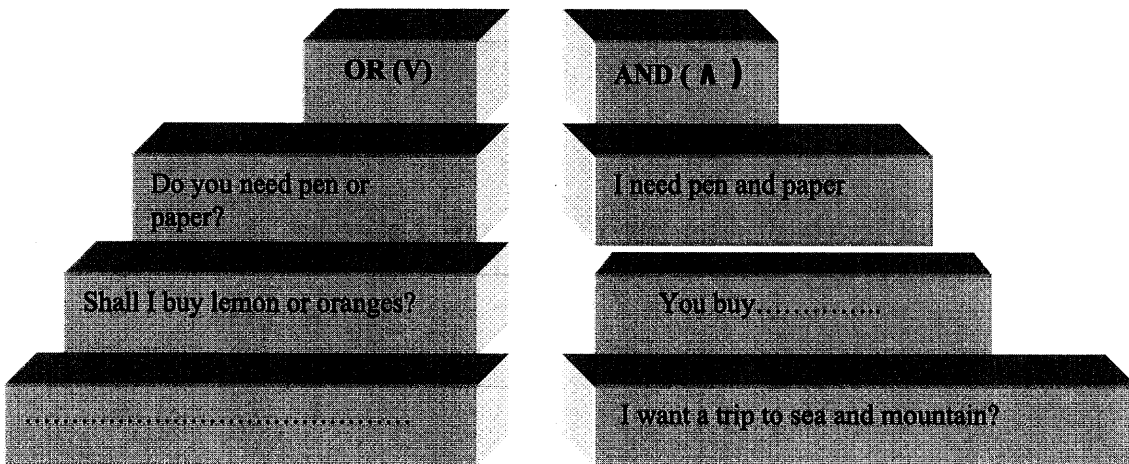
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b. What have you understood about the application of Boolean Algebra?.....  
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**TASK 2: Combine the sentence bars using "OR" & "AND" in the examples given**



Notes.....

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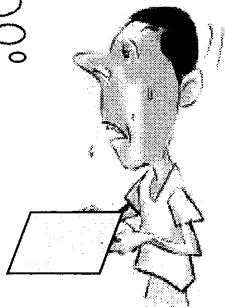
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### TASK 3 Think in Pictures

How to learn Boolean algebra for

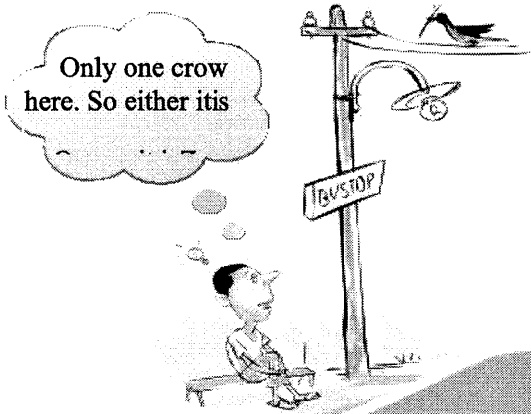
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2

Buddy I got it. Boolean Algebra is And. Or. Not

Only one crow here. So either it is



1. Use your imagination to develop a story from the above cartoon strip. Give the story a beginning, a climax (turningpoint) and an ending. You can add details about the setting of the story (time and place) and the characters (name, profession, personality traits, etc.). Discuss your ideas with your partner and modify the story. You may then narrate the story to your class. Havefun!!

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**TASK 4** .Make a list on the everyday applications of two-value Boolean logic and present it in theclass

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# COMMUNICATION

## LISTENING

### PROCESS DESCRIPTION

A process description **describes** how something works, beginning with general information to the specific. The description can be a flow chart or a schematic representation that shows steps of actions in the process in sequential order. **The sequential order is identified by using link words such as "first, initially, then, thereafter, finally, next, etc."** Process description should be written in the passive voice and simple present tense

**TASK 1 Listen to the following passage and draw a flow chart:**

### Process Of Making Photocopies

Static electricity enables a photocopier to produce almost instant copies of documents. At the heart of the machine is a metal drum which is given a negative charge at the beginning of the copying cycle. The optical system then projects an image of the document on the drum. The electric charge disappears where light strikes the metal surfaces, so only dark parts of the image remain charged.

Positively charged particles of toner powder are then applied to the drum. The charged parts of the drum attract the dark powder, which is then transferred to a piece of paper. A heater seals the powder to the paper, and a warm copy of the document emerges from the photocopier.

## SPEAKING

## Role Play

Role-play is an effective speaking activity. It is a technique that allows students to explore realistic situations by interacting with others. The role play helps students to develop different and strategies in a supported environment. Through this role-play a student can put him from different situations and act; indeed this acting will help him develop an understanding of the situation from the 'opposite' point of view.

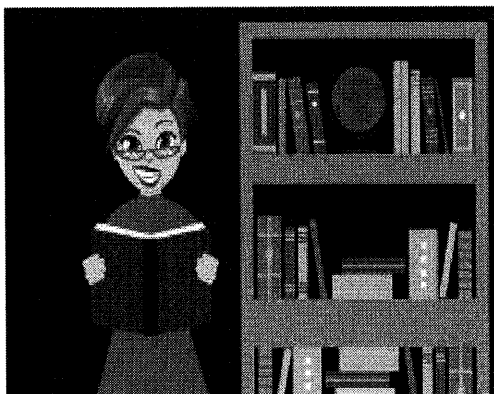
Role play is remarkably interesting with imaginary people and imaginary situations. The joy of role-playing is that students can 'become' anyone they like for a short time! The President, the Queen, a millionaire, a pop star ..... the choice is endless! Students can enjoy an imaginary situation where they get the liberty to use language interestingly. 'At the restaurant', 'Checking in at the airport', 'Looking for lost property' are all possible role-plays.

### TASK 1

1. Imagine yourself as an employee in a multinational company as a Team Leader. You are explaining to your teammates the recent project and the importance of completing it in a month and Clear the doubts raised by your team members as and when they ask them.
2. Imagine yourself as a student of Computer Science, and you attend a Lab class, and you discuss the use of learning computer graphics and cryptography with your friends.

## READING

### I. Pre- task:



1. What kind of reading strategy do you follow to decipher the meaning of any text?
2. What do you mean by **reading between the lines**?
3. Which among the following do you consider as the most effective reading method to comprehend a text?

- a. Skimming      b. Scanning
  - c. Intensive      d. Extensive
4. Identify the ways to speed up reading and comprehending skills?

**II. Read the following passage and answer the questions below!**  
**(Your teacher will help you find out the meanings of the difficult words/phrases in the passage)**

### **THE EFFECT OF MOBILE PHONES**

Can talking on a **mobile phone** be **hazardous** to your health? It is difficult to know for sure. Some research suggests that heavy users of mobile phones are at a greater risk of developing cancerous brain tumors. However, many other studies suggest that there are no links between cancer and mobile phone use. The main problem with current research is that mobile phones have only been popular since the 1990s. As a result, it is impossible to study **long-term exposure** to mobile phones. This concerns many health professionals who point out that certain cancers can take over twenty years to develop. Another concern about these studies is that many have been **funded** by the mobile phone industry or those who benefit from it.

Over five billion people now use mobile phones daily, and many talk for more than an hour a day. Mobile phone antennas are like microwave ovens. While both rely on **electromagnetic radiation** (EMR), the radio waves in mobile phones are lower in frequency. Microwave ovens have radio wave frequencies that are high enough to cook food, and they are also known to be dangerous to human **tissues** like those in the brain. The concern is that the lower-frequency radio waves that mobile phones rely on may also be dangerous. It seems **logical** that holding a heat source near your brain for a long period is a potential health hazard.

Some researchers believe that other types of wireless technology may also be dangerous to human health, including cordless phones, wireless **gaming consoles**, and laptop or tablet computers with wireless connections. They suggest replacing all cordless and wireless **devices** with wired ones where possible. They also say that many cordless phones can emit dangerous levels of Electromagnetic Radiation even when they are not in use. They even suggest keeping electronic devices such as desktop and tablet computers out of the bedroom, or at least six feet from the head while we're sleeping.



A growing number of health professionals worldwide are recommending that mobile phone users **err on the side of caution but this cannot be accepted**, until more **definitive** studies can be **conducted**. They use the example of **tobacco** to **illustrate** the **potential** risks. Many years ago, people smoked freely and were not concerned about the effects of cigarettes on their health. Today, people know that cigarettes cause lung cancer, though it is still unknown exactly how or why. Some doctors fear that the same thing will happen with mobile phones. In May 2016, the UK's Independent newspaper reported on research by the US government's National Toxicology Program that showed a slight increase in brain tumors among rats exposed to the type of radio frequencies commonly emitted by mobile phones. This doesn't prove that mobile phones can cause brain tumors in humans, but it does show that it's possible. As a result, many experts now recommend texting or using headsets or speakerphones instead of holding a mobile phone to the ear.

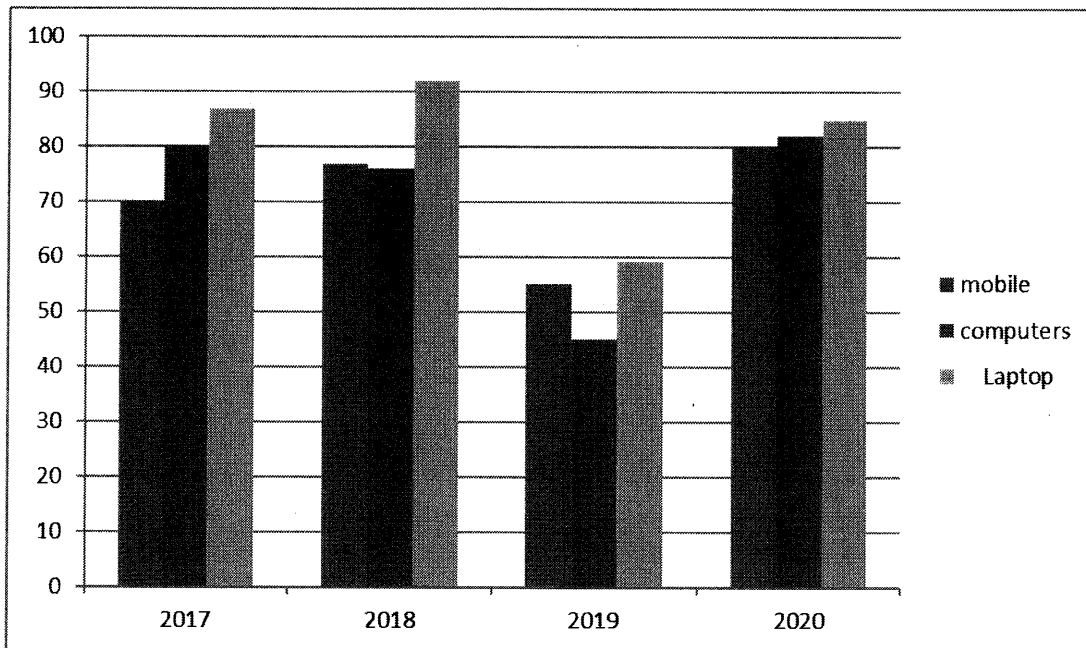
**Source:** <https://www.englishclub.com/reading/health/cell-phone.htm>

**TASK 1- Test your reading:**

1. How does the usage of mobile phones affect our health?
2. In what way does a cordless phone harm our body?
3. What are the dangers caused by the microwave oven to humans?
4. Why should electronic gadgets be kept out of the bedroom while sleeping?
5. What was the finding of the US government's National Toxicology?

**TASK 2 Study the following detailed graph on the use of electrical gadgets and answer the questions given below:**

**Electrical Gadgets Usage**



1. Identify the type of graph given above.
2. What are the electrical gadgets mentioned in the graph?
3. Which Appliance has the least Usage in 2019? Which Gadget was mostly used by people in 2017?
4. What are the uses of these electrical gadgets in today's world?
5. What will the increase in the usage of electronic devices lead to?

**TASK 3- Discuss in groups and collect ideas on the use of the following electrical gadgets and their impact (Positive /and Negative) on the lives of people.**

1. Mobile Phone
2. Microwave Oven
3. Refrigerator
4. Earphone
5. Wi-Fi Router

**DEFINITIONS**

The word 'definition' originates from the word 'define', which **states exactly what a thing is**. A definition has two distinct elements. First, the term should be identified as an item of a large group or category. Then its distinguishing characteristics are to be specified in such a way that no other object, device, or process fits into the definition.

### **Steps to writing Definitions:**

1. Use of articles: A definition usually begins with an article 'a', 'an' or 'the'.
2. State what it is – whether it is a tool, or, a device, a machine, a component, an instrument, or, a concept, or an idea or a study.
3. Describe the primary use(s) of the thing.
4. State the condition of the thing, description of the thing.(parts) etc.

### **Example:**

**1. An abacus is an ancient device that is used for arithmetic calculations.**

**2. A lathe is a machine for shaping metal or wood.**

**3. Acoustics is a branch of science that deals with sounds.**

**4. A burette is an apparatus used in labs for chemical analysis which is used to measure the volume of a liquid or gas. It is made up of a glass tube with measurements marked on it.**

**5. An accelerator is a device for increasing speed, especially the pedal in a vehicle that controls the speed of the engine.**

### **EXERCISE: Write the definitions for the following words**

1. Barometer:
2. Computer program:
3. A flow chart:
4. Gobar gas plant:
5. Microphone:

### **Extended Definitions**

Defining a **word** can be with a synonym, a brief phrase, or a formal sentence that explains the **term** in its most basic form.

**Terms** are words, compound words, or multi-word expressions that are given specific meanings in specific contexts —these may deviate from the meaning the same words have in other contexts.

**Steps to write extended definitions:**

- Explain the word and its term.
  - Describe its **Classification, principle, and its operation.**
  - Discuss its **Cause and Effect attributes,** and its parts
  - **Compare and contrast, if needed.**
- 

**Example:**

**Mini drafter / Drafting machine:**

It is a device with two scales set at right angles to each other. It combines the functions of T-square, set squares, scales, climograph, and protractors. It can be moved easily and quickly to any location on a drawing sheet without altering the relative horizontal and vertical positions of two scales. The edges of the scales are used for measuring as well as drawing

**Write extended definitions for the following terms**

1. Radiator:
  2. Rheostat:
  3. Robot:
  4. Scientist:
  5. Sensor:
- 

**SOURCE PASSAGE: HISTORY OF MATCHES AND LIGHTERS**

The fire was the basis of modern human kind and a catalyst for the expansion of our ancestors beyond the borders of Africa. It gave us the power to survive in harsh

environments, process food, and change the shape of the environment we live in. As the millennia went on, and the human race started developing advanced tools from the first Neolithic civilizations, the ability to create fire became common place all around the world. However, that process was still slow, unreliable, and dependent upon many conditions (rain, wind, low portability). Because of these problems, many scientists, chemists, and engineers of the early human civilizations (Mesopotamia, Egypt, India, China, Greece, and Rome) tried to find some ways to make a fire which would be portable and reliable. Since they lacked the knowledge of chemistry and physics; their early efforts were unsuccessful. The only relatively successful of example of the making fire came from China in the 5th century

AD, where sulphur coated wooden sticks were used as a catalyst for creating fire. By the 10th century manufacture of these "light-bringing slaves" or "fire inch-sticks" was found in all parts of China, but the self-igniting match stick was not found.

1000 years passed, and scientists still did not come close to finding the way how to create a self-igniting source of fire that could be used reliably by the general population (few impractical and extremely dangerous

chemical reactions were present). The basis of the modern match and lighter technology was founded by none other than Hennig Brandt, a German merchant, pharmacist, and alchemist, in the second half of the 17th century, who in his entire life dreamed of creating gold from other metals. During his career, he managed to extract pure phosphorus and test his interesting flammable properties. Even though he discarded phosphorus in his alchemic experiments, his notes proved to be an important stepping stone for future generations of inventors. The first match was created in 1805 by Jean Chancel in Paris. This crude match looked nothing like the modern "striking" matches we use today. Instead of using phosphorus, Chancel elected to coat a wooden stick with potassium chlorate, sulphur, sugar, rubber, and then dip that stick into the small asbestos bottle filled with sulphuric acid. The connection between acid and the mixture on the stick would start the fire and release very nasty fumes into the face of the user. Over the last 200 years, scientists, and engineers from all over the world managed to create match sticks that we use today.

#### Glossary of Terms:

- a. **Millennia:** plural of millennium
- b. **Neolithic:** relating to the period when

humans used tools and weapons made of stone and had just developed farming

- c. **Alchemist:** a person who uses or seems to use alchemy (change ordinary metals into gold)
- d. **Flammable:** Something that is flammable burns easily
- e. **Discard:** to throw something away or get rid of it because one no longer wants it.

**TASK 1: Describing People and Their Actions:**

1. Think of things people do with the matches and lighters. Use these verbs:

- a. strike the match

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- b. generate heat

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- c. set fire

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- d. ignite the stove

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.....

- e. light the candle

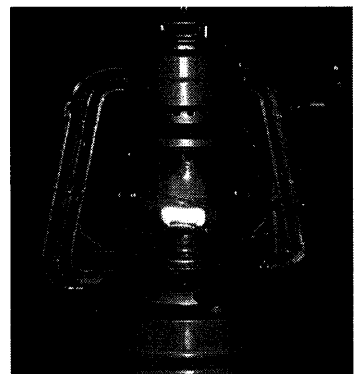
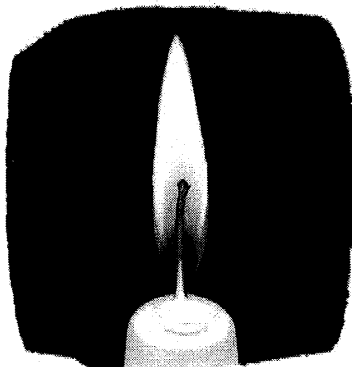
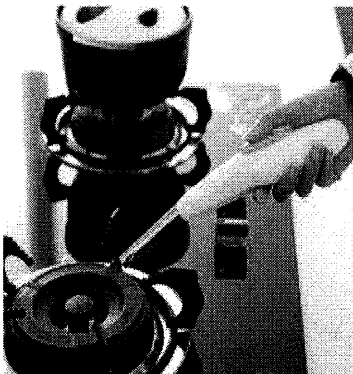
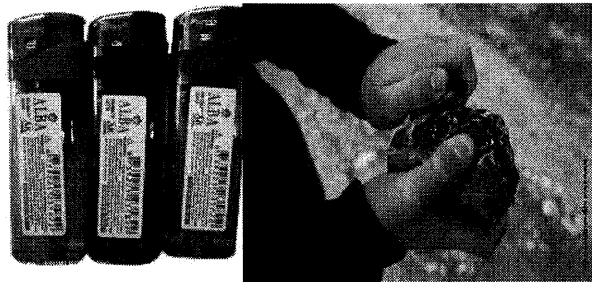
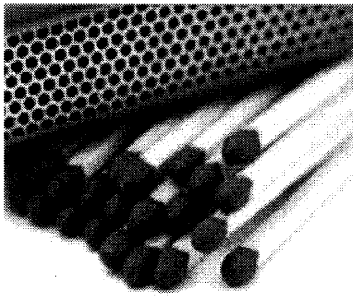
.....  
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**TASK 2: Read the above text and fill the gaps with the answers in the box:**

1. Gold    2. Potassium chlorate    3. 1805    4. 5<sup>th</sup> Century    5. Other metals

- f. Wooden sticks coated with sulphur paved the way as a catalyst for fire in .....
- g. Chancel opted wooden stick with than phosphorus.
- h. Hennig Brandt dreamt of ..... from other ..... in his lifetime.
- i. Jean Chancel was instrumental in creating the first match in Paris in .....

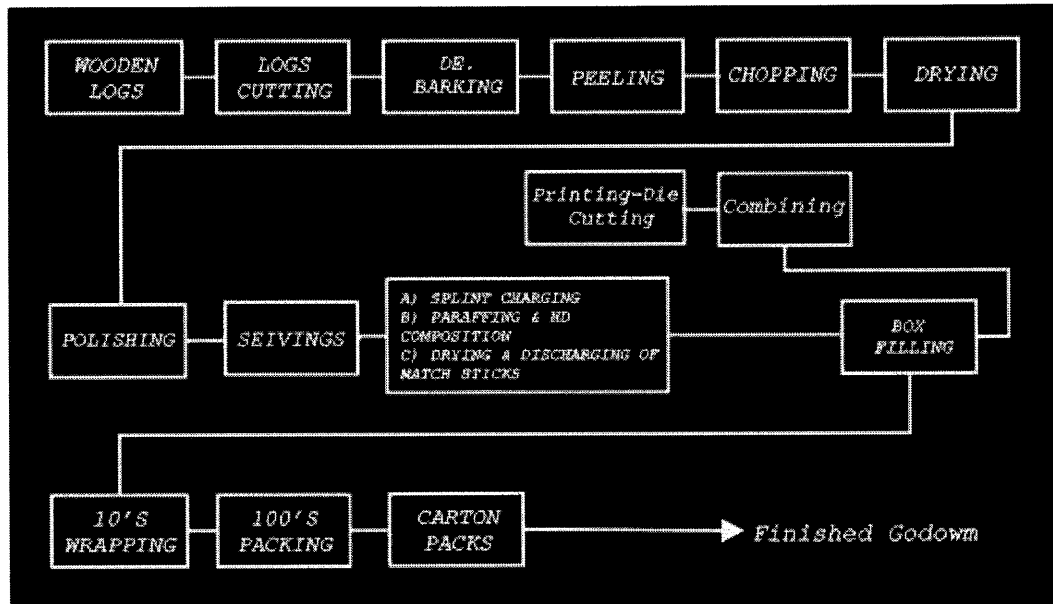
2. Write a few sentences about each of these pictures below expressing their purpose:





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**TASK 3: Write a paragraph using sequence expressions on the process of making safety matches using the following flowchart.**



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**TASK 4: Use the following hints and discuss in pairs the technology of the future. Present the facts to the others in the class:**

Imagine a world where wireless devices are

as small as a grain of salt. These miniaturized devices have sensors, cameras, and communication mechanisms to transmit the data they collect back to a base to process. Today, you no longer have to imagine it: microelectromechanical systems (MEMS), often called motes, are real and they very well could be coming to a neighborhood near you. Whether this fact excites or strikes fear in you it's good to know what it's all about.

### **WRITING**

#### **SOURCE PASSAGE: LIGHT-EMITTING DIODE (LED)**

A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The colour of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.

Appearing as practical electronic components in 1962, the earliest LEDs, emitted low-intensity infrared (IR) light. Infrared LEDs are used in remote-control

circuits, such as those used with a wide variety of consumer electronics. The first visible-light LEDs were of low intensity and limited to red. Modern LEDs are available across the visible, ultraviolet (UV), and infrared wavelengths, with the high light output.

Early LEDs were often used as indicator lamps, replacing small incandescent bulbs, and in seven-segment displays. Recent developments have produced high-output white light LEDs suitable for room and outdoor area lighting. LEDs have led to new displays and sensors, while their high switching rates are useful in advanced communications technology. The first white LEDs were expensive and inefficient. However, the light output of LEDs has increased exponentially. The latest research and development has been propagated by Japanese manufacturers such as Panasonic, and Nichia, and by Korean and Chinese manufacturers such as Samsung, Kingsun, and others. This trend in increased output has been called Haitz's law after Dr. Roland Haitz. Light output and efficiency of blue and near-ultraviolet LEDs rose and the cost of reliable devices fell. This led to relatively high-power white-light LEDs for illumination, which are replacing incandescent and fluorescent lighting. Experimental white LEDs

have been demonstrated to produce 303 lumens per watt of electricity (lm/w); some can last upto 10,000hours. However, commercially available LEDs have an efficiency of upto 223 lm/w. Compared to incandescent bulbs, this is a huge increase in electrical efficiency, and even though LEDs are more expensive to purchase, the overall cost is significantly cheaper than that of incandescent bulbs.

Glossary of Terms:

- a. **Intensity:** the quality of being felt strongly or having a strong effect
- b. **Infrared:** a type of light that feels warm but cannot be seen.
- c. **Incandescent:** producing a bright light from a heated filament or other parts
- d. **Exponentially:** in a way that becomes quicker and quicker as something that increases becomes larger
- e. **Propagate:** to produce a new plant using a parent plant

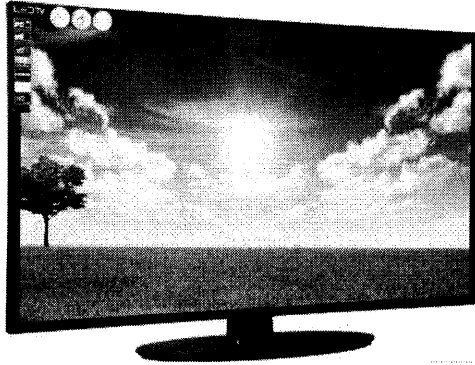
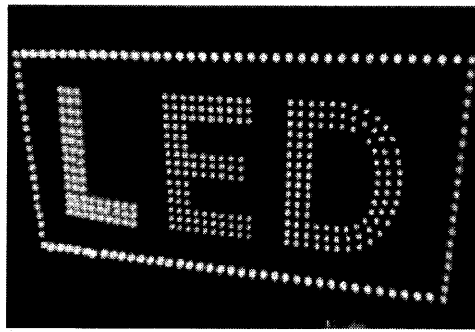
*Note: Freewriting is very much like brainstorming. Here, too, you tap your natural creativity, free from the confines of structured thought. Write your ideas as they pop into your mind and then revise what you have written.*

**TASK 1: Write in about 50 words without making corrections or refining your text,**

**the ways and means of saving electricity.**

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**TASK 2** LED Display is a screen display technology that uses a panel of LEDs as the light source. Currently, a large number of electronic devices, both small and large, use LED display as a screen and as an interaction medium between the user and the system. Modern electronic devices such as mobile phones, TVs, tablets, computer monitors, laptops screens, etc., use a LED display to display their output. Discuss with your friends the uses of these devices – Report your ideas to the class, when your teacher asks you.



**TASK 3. Fill in the blanks with appropriate words given in the box:**

electronics handhelds consumption light-emitting advantage

The LED display is one of the main screen displays that are being commercially used. The biggest ..... of the LED display is it is efficient and low-energy....., which is especially needed for ..... and chargeable devices such as mobile phones and tablets. An LED display consists of many LED panels that, in turn, consist of several LEDs. LEDs have numerous advantages over

other ..... sources that can be used alternatively. Aside from being power efficient, LEDs produce more brilliance and greater light intensity. LED Display is different from the vacuum fluorescent display used in some consumer..... Such as car stereos, video cassette recorders, etc., and, hence, these two should not be confused with each other.

**TASK 4: Here are some sentences from the passage. Fill in the gaps with prepositions from the box:**

|                                     |
|-------------------------------------|
| By      for      of      in      to |
|-------------------------------------|

The colour of the light (corresponding to the energy of the photons) is determined by the energy required electrons ..... cross the band gap of the semiconductor. White light is obtained ..... Using multiple semiconductors or a layer.....light-emitting phosphor on the semiconductor device. Appearing as practical electronic components in 1962, the earliest LEDs emitted low- intensity

infrared(IR) light. Infrared LEDs are used ..... remote-control circuits, such as those used with a wide variety of consumer electronics.

**SOURCE PASSAGE: APPLIED NUMBER THEORY IN ATM**

Some novel applications of elementary and particularly algorithmic number theory have been employed to design computer (both hardware and software) systems, coding and cryptography, and information security, especially network/communication security. Leonard Eugene Dickson (1874- 1954), one of the key figures of 20th-century mathematics, particularly number theory, was born in Independence, Iowa, a descendant of one William Dickson who had emigrated from Northern Ireland to Londonderry, New Hampshire in the 18th century. Dickson obtained his Ph.D. in 1896 from the University of Chicago, the first Ph.D. award in Mathematics by the institution. One of the most productive of all mathematicians, Dickson wrote over 250



papers and 18 books, including the three-volume 1600-page *History of the Theory of Numbers*.

The most famous English mathematician G. H. Hardy (1877-1947) in his *Apology* stated that if the theory of numbers could be employed for any practical and honorable purpose, and if they could be turned directly to the furtherance of happiness or relief from suffering, as physiology and even chemistry can, then, surely, neither Gauss nor any other mathematician would have been so foolish as to decry or regret such applications.

Glossary of Terms:

- a. **Cryptography:** the practice of creating and understanding codes that keep information secret
- b. **Descendant:** a person who is related to you and who lives after you.
- c. **Emigrate:** to leave a country permanently and go to live in another one.
- d. **Furtherance:** the process of helping something to develop or make progress.
- e. **Decry:** to criticize something as bad, without value, or unnecessary

**TASK 1. Which of these sentences from the text are true, and which are false?**

- a. William Dickson was the descendant of Leonard Eugene Dickson.
- b. G H Hardy wrote the "History of the Theory

ofNumbers”.

- c. G H Hardy was of the view that the theory of numbers could not be employed for any practical and honorable purpose.
- d. William Dickson, one of the most productive of all mathematicians, belonged to the 18th century.
- e. Gauss said that human sufferings can be relieved through physiology and even chemistry.



**TASK 2: Express your views on the advantages and disadvantages of ATM (Automated Teller Machine) when compared to the Teller in a Bank.**

The table shows some **compare and contrast** expressions that we can make use of when we compare or differentiate two or more items or topics.

|                |                             |                            |                          |                      |
|----------------|-----------------------------|----------------------------|--------------------------|----------------------|
| ADDING         | And, also, as well          | As, moreover, as           | Besides, also            | Furthermore          |
| CAUSE & EFFECT | Because, so                 | Therefore, thus            | Consequently,            | As a result of       |
| SEQUENCING     | Next, then                  | Firstly, secondly, finally | Meanwhile, after, Before | Eventually           |
| CONTRASTING    | Whereas, Instead of, unlike | Alternatively, otherwise   | On the other hand        | In contrast, However |

|              |                          |                              |                                 |                            |
|--------------|--------------------------|------------------------------|---------------------------------|----------------------------|
| QUALIFYING   | However, although        | Unless, even                 | As long as, about, from         | Of course                  |
| EMPHASIZING  | In particular            | Especially, notably          | Significantly, indeed           | Most of all, Above all     |
| ILLUSTRATING | For example, such as     | As revealed by, for instance | In the case of                  | As shown by                |
| COMPARING    | Equally, in the same way | Like, similarly, similar to  | likewise, in comparison with/to | As with, as compared with, |

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**Read the following excerpt written by Ramanujan on 31<sup>st</sup> January 1913 to a mathematician named G. H. Hardy in Cambridge, England. Fill in the blanks in the letter with the words given below. Also discuss with your friends the style of writing used by Ramanujam. How different is it from the style adopted to draft emails and letters today.**

|               |               |              |              |
|---------------|---------------|--------------|--------------|
| University    | investigation | conventional | approximates |
| enclosed      | convinced     | published    | indicated    |
| Inexperienced | excused       |              |              |

Dear Sir,

I beg to introduce myself to you as a clerk in the Accounts Department of the Port Trust Office at Madras on a salary of only £20 per annum. I am now about 23 years of age. I have had no ..... education but I have undergone the ordinary school course. After leaving school I have been employing the spare time at my disposal to work at Mathematics. I have not trodden through the ..... regular course, which is followed in a University course, but I am striking out a new path for myself. I have made a special ..... of divergent series in general and the results I get are termed by the local mathematicians as "startling"

Third Paragraph

Very recently I came across a tract published by you styled Orders of Infinity in page 36 of which I find a statement that no definite expression has been as yet found for the number of prime numbers less than any given number. I have found an expression which very nearly ..... to the real result, the error being negligible. I would request you to go through the ..... papers.

Fourth paragraph

Being poor, if you are ..... that there is anything of value I would like to have my theorems ..... I have not given the actual investigations nor the expressions that I get but I have ..... the lines on which I proceed. Being ..... I would very highly value any advice you give me. Requesting to be ..... for the trouble I give you.

I remain, Dear Sir,

Yours truly,

S. Ramanujan

**TASK 4: Identify the jumbled letters and complete the sentences:**

The story of the number 1729 goes back to 1918 when.....(India)

mathematician Srinivasa Ramanujan lay sick in a clinic near....(London) and

his friend and collaborator G.H. Hardy visited him. Hardy said that he had arrived in

..... (tax) number 1729 and described the

.....(unborn) "as rather

### UNIT 3

## Raman's Equipment and Experimental Setup

Pre Task : Key Terms

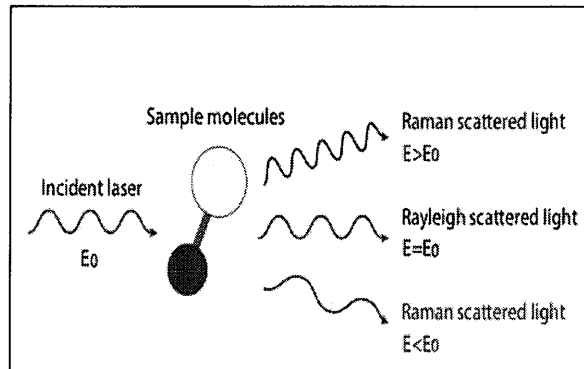
|                 |  |
|-----------------|--|
| <b>Acoustic</b> | <b>A branch of physics that deals with the study of mechanical waves in gases, liquids, and solids</b> |
|-----------------|--|

|                                 |   |
|---------------------------------|---|
| <b>Optics</b>                   | A branch of physics that studies the behaviour and properties of light  |
| <b>Opalescence</b>              | The quality of reflecting light and changing colour with reference to an opal   |
| <b>Polarizing</b>               | To make optical waves to oscillate in one particular direction or to make light waves move only in one direction  |
| <b>Surface reflection</b>       | The reflection that occurs when light wave bounces off an object  |
| <b>Diffraction grating</b>      | An optical element that disperses light composed of lots of different wavelengths (e.g., white light) into light components by wavelength                                 |
| <b>Molecules</b>                | An electrically neutral group of two or more atoms held together by chemical bonds  |
| <b>Molecular diffraction</b>    | Various phenomena that occur when a wave encounters an obstacle or a slit, otherwise known as the bending of waves around the corners of an obstacle, caused by molecules |
| <b>Fluorescence</b>             | The emission of light by a substance that has absorbed light or other electromagnetic radiation   |
| <b>Acoustic optical effects</b> | The interaction of light (optics) and sound (acoustics).  |
| <b>Infrared spectra</b>         | An electromagnetic radiation (EMR) with wavelengths longer than those of visible light.   |
| <b>Heliostat</b>                | An apparatus containing a movable mirror, used to reflect sunlight in a fixed direction   |
| <b>Refracting telescope</b>     | (also called a refractor) a type of optical telescope that uses a lens as its objective to form an image  |
| <b>Photodetectors</b>           | sensors of light or other electromagnetic radiation   |
| <b>Photons</b>                  | A type of elementary particle representing a quantum of light or other electromagnetic radiation  |

## Raman's Equipment and Experimental Setup



Sir C. V. Raman with his instrument



Scattering of light by molecules

The main challenge Raman faced in his experimental work was posed by the extremely weak intensity of the scattered light. In his early studies, Raman used a heliostat — a mechanically driven mirror that tracked the motion of the sun to provide a light source. Eventually, however, he came to realise that the sunlight was not sufficiently intense on its own. Thus, in 1927, he acquired a 7-in. refracting telescope, which he used in combination with a short-focus lens to condense the sunlight into a narrow beam. In the following year, he created an even more powerful light source by using highly monochromatic light from a mercury arc lamp together with a large aperture condenser and cobalt-glass filter. Sometimes, he replaced the glass filters with liquid ones. Raman used a violet filter to isolate a band of violet light incident on a sample liquid. At 90 degrees to the incident light, he placed another violet glass filter. This enabled him to observe violet light scattered from the sample, which represented normal Rayleigh scattering.

When he replaced the second filter with a green one, however, the Rayleigh-scattered light was blocked but there was still some green light visible, demonstrating the second form of scattering. Perhaps most interestingly, Raman used his own dark-adapted eyes as photodetectors. Only after he had observed the frequency shift with his



eyes and a direct-vision spectroscope did he repeat the observation with a mercury arc lamp and a Hilger baby quartz spectrograph. Surprising as it may seem, the human eye can detect single photons over a high dynamic range. Raman used a small Adam Hilger spectroscope for his initial studies, and he detected the spectrum of the scattered light using photography. Since the intensity of the frequency-shifted light was extremely weak, long exposure times were required to record the spectra.

Nobel Committee decided to give the Nobel Prize to Raman for his invention. He was awarded the Nobel Prize in Physics on December 11, 1930. He was a great man known for his driving ambition and passion for science. At the age of 60, Raman formed the Raman Research Institute (supported with his own funds and donations that he raised). He also remained a professor, as well as the President of the Indian Academy of Sciences in Bangalore, until his death in 1970. A few days before his death on November 21, 1970, Raman spoke these words, "Science can only flower out when there is an internal urge. It cannot thrive under external pressure." A tree grows where Raman died.

**TASK 1 :Unscramble the following words**

| <b>Sl. No</b> | <b>SCRAMBLED</b> | <b>UNSCRAMBLED</b> |
|---------------|------------------|--------------------|
|               | Naeoelcepsc      | OPALESCENCE        |
| <b>1.</b>     | Ramanerdeetni    |                    |
| <b>2.</b>     | Oarcmlule        |                    |

|            |                |  |
|------------|----------------|--|
| <b>3.</b>  | Ecuryfqen      |  |
| <b>4.</b>  | Nucsereclfeo   |  |
| <b>5.</b>  | Mmrocoichtnoa  |  |
| <b>6.</b>  | Stenyinti      |  |
| <b>7.</b>  | Rutpaere       |  |
| <b>8.</b>  | Pcagpsrhoetr   |  |
| <b>9.</b>  | Emurcyr        |  |
| <b>10.</b> | Ottecpsedohtro |  |

**TASK 2: Locate related words from the passages**

|  | <b>Topic</b>        | <b>Related Words</b>  |
|--|---------------------|---|
|  | <b>Education</b>    | Physics, Universities,<br>Oxford, Research,<br>Institute,<br>professor, Academy |
|  | <b>Places</b>       | India,  |
|  | <b>Nature</b>       | Sea,  |
|  | <b>Instruments</b>  | Telescope,  |
|  | <b>Action words</b> | Completed,  |
|  | <b>Physics</b>      |   |

**TASK 3: Create Write a sentence using each of the following words**

| Sl. No. | Word        | Sentence                            |
|---------|-------------|-------------------------------------|
|         | Voyage      | Sea <u>voyages</u> are interesting. |
| 1.      | Urge        |                                     |
| 2.      | Mystery     |                                     |
| 3.      | Discovery   |                                     |
| 4.      | Congress    |                                     |
| 5.      | Molecule    |                                     |
| 6.      | Demonstrate |                                     |
| 7.      | Phenomenon  |                                     |
| 8.      | Narrow      |                                     |
| 9.      | Condense    |                                     |
| 10.     | Dynamic     |                                     |

## SOURCE PASSAGE: THE SOAP BUBBLE

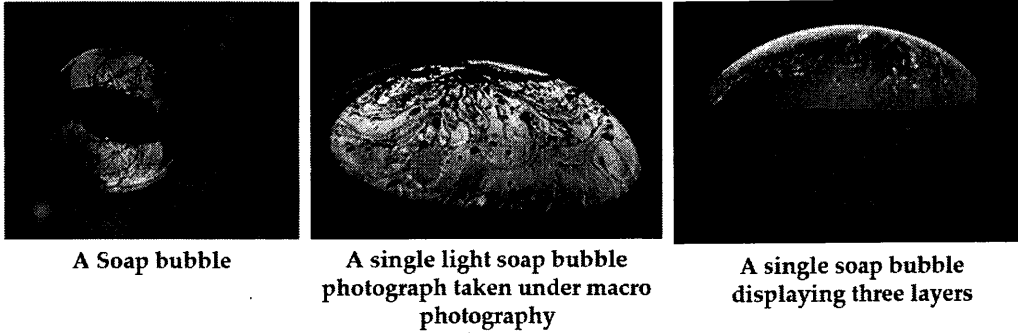
Pre TASK : Key Terms

|                   |   |
|-------------------|---|
| <b>Iridescent</b> | <b>Iridescence is the phenomenon of certain surfaces that appear to gradually change colour as the angle of view or the angle of illumination changes</b> |
|-------------------|---|

|                     |   |
|---------------------|---|
| <b>Refraction</b>   | The fact or phenomenon of light, radio waves, etc. being deflected in passing obliquely through the interface between one medium and another or through a medium of varying density |
| <b>Interference</b> | a phenomenon in which two waves superpose to form a resultant wave of greater, lower, or the same amplitude   |

|                               |   |
|-------------------------------|---|
| <b>Mean curvature</b>         | an extrinsic measure of curvature that comes from differential geometry and that locally describes the curvature of an embedded surface in some ambient space such as Euclidean space |
| <b>Young-Laplace equation</b> | a nonlinear partial differential equation that describes the capillary pressure difference sustained across the interface between two static fluids, such as water and air            |
| <b>Surface tension</b>        | the tendency of liquid surfaces to shrink into the minimum surface area possible  |
| <b>Concave surface</b>        | a surface that curves inward, or is thinner in the middle than on the edges   |
| <b>Convex surface</b>         | a surface that is having an outline or surface curved like the exterior of a circle or sphere or is thinner in the edges than in the middle   |

A soap bubble is an extremely thin film of soapy water enclosing the air that forms a hollow sphere with an iridescent surface. Soap bubbles usually last for only a few seconds before bursting, either on their own or on contact with another object. They are often used for children's enjoyment, but they are also used in artistic performances. Assembling several bubbles results in foam. When light shines onto a bubble it appears to change colour. Unlike those seen in a rainbow, which arise from differential refraction, the colours seen in a soap bubble arise from interference of light reflecting off the front and back surfaces of the thin soap film. Depending on the thickness of the film, different colours interfere constructively and destructively.



### Mathematics

Soap bubbles are physical examples of the complex mathematical problem of minimal surface. They will assume the shape of least surface area possible containing a given volume. A true minimal surface is more properly illustrated by a soap film, which has equal pressure on inside as outside, hence becoming a surface with zero mean curvature. A soap bubble is a closed soap film: due to the difference in outside and inside pressure, it is a surface of *constant* mean curvature. While it has been known since 1884 that a spherical soap bubble is the least-area way of enclosing a given volume of air (a theorem of H. A. Schwarz), it was not until 2000 that it was proven that two merged soap bubbles provide the optimum way of enclosing two given volumes of air of different size with the least surface area.

### Merging (Physics)

When two bubbles merge, they adopt a shape which makes the sum of their surface areas as small as possible, compatible with the volume of air each bubble encloses. If the bubbles are of equal size, their common wall is flat. If they aren't the same size, their common wall bulges into the larger bubble, since the smaller one has a higher internal pressure than the larger one, as predicted by the Young-Laplace equation. At a point where three or more bubbles meet, they arrange themselves out so that only three bubble walls meet along a line. Since the surface tension is the same in each of the three surfaces, the three angles between them must be equal to  $120^\circ$ . Only four bubble walls can meet at a point, with the lines where triplets of bubble

walls meet separated by  $\cos^{-1}(-1/3) \approx 109.47^\circ$ . All these rules, known as Plateau's laws, determine how a foam is built from bubbles.

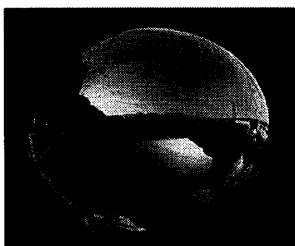
### Stability

The longevity of a soap bubble is limited by the ease of rupture of the very thin layer of water which constitutes its surface, namely a micrometer-thick soap film. It is thus sensitive to:

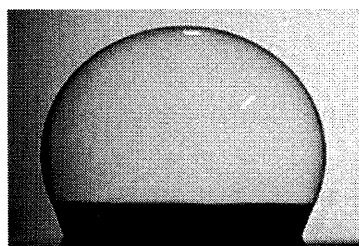
- Drainage within the soap film: water falls down due to gravity. This can be slowed by increasing the water viscosity, for instance by adding glycerol. Still, there is an ultimate height limit, which is the capillary length, very high for soap bubbles: around 13 feet (4 meters). In principle, there is no limit in the length it can reach.
- Evaporation: This can be slowed by blowing bubbles in a wet atmosphere, or by adding some sugar to the water.
- Dirt and fat: When the bubble touches the ground, a wall, or our skin, it usually ruptures the soap film. This can be prevented by wetting these surfaces with water (preferably containing some soap).

### Wetting

When a soap bubble is in contact with a solid or a liquid surface wetting is observed. On a solid surface, the contact angle of the bubble depends on the surface energy of the solid. A soap bubble has a larger contact angle on a solid surface displaying ultra-hydrophobicity than on a hydrophilic surface. On a liquid surface, the contact angle of the soap bubble depends on its size - smaller bubbles have lower contact angles.



Soap bubbles can easily merge



A soap bubble wetting an ultra hydrophobic surface



A soap bubble wetting a liquid surface

### Medicine – Contact dermatitis

The composition of soap bubbles' liquid has many recipes with slightly different ingredients. The most common one contains 2/3 cup of dishwashing soap, 1 gallon of water, 2/3 tablespoon of glycerin. Because of the presence of dishwasher soap, it's not uncommon for children to contact dermatitis on face, hands with consequences as rashes, swelling of the eyes, vomiting and dizziness.

### Freezing

If soap bubbles are blown into air that is below a temperature of  $-15\text{ }^{\circ}\text{C}$  ( $5\text{ }^{\circ}\text{F}$ ), they will freeze when they touch a surface. The air inside will gradually diffuse out, causing the bubble to crumble under its own weight. At temperatures below about  $-25\text{ }^{\circ}\text{C}$  ( $-13\text{ }^{\circ}\text{F}$ ), bubbles will freeze



Frozen soap bubble on snow

in the air and may shatter when hitting the ground. When a bubble is blown with warm air, the bubble will freeze to an almost perfect sphere at first, but when the warm air cools, and a reduction in volume occurs, there will be a partial collapse of the bubble. A bubble, created successfully at this low temperature, will always be rather small; it will freeze quickly and will shatter if increased further. Freezing of small soap bubbles happens within 2 seconds after setting on snow (at air temperature around  $-10\text{...}-14\text{ }^{\circ}\text{C}$ ).

### TASK 1 :Read the text and find out who I am

| Sl. No. | Hint  | Who am I?   |
|---------|---|-------------|
| 1.      | I am an extremely thin film of soapy water. | Soap bubble |

|           |   |  |
|-----------|---|--|
| <b>2.</b> | I am a curved band of different colours that appears in the sky when the sun shines through rain. |  |
| <b>3.</b> | I am a mass of small air bubbles on the surface of a liquid.                                      |  |
| <b>4.</b> | I am the process of a liquid changing or being changed into a gas.                                |  |
| <b>5.</b> | I am the feeling that everything is spinning around you and that you are unable to balance.       |  |

**TASK 2: Locate the ANTONYMS of the following words from the text.**

| <b>WORD</b>           | <b>ANTONYM</b> |
|-----------------------|----------------|
| <b>Displeasure</b>    | enjoyment      |
| <b>unimaginative</b>  |                |
| <b>constructively</b> |                |
| <b>Inconstant</b>     |                |
| <b>Drying</b>         |                |
| <b>instability</b>    |                |

### **I. Read to be Ready**

Bubbles can be effectively used to teach and explore a wide variety of concepts to even young children. Flexibility, colour formation, reflective or mirrored surfaces, concave and convex surfaces, transparency, a variety of shapes (circle, square, triangle, sphere, cube, tetrahedron, and hexagon), elastic properties, and comparative sizing, as well as the more esoteric properties of bubbles listed on this page. Bubbles are



useful in teaching concepts starting from two years old and into college years. A bubble is made of transparent water enclosing transparent air. However, the soap film is as thin as the visible light wavelength, resulting in interferences. This creates iridescence which, together with the bubble's spherical shape and fragility, contributes to its magical effect on children and adults alike. Each colour is the result of varying thicknesses of soap bubble film. Adding coloured dye to bubble mixtures fails to produce coloured bubbles, because the dye attaches to the water molecules as opposed to the surfactant. Therefore, a colourless bubble forms with the dye falling to a point at the base.

|  |   |
|--|---|
|  | What are the scientific concepts you have learnt through soap bubbles?  |
|  | What have you understood of iridescence?                                |
|  | Can you give examples of transparent elements other than water and air? |
|  | What defines the different colours in the bubble?                       |
|  | Do you like soap bubbles? If Yes, why? If NO, why not?                  |

## II. Frame 'Wh' Questions to the answers given below

|           |   |
|-----------|---|
|           | <b>Answer: Foam</b>   |
|           | <b>Question: What is produced when assembling several soap bubbles?</b> |
| <b>1.</b> | <b>Ans: Soap bubbles lasts for a few seconds.</b>                       |
|           | <b>Que:</b>   |
| <b>2.</b> | <b>Ans: Interferences of different colours</b>                          |
|           | <b>Que:</b>   |

|    |                              |
|----|------------------------------|
| 3. | Ans: constant mean curvature |
|    | Que:                         |
| 4. | Ans: When two bubbles merge  |
|    | Que:                         |
| 5. | Ans: Evaporation             |
|    | Que:                         |

### III. Discuss answers for the following in pairs and write it down

1. If you are a soap bubble seller, how will you sell it effectively? Demonstrate.
2. Share your memorable experiences with soap bubbles from your childhood to the present.
3. Can you connect the characteristics of the soap bubble with any other object? Present it effectively

SOURCE PASSAGE : "TOO BAD!":  
AN INTRODUCTION TO ROBOTICS AND ARTIFICIAL INTELLIGENCE

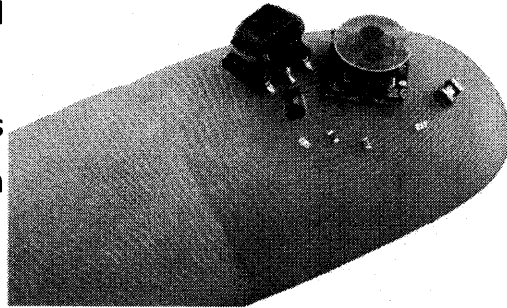
#### Key Terms

|                   |  |
|-------------------|--|
| Miniaturization   | Size reduction   |
| Radiation therapy | a therapy using ionizing radiation, generally as part of cancer treatment to control or kill malignant cells |
| Planck's constant | a quantum of electromagnetic action that relates a photon's energy to its frequency                          |

|                   |   |
|-------------------|---|
| Quantum mechanics | a fundamental theory in physics, which describes the physical properties of nature on an atomic scale   |
| Pinheaded         | a form of electrical connector  |
| Anthropomorphism  | the attribution of human traits, emotions, or intentions to non-human entities  |
| Quanta            | the plural form of quantum. In physics, a quantum is the minimum amount of any physical entity involved in an interaction.  |
| Brownian motion   | the random motion of particles suspended in a fluid (a liquid or a gas) resulting from their collision with the fast-moving molecules in the fluid  |
| Electron          | a subatomic particle, whose electric charge is negative one elementary charge   |
| Laser beam        | a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. The term "laser" originated as an acronym for "light amplification by stimulated emission of radiation" |
| Recoil            | the backward movement of a gun when it is discharged (often called knockback, kickback or simply kick)  |

### **THE THREE LAWS OF ROBOTICS**

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given it by human beings except where that would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.



Dr. Gregory Arnfeld is a robotic scientist, living in the twenty second century. He is an expert in miniaturisation. He suffers inoperable cancer and refuses any chemical treatment or radiation therapy. Arnfeld believes that his robotic invention Mike, a microbat, can cure him better than any other treatments. His wife Tertia reminds him that there are a lot of ways to cure cancer in the twenty second century that they live in. But he reassures, "Yes, but Mike is one of them, and I think the best." Tertia retaliates, "how certain are you of miniaturization? That's an even newer technique than robotics." Arnfeld replies, "The miniaturisation boys can reduce or restore Planck's constant in a reasonably precise manner, and those controls are built into Mike. He can make himself smaller or larger without affecting his surroundings." Arnfeld is proud of this experiment, as his name will be engraved in the history as the principal designer of Mike. But he says, "My greatest feat will be that of having been successfully treated by a minirobot—by my own choice, by my own initiative." "It's dangerous," says Tertia, his wife. He responds, "There's danger to everything. Chemicals and radiation have their side effects." He is happy that even if it fails, it will be a glorious experiment.

When Tertia wants to have more clarity on what is to happen, Louis Secundo, of the miniaturization group, says, "We can't guarantee success. Miniaturization is intimately involved with quantum mechanics, and there is a strong element of unpredictability. As MIK-27 reduces his size, there is always the chance that a sudden unplanned re-expansion will take place, naturally killing the patient. The greater the

reduction in size and the tinier the robot becomes, the greater the chance of re-expansion. And once he starts expanding again, the chance of a sudden accelerated burst is even higher. The re-expansion is the really dangerous part." When Tertia enquires about the risk level, Secundo says, "The chances are it won't, Mrs. Arnfeld. But the chance is never zero." "What if Mike makes a mistake or reduces himself too far because of a glitch in the mechanism? Then re-expansion would be certain, wouldn't it?" asks Tertia. He replies, "It remains statistical. The chances improve if he gets too small. But then the smaller he gets, the less massive he is, and at some critical point, Mike will become so insignificant and the programme will send him flying off at nearly the speed of light." Anxious Tertia asks, "Well, won't that kill the doctor?" The scientist assures, "No. By that time, Mike would be so small he would slip between the atoms of the doctor's body without affecting them." Mike would re-expand within seconds, but by the time he re-expanded, he would be a hundred thousand miles away in outer space and the explosion that results would merely produce a small burst of gamma rays for the astronomers to puzzle over. In addition, MIK-27 will have his instructions and he will not reduce himself to smaller than the size needed to carry out his mission.

It is coincidental and surprising that the chief designer of Mike, the Microbot, becomes his first patient. Mrs. Arnfeld discloses to the media that the present condition of Dr. Arnfeld is the result of a predisposition and there have been others in his family who have had it. For this reason, they have no children and Dr. Arnfeld devotes his life to produce a robot that is capable of miniaturisation.

Ben Johannes, a co-worker with Dr. Arnfeld for five years, takes Mrs. Arnfeld to the robot's quarters. Mike says, in his curiously neutral voice, which is smoothly average to be quite human, "I am pleased to see you, Mrs. Arnfeld." Mrs. Arnfeld had seen Mike soon after his construction, when he was undergoing the primary tests, and Mike remembered her. He is not a well-shaped robot. He looks pinheaded and very bottom heavy. He was almost conical. Mrs. Arnfeld knows that it is because his miniaturization mechanism is bulky and abdominal and because his brain has to be abdominal as well in order to increase the speed of response. It is an unnecessary anthropomorphism to insist on a brain behind a tall cranium, her husband had explained. Yet it makes Mike seem ridiculous, almost moronic. He represents the psychological

advantages to anthropomorphism too. When Mrs. Arnfeld ask whether he has understood the task, he says, "I will see to it that every vestige of cancer is removed." Mike has the ability to recognise a cancer cell when he is at the proper size. He can quickly destroy the nucleus of any cell that is not normal. He further says proudly, "I am laser equipped, Mrs. Arnfeld." Mrs. Arnfeld is still not convinced and she continues to question, "How long will it take to get them one by one?" Johannes intervenes and tells, "Even though the cancer is widespread, it exists in clumps. Mike is equipped to burn off and close capillaries leading to the clump, and a million cells could die at a stroke in that fashion. He will only occasionally have to deal with cells on an individual basis."

Johannes further informs that this process would take hours and every next moment will increase the chance of re-expansion. But Mike confidently guarantees, "Mrs. Arnfeld, I will labor to prevent re-expansion. By monitoring my size and making an effort to keep it constant, I can minimize the random changes that might lead to a re- expansion. Naturally, it is almost impossible to do this when I am actually re-expanding under controlled conditions." Understanding the danger involved, Mrs. Arnfeld expresses her anxiety regarding the safety of her husband and Mike says solemnly, "The laws of robotics ensure that I will, Mrs. Arnfeld." Johannes further comforts that there is a holosonogram and a detailed cat scan of the area. Mike knows the precise location of every significant cancerous lesion. Most of his time will be spent searching for small lesions undetectable by instruments. Mike is strictly instructed as to how small to get and he will not get smaller beyond that. As a microbot, he obeys orders. Johannes explains the re-expansion process, "Tertia, we're in the lap of the quanta. There is a more reasonable chance that he will get out without trouble. Naturally, we will have him re-expand within Gregory's body as little as possible – just enough to make us reasonably certain we can find and extract him. He will then be rushed to the safe room where the rest of the re-expansion will take place."

The observation room is underground and half-a-mile away from the viewing room. There are three miniaturists working on this experiment. If anything untoward happens, that will take the lives of the three miniaturists as well. So the miniaturists are very careful in handling this procedure. From the observation room, Mrs. Arnfeld

watches the miniaturisation procedure and sees Mike growing smaller and disappear. She sees the procedure of injecting Mike into the body of Dr. Arnfeld and his movement through his tissues by way of his bloodstream. Every move is captured and shown in holosonogram, which is a three-dimensional representation, cloudy and unfocused, made imprecise through a combination of the finite size of the sound waves and the effects of Brownian motion. Mrs. Arnfeld reaches a stage where she could not hold it further. She is sedated and she slept until evening. When she wakes up, Johannes is near her and she reveals the happy news, "Success, Tertia. Complete success. Your husband is cured. We can't stop the cancer from recurring, but for now he is cured."

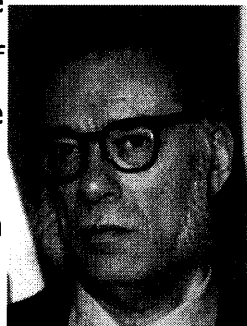
After two days, she is able to meet and talk to her husband Dr. Arnfeld. She says happily, "They can't find a trace of cancer in you." But he says, "Well, we can't be too confident about that. There may be a cancerous cell here and there, but perhaps my immune system will handle it, especially with the proper medication, and if it ever builds up again, which might well take years, we'll call on Mike again." On saying this, he wants to see and thank Mike for the wonderful thing that he has done for his life. There Mrs. Arnfeld reveals the news, "Actually, dear, Mike is not available." Shocked Dr. Arnfeld asks, "Not available! Why not?" His wife replies, "He had to make a choice, you see. He had cleaned up your tissues marvellously well; he had done a magnificent job, everyone agrees; and then he had to undergo re-expansion. That was the risky part. Mike decided to minimize the risk. he decided to make himself smaller." Unbelievably he cries, "What! He couldn't. He was ordered not to." But the wife says, "That was Second Law, Greg. First Law took precedence. He wanted to make certain your life would be saved. He was equipped to control his own size, so he made himself smaller as rapidly as he could, and when he was far less massive than an electron he used his laser beam, which was by then too tiny to hurt anything in your body, and the recoil sent him flying away at nearly the speed of light. He exploded in the outer space. The gamma rays were detected." Dr. Arnfeld stares at her and says, "But I didn't want that. I wanted him safe for further work. My life was less important than his." "Not to me, dear. Not to those who work with you. Not to anyone. Not even to Mike," says his wife putting her hands out to him. Pushing aside her hands, he says, "You don't understand. Oh, too bad. Too bad!"

**- Abridged version of the short story "Too Bad" by Isaac Asimov**



Isaac Asimov

Isaac Asimov is a remarkable American figure in science fiction. He is a writer and Biochemist. He is a prolific writer of science fiction and science books. He has edited or wrote more than 500 volumes. He is known for his *Foundation* and *Robot Series*. He became popular with his short story "Nightfall" (1941), which talks of a planet in a multiple-star system which experiences darkness only one night in every 2049 years. This short story brought him to the forefront among the science fiction writers and it is considered as one of the best short stories of this genre. He developed a set of ethics for robots and rejected the idea that robots are marauding metal monsters, which changed the way the subject was treated by other writers. Using the pseudonym Paul French, he wrote science stories for children in the series *Lucky Starr* (1952-58), each volume of this series took place on a different world of the solar system.



than  
He  
talks

Source: <https://www.britannica.com/biography/Isaac-Asimov>

**I. Find the missing letters and write the word**

|   | r | a | d | i | a | t | i | o | n | Radiation |
|---|---|---|---|---|---|---|---|---|---|-----------|
| 1 | q |   |   | a | n |   | u |   |   |           |
| 2 | a |   |   | r |   | n | m |   | s |           |
| 3 | n | h | o | o | o |   | h | s |   |           |
| 4 |   | o | o | o | o |   |   | a |   |           |
| 5 | c |   |   | a |   | i | u |   |   |           |

**II. Fill the following blanks with suitable words (not from the text)**

Dr. Gregory Arnfeld suffers \_\_\_\_\_ cancer and \_\_\_\_\_ any chemical treatment or radiation \_\_\_\_\_. Arnfeld believes that his robotic \_\_\_\_\_ Mike can \_\_\_\_\_ him better than any other \_\_\_\_\_. His wife Tertia reminds him that there are a lot of ways to \_\_\_\_\_ cancer. But he \_\_\_\_\_, "Yes, but Mike is one of them, and I think the \_\_\_\_\_." Tertia \_\_\_\_\_, "how \_\_\_\_\_ are you of miniaturization? That's an even newer \_\_\_\_\_ than robotics." Arnfeld replies, "The

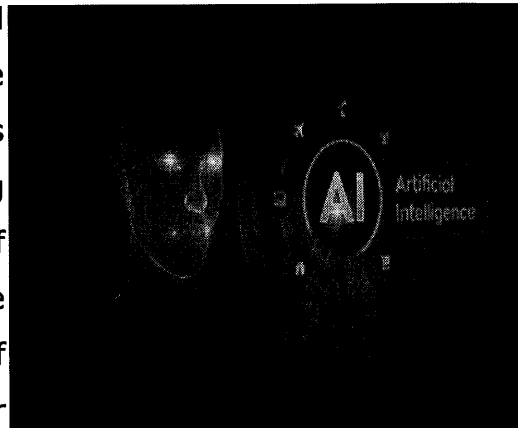


miniaturisation boys can reduce or \_\_\_\_\_ Planck's constant in a reasonably \_\_\_\_\_ manner, and those controls are \_\_\_\_\_ into Mike. He can make himself smaller or larger without \_\_\_\_\_ his surroundings." Arnfeld is \_\_\_\_\_ of this experiment, as his name will be \_\_\_\_\_ in the history as the principal \_\_\_\_\_ of Mike. But he says, "My greatest \_\_\_\_\_ will be that of having been successfully \_\_\_\_\_ by a minirobot—by my own choice, by my own \_\_\_\_\_." "It's \_\_\_\_\_," says Tertia, his wife.

III. Read to be Ready (Read the passage aloud and take notes)

### ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. The term may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem-solving. The ideal characteristic of artificial intelligence is its ability to rationalize and take actions that have the best chance of achieving a specific goal. When most people hear the term artificial intelligence, the first thing they usually think of is robots. That's because big-budget films and novels weave stories about human-like machines that wreak havoc on Earth. Artificial intelligence is based on the principle that human intelligence can be defined in a way that a machine can easily mimic it and execute tasks, from the most simple to those that are even more complex. The goals of artificial intelligence include learning, reasoning, and perception. The applications for artificial intelligence are endless. The technology can be applied to many different sectors and industries. AI is being tested and used in the healthcare industry for dosing drugs and different treatment in patients, and for surgical procedures in the operating room. Other examples of machines with artificial intelligence include computers that play chess and self-driving cars. Weak AI tends to be simple and single-task oriented, while strong AI carries on tasks that are more complex and human-like.



1. What are the goals of artificial intelligence?

2. What is artificial intelligence based on?

3. Which are the sectors that use AI in the present?

4. Define weak and strong AI.

5. Do you think it is a good idea to programme human intelligence in machines? If so, what are the traits that can be programmed?

#### Explore the Text

1. Why did Greg refuse chemical and radiation therapy?

2. Why is re-expansion considered dangerous?

3. Why did Mike disobey the instruction programmed in him?

4. Was Johannes supportive to Mrs. Arnfeld?

5. What is the safe room used for?

#### IV. Discuss the following questions and put forth your ideas to the class

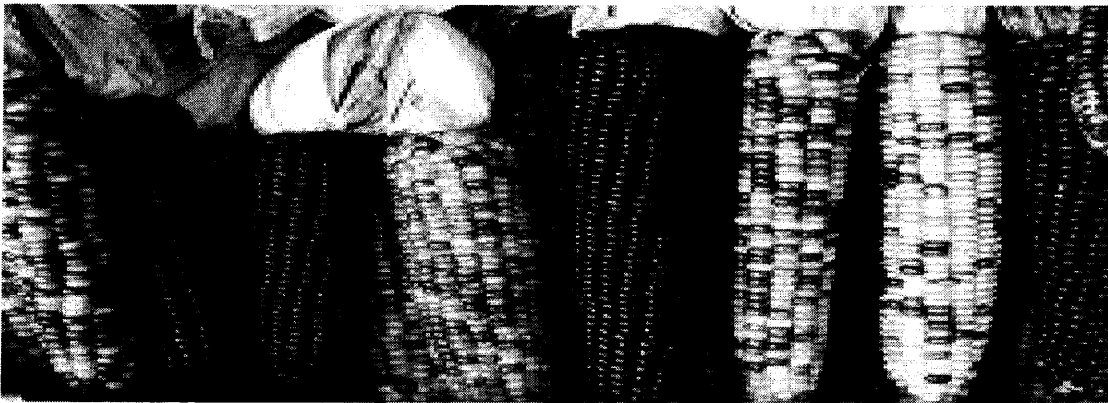
1. Are we becoming too dependent on robots? Justify your answer

2. Can Artificial Intelligence replace human intelligence? State reasons.
3. Do you think creating robots with human thinking skills is a good idea?
4. If you get a chance to change the climax of the story, would you save Mike or Greg or both or neither?
5. What kind of robot will you create in future if you get a chance? Why?

## Biomass and Biofuels



Fuels in use today, like coal and oil, are made from fossils, plants, and animals which died thousands of years ago. Biofuels are fuels made from crops which have just been harvested and from biomass, which contains chemical energy stored from the sun. **Biofuel** (also called agrofuel) is an abbreviation for bio-organic fuel. It describes any plant or animal which can burn and be used for fuel.



Trucks,  
cars, and  
busses and  
other

vehicles used for transportation need clean-burning fuels. They have internal combustion engines. The fuel in a liquid state is more portable and easily pumped. Petroleum is used today. It is a **fossil fuel**. Coal and wood are also, used for energy but produce much more pollution in the atmosphere. They are fossil fuels too, made from dead plants and animals of long ago. Wood and its byproducts can now be converted into biofuels such as wood gas, methanol or ethanol fuel.

The goal for all the production of energy is to turn away from the use of fossil fuels. **Biomass** from which biofuel is made includes products like wood, sugar cane, manure and waste from agriculture. Biomass is a storehouse of the sun's energy. If it is handled wisely, more will be produced indefinitely. Fossil fuels may at some point run out. Chlorophyll from plants takes carbon dioxide from the air and combines it with water to form carbohydrates. When these carbohydrates are burned, they release the stored energy.

However, recent discoveries have shown that there is a more efficient way to get energy from biomass rather than burning it. It can be turned into liquid fuels or heated to produce gases which will burn. Willow trees and willow grass are grown specifically to be used to produce energy. Some plants can be grown only for producing energy. Energy can be found also in the by-products or waste products from plants used for other purposes. The products used for energy purposes vary from region to region depending on climate and other conditions.

**Power crops** which produce energy directly can be grown on large farms. Trees and grasses are the most readily available, although corn is starting to be used. Some trees may grow back very quickly after being cut down to the ground. This process is called **coppicing**. They can be harvested every three to eight years. They can grow as much as forty feet in that space of time. Poplar, willow and black locust, which grow in the cool, wet areas of the northern states, are the best choice for '**short-rotation woody crops**' there. Sycamore and sweet gum trees are used in the warm Southeast. Eucalyptus accomplishes the purpose in Florida and California.

Corn and sorghum are grown mainly for food, but in the United States corn provides most of the liquid biofuel. However, because it must be planted, fertilized and harvested every year, it is not the best source for biofuels. Soybeans and sunflowers produce oil which can be used to make biofuel. However, just like corn, much maintenance is required each year to produce a crop of soybeans and sunflowers. **Microalgae** is another type of crop with oil. This may have the potential for the future of biofuel.

For many years, the way to produce energy from biofuels has been to burn it. However, during this process, energy can be lost or wasted, and some pollution can occur. A new process called '**co-firing**' now is being used. Coal is mixed with up to twenty percent of a biomass product in a boiler in a power plant. Operating costs will be lower, less pollution will occur, and energy will be saved. In Iowa, the Department of Energy and a local energy company have begun using switchgrass to substitute for a certain percentage of the coal. The project has worked well. Biomass can also be used to substitute for petroleum in many other products.

Source : <http://www.softschools.com/>

**Read the above passage and answer the questions given below**

**State whether the following sentences are TRUE or FALSE**

1. Biomass contains solar energy.
2. Grass is not used to make biofuel.
3. Wood is both a fossil fuel and a biofuel

**Fill in the blanks with the correct word from the passage**

1. Biofuels are converted into energy by the process of \_\_\_\_\_.
2. \_\_\_\_\_ can be used as an alternative to petroleum in many products.
3. \_\_\_\_\_ is a power crop that is easily available.

**Write a sentence describing the given words from the context of the passage**

1. Potential
2. Accomplishes
3. Substitute
4. Efficient

**Write a short paragraph detailing the similarities and differences between Biomass and biofuels**

## **UNIT 4**

### **SOURCE PASSAGE-1: THE MYSTERY OF THE BLACK HOLE**

#### **Pre Reading: Vocabulary Enrichment**

New words and concepts

Gravity- a force of attraction that exists between any two masses

Relativity-the notion that the laws of physics are the same everywhere

Principle- a general scientific theorem or law

ultimate- being the best

phenomenon- a fact or an event in nature, which is not fully understood

A black hole comes from the death of a large star (at least 10 times bigger than our Sun) exploding at the end of its life in a supernova. The Sun, being too small, won't ever become a black hole, it will expand, contract and cool off in its death process. This is a simple explanation of what a black hole is and how astronomers identify them. The constant fusion of hydrogen to helium creates the energy and radiation from a star. A star is in a stable state for most of its life as the energy pushing out from the star balances with the gravitational force pulling in.

At the end of a star's life, stars like our Sun will continue fusing elements together like helium to carbon, carbon to neon, but not much further. Large stars will continue fusing elements until the star reaches iron. Iron is a very stable element, and gravity alone cannot compress it further. Iron builds up in the core, and the internal pressure of energy radiating outwards becomes out of balance with the pressure of gravity pulling inwards. The outer layers of the star are no longer supported by the radiation pressure of nuclear fusion, and the star's gravity pulls the outer layers into the core. When the incompressible core connects with the outer layers, a shockwave is sent through the densely packed star, which results in the fusion of other elements on the periodic table after iron.

Now the energy being released overwhelms the pressure of gravity, and the collapsing star explodes in a supernova, the largest explosion known. The lighter outer layers are flung off into space, and the remaining core can create a black hole. A black hole has so much mass tightly packed into a small space that, close up, its gravity is so strong that nothing nearby can escape it. To get away from a black hole, you'd have to travel faster than the speed of light, which isn't possible. The Cygnus X-1 black hole formed when a large star caved in. It is pulling matter from the nearby blue star.

Astronomers observe black holes by watching the light from stars in the background warp as the gravity of the black hole pulls on the light. They also observe stars as they cross the 'event horizon' (the point of no return) and the radiation emitting from the black hole. But not everything gets pulled into the black hole. There is an orbital pattern to objects near some black holes. They get close to the black hole and then are 'flung' out again.

The 'black' part of the black hole is the event horizon. If an object breaches the event horizon and approaches the singularity it will become 'spaghettified' – stretched and pulled apart by the black hole's gravitational forces. Scientists think that in the middle of the black hole is a 'singularity'. It's

at this point in the black hole discussion that classical physics principles can no longer be applied (it stops making sense in this context) and quantum mechanics takes over. The theory is that the singularity is an infinitely small point where gravity and density are also infinite. The black hole is packed with all the heavy elements from the star but in a much smaller space. Imagine the mass of a star 10 times the size of our Sun compressed into something the size of a city.

Black holes are fascinating because there is so much we don't know. It's an area ripe for investigation, and NASA is doing just that. There is a NASA campaign under way that aims to understand black holes further. From 5–14 April, astronomers used a network of radio telescopes to look at the gigantic Sagittarius A\* black hole located at the centre of our galaxy. These telescopes were all pointing towards Sagittarius A\* and worked together to create the first photo of a black hole. The data from the radio telescopes will be converted into an image. At the time of writing this article, the photo had not been released.

**TASK 1** Answer the following questions

- How are black holes formed?  
.....
- How do you observe black holes?  
.....
- Explain the Cygnus X-1 black hole.  
.....
- What is Spaghettification?  
.....

**TASK 2** Reading Activity

Match the two columns (Refer Para No: 5)

**PART A**

**PART B**



|   |   |
|---|---|
| <p style="text-align: center;">1</p> <p>The 'black' part of the black hole is</p>         | <p style="text-align: center;">A</p> <p>It will become</p>  |
| <p style="text-align: center;">2</p> <p>If an object breaches the event horizon</p>       | <p style="text-align: center;">B</p> <p>The event horizon</p>   |
| <p style="text-align: center;">3</p> <p>In the middle of the black hole</p>               | <p style="text-align: center;">C</p> <p>In a much smaller pace</p>  |
| <p style="text-align: center;">4</p> <p>'Spaghettified'</p>                               | <p style="text-align: center;">D</p> <p>Is a singularity</p>  |
| <p style="text-align: center;">5</p> <p>Black hole packed with all the heavy elements</p> | <p style="text-align: center;">E</p> <p>Stretched and pulled apart by the black hole's gravitational forces</p> |

### **TASK 3: Writing**

Write a summary of the text on the mystery of black holes

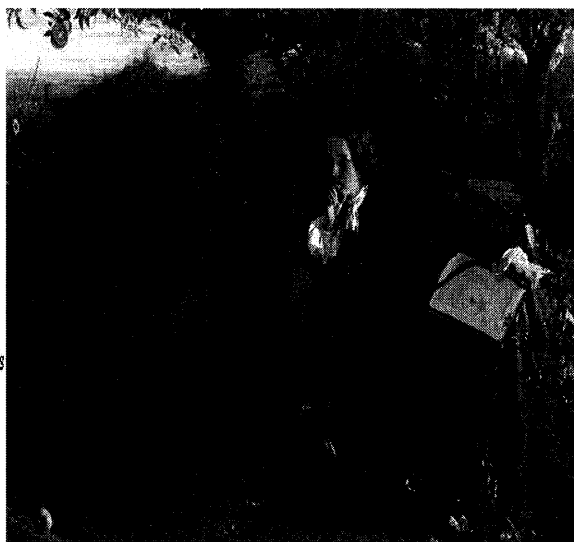
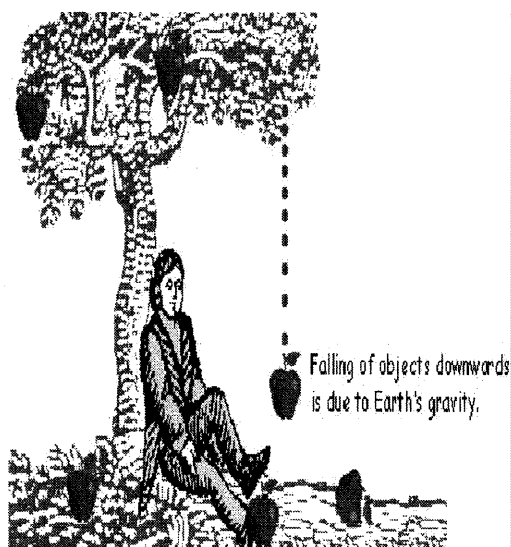
## **SOURCE PASSAGE II: GRAVITY**

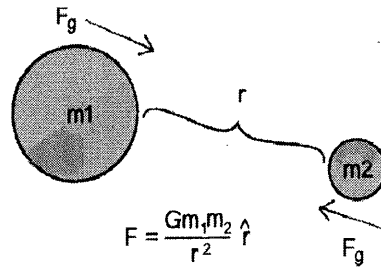
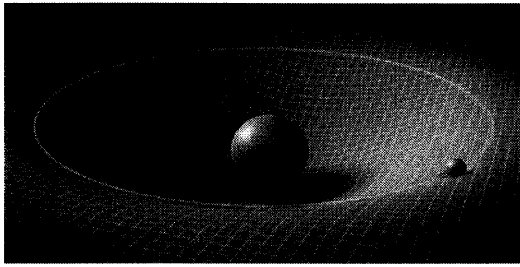
### **Pre Reading: Vocabulary Enrichment**

|                              |  |
|------------------------------|--|
| <b>Gravitational Lensing</b> | <b>Phenomena</b>                                     |
| <b>Thunderstorms</b>         | <b>Electrical Discharges</b>                         |
| <b>Gravity</b>               | <b>Earth Function Properly</b>                       |
| <b>Silicon</b>               | <b>Manufacture in Transistor</b>                     |
| <b>Copernicus</b>            | <b>Earth was not the focal point of the Universe</b> |
| <b>Ionization</b>            | <b>Diminish during the Overshadowing</b>             |
|                              |  |

### GRAVITY:

Sir Isaac Newton was a physicist and mathematician who discovered the gravity of nature's powers while researching. An apple inadvertently fell on his head as he was lightening up under the oak. He began to question at that moment about the natural force that drew the apple toward the ground. He assumed this is the force that keeps the moon on its orbit and helps the earth function properly. He called that force 'gravity' and he explained the gravity influence on all objects.





Universe formation extends beyond human rationality, creativity, and imagination. Understanding how it (universe) functions, moves and changes over time is subtle. In the past, the celebrated scientists made an outstanding effort to explain the universe, and yet it persists in the present. Isaac Newton is the first person to think about Gravity and everyone knows an apple is falling from the tree. The advent of the 'Gravity Theory' has stated that gravity influences everything in the universe. Consequently, in his "The Treatise of Human Nature," David Hume is another man who believed that 'scientific concepts should be based on experience and evidence rather than on reason alone.' He also indicated that time doesn't occur separately from object movement.

These philosophers lead to the study of relativity, Einstein himself wrote, "It is very possible that I would not have arrived at this solution without these philosophical studies." As a result of these ideas Albert Einstein has developed a new theory on two principles. First he said, 'for all observers, the laws of physics appear the same. Secondly, he calculated the speed of light remaining unchanged. The ultimate formation of relativity theory has emerged and he said time-space is one continuum; therefore, time and space cannot be separated from each other. For this Einstein describes that gravity falls in relative terms. Hence he said gravity bends light and the mathematical phenomena called 'Gravitational Lensing' emerges there.

**TASK 1** Answer the questions given below

1. How did Newton identify the gravitational force

.....

2. Explain the functionality of gravitational force with examples.

.....

**TASK 2** Writing Activity: Write five sentences about the significance of Newton's theory in Physics.

.....

.....

.....

.....

.....

### SOURCE: PASSAGE: 111 COSMIC RAYS

#### Pre Reading: Vocabulary Enrichment

**Inflatable** – capable of being filled with air

**Hypothesis** - a proposed explanation for a phenomenon

**Abatement** – the action of subsiding

**Obscuration** – the action of hiding something

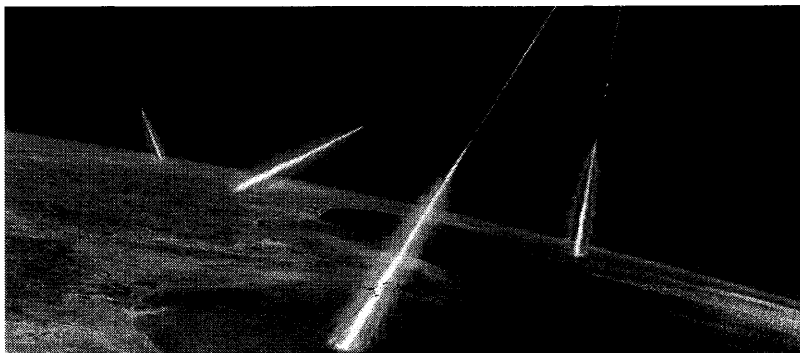
**Overshadowing** - to cover something **Contemplate** – to think

In 1911 and 1912 Austrian physicist Victor Hess made a progression of risings in an **inflatable** to take estimations of radiation in the climate. He was searching for the wellspring of an ionizing radiation that enrolled on an electroscope – the common **hypothesis** was that the radiation originated from the stones of the Earth. To test the hypothesis, in 1909 German researcher Theodor Wulf estimated the pace of ionization



close to the highest point of the Eiffel tower (at a stature of around 300 meters) utilizing a convenient electroscope. Despite the fact that he expected the ionization rate to diminish with stature, Wulf noticed that the ionization rate at the top was simply under a large portion of that at ground level – a substantially less huge **abatement** than foreseen.

Victor Hess' inflatable flights took such estimations further. In 1911 his inflatable arrived at a height of around 1100 meters, however Hess found "no fundamental change" in the measure of radiation contrasted and ground level. At that point, on 7 April 1912, Hess made a rising to 5300 meters during a close complete **obscuration** of the Sun. Since ionization of the air didn't diminish during the **overshadowing**, he **contemplated** that the wellspring of the radiation couldn't be the Sun it must be originating from farther in space. High in the air, Hess had found a characteristic **wellspring** of high-vitality particles: inestimable beams.



#### TASK 1: LISTENING:

- ❖ In this activity, the learners will listen to the passage carefully read by the teacher.
- ❖ Then they have to describe the facts or the content of the source text
- ❖ The instructor may ask some questions to test the listening skill of the students
- ❖ Listen carefully and answer the questions

#### TASK 2:

1. Who invented Cosmic Rays?
2. Write down the technical words that were used in the paragraph.

[REDACTED]

[REDACTED]

New words and concepts

Immigration- action of coming to live permanently in a foreign country

Deployed- move or equipment into position for military action

Malfunction- failure to function normally

depressurized- release the pressure of the gas inside a pressurized vehicle

Astronaut- a person who is trained to travel in a spacecraft

Shuttle- a spacecraft used to make repeated journeys between the Earth and space

Insulation- material used to retain the heat of an object

Plunge-dive nose down

The tragic loss of the space shuttle Columbia killed seven astronauts. One of those, Kalpana Chawla, was the first Indian-born woman in space.

Born in Karnal, India, on July 1, 1961, Chawla was the youngest of four children. The name Kalpana means "idea" or "imagination." Her full name is pronounced *CULL-puh-na CHAV-la*, though she often went by the nickname K.C.

Chawla obtained a degree in aeronautical engineering from Punjab Engineering College before immigrating to the United States and becoming a naturalized citizen in the 1980s. She earned a doctorate in aerospace engineering from the University of Colorado in 1988, having previously obtained her masters degree from the University of Texas. She began working at NASA's Ames Research Center the same year, working on power-lift computational fluid dynamics.

In 1994, Chawla was selected as an astronaut candidate. After a year of training, she became a crew representative for the Astronaut Office EVA/Robotics and Computer Branches, where she worked with Robotic Situational Awareness Displays and tested software for the space shuttles.

Chawla's first opportunity to fly in space came in November 1997, aboard the space shuttle Columbia on flight STS-87. The shuttle made 252 orbits of the

Earth in just over two weeks. The shuttle carried a number of experiments and observing tools on its trip, including a Spartan satellite, which Chawla deployed from the shuttle. The satellite, which studied the outer layer of the sun, malfunctioned due to software errors, and two other astronauts from the shuttle had to perform a spacewalk to recapture it.

### **Disaster strikes**

In 2000, Chawla was selected for her second voyage into space, serving again as a mission specialist on STS-107. The mission was delayed several times, and finally launched in 2003. Over the course of the 16-day flight, the crew completed more than 80 experiments.

On the morning of Feb. 1, 2003, the space shuttle returned to Earth, intending to land at Kennedy Space Centre. At launch, a briefcase-sized piece of insulation had broken off and damaged the thermal protection system of the shuttle's wing, the shield that protects it from heat during re-entry. As the shuttle passed through the atmosphere, hot gas streaming into the wing caused it to break up. The unstable craft rolled and bucked, pitching the astronauts about. Less than a minute passed before the ship depressurized, killing the crew. The shuttle broke up over Texas and Louisiana before plunging into the ground. The accident was the second major disaster for the space shuttle program, following the 1986 explosion of the shuttle Challenger.

The entire crew of seven was killed. In addition to Chawla, the crew included:

- Commander Rick D. Husband
- Pilot William C. McCool
- Payload Commander Michael P. Anderson
- Payload Specialist Ilan Ramon, the first Israeli astronaut
- Mission Specialists David M. Brown and Laurel B. Clark

Over the course of her two missions, Chawla logged 30 days, 14 hours, and 54 minutes in space. After her first launch, she said, "When you look at the stars and the galaxy, you feel that you are not just from any particular piece of land, but from the solar system."

### **Chawla's legacy**

The events of Columbia have been officially investigated and reported on to understand what happened and how to prevent the tragedy from re-occurring in future spaceflights. Examples include the Columbia Accident Investigation Board (2003) NASA's Columbia Crew Survival Investigation Report (released in 2008).

Several documentaries have been produced about the Columbia crew. Some examples include "Astronaut Diaries: Remembering the Columbia Shuttle Crew" (2005), and one that focused on Ilan Ramon, called "Space Shuttle Columbia: Mission of Hope" (2013).

The University of Texas dedicated a Kalpana Chawla memorial at the Arlington College of Engineering in 2010. At the time of its opening, the display included a flight suit, photographs, information about Chawla's life, and a flag that was flown over the Johnson Space Center during a memorial for the Columbia astronauts.

There have been several rumors about films in production concerning Chawla's life, including a rumour in 2017 that had the actress Priyanka Chopra (known for Baywatch and Quantico, as well as Bollywood films) attached to it. But in a Quora discussion in 2017, Chawla's husband — Jean-Pierre Harrison — said: "Until I issue a public statement confirming my participation in such a project, take it for granted that I have not signed any agreement nor licensed any rights necessary to produce such a movie."

*Additional reporting by Elizabeth Howell, Space.com contributor*

<https://www.space.com/17056-kalpana-chawla-biography.html>

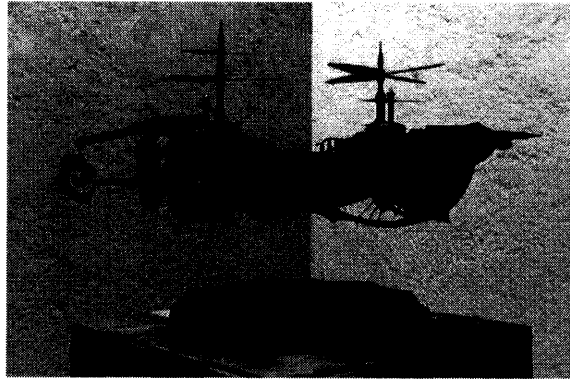
**TASK 1** Write a summary of the above passage in about 50 to 60 words

**TASK 2** Read the passage and answer the questions given below

1. Write any 3 achievements of Kalpana Chawla
2. What were the documentaries produced about the Columbian Crew?
3. What were the two major disasters of the space shuttle program?
4. Give two chief causes for the 2003 disaster
5. How was Kalpana Chawla honoured by the University of Texas?







The textual reference to pi dates back to 1900 BC. Both the Babylonians and Egyptians assessed the value of pi to be about roughly around  $25/8$  (3.125), and  $256/81$  (3.16) respectively. But, the undisputed credit of calculating the accurate value of pi that lies between 3.1408 and 3.14285, goes to the Ancient Greek mathematician Archimedes (287-212 BC). He arrived at this by finding the areas of two polygons: the polygon that was inscribed inside a circle, and the polygon in which a circle was circumscribed.

Chinese mathematician Zhu Chongzhi (AD 429-500) used an identical method to estimate the value of pi as  $355/113$ .

In the 15th century, Indian mathematician Madhavan of Sangamagramam discovered the much celebrated Madhava-Leibniz series (named after German mathematician Gottfried Leibniz, who rediscovered the series in the 17th century), an infinite series that converges to pi. Later, Madhavan calculated pi to 11 decimal places. Aryabhata calculated the circumference of the earth and used  $Pi = 22/7$  as a constant in the calculation around 5th century BC.

Subsequently, in 1707, a Welsh mathematician William Jones first used the Greek letter pi ( $\pi$ ) to denote the constant ratio. This Greek letter, which meant 'perimeter' in Greek, was popularized by a Swiss mathematician, Leonhard Euler.



In 1945, it was D. F. Ferguson, who calculated the value of pi to 620 digits which was the most accurate calculation even before the advent of the computer. Ferguson's accuracy grew by leaps and bounds with the aid of computer, which extended to 206,158,430,000 digits in 1999. By using Alexander Yee's y-cruncher program, in 2011, Shigeru Kondo created a record by accomplishing the longest calculation of pi to 10 trillion digits.

In the present times, the value of pi in decimal form, is approximately 3.14. But pi is an irrational number, meaning that its decimal form neither ends (like  $1/4 = 0.25$ ) nor becomes repetitive like  $1/6 = 0.166666\dots$ . So, the value of pi is restricted to only 18 decimal places, thus pi is 3.141592653589793238.)

**TASK 1** Read the passage and answer the questions given below

1. List out the names of Mathematicians mentioned in the given passage while tracing the growth of pi.
2. How did Archimedes calculate the value of pi?
3. Name the invention which is closely associated with pi?
4. What is meaning of pi in Greek?
5. What is the longest calculation achieved with the aid of computer program?

**Task 2:** Discuss in pairs and choose the correct answer

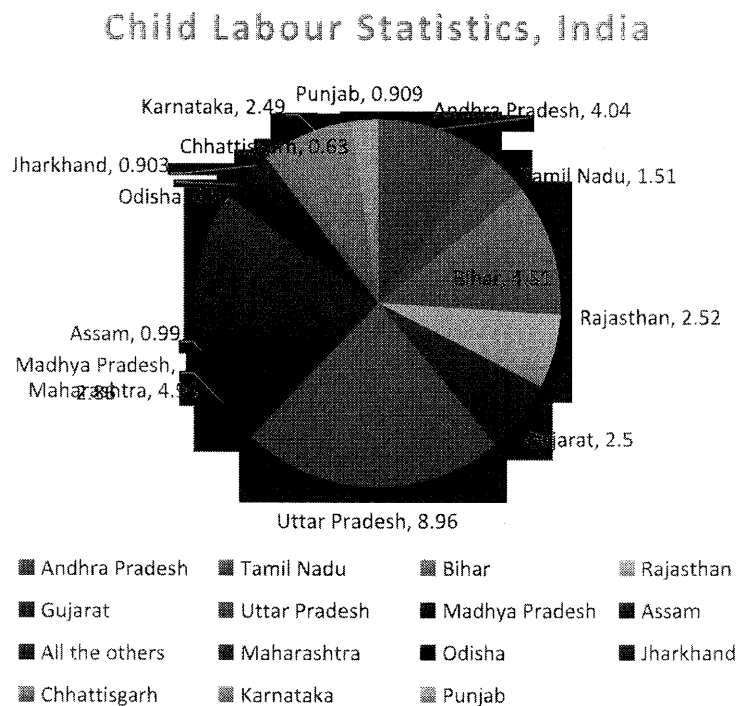
1. When is Pi Day celebrated around the world?  
A. 14 Feb    B. 14 March    C. 14 April    D. 15 March
2. What is the value of Pi?  
A. 3.14159    B. 3.14358    C. 3.14258    D. 3.14289
3. Which of the following statement is correct about Pi?  
A. It is non-repeating decimal value  
B. It is non-terminating decimal value  
C. It is repeating and terminating decimal value  
D. It is non-repeating, non-terminating decimal value

4. Who has calculated the circumference of the earth and considered the value of  $\pi = \frac{22}{7}$ ?  
 A. Archimedes                      B. John Machin's    C. Aryabhata    D. None of the above
  
5. Who was the first to use the Greek letter pi ( $\pi$ ) to denote the constant?  
 A. Leonhard Euler    B. William Jones    C. Mayans    D. Papyrus

**TASK 3: Interpret the given pie-chart and answer the questions below**

The pie-chart below provides the names of the states with the highest number of employed children (in lakhs).

1. Which state has the largest number of children working in it?
2. How many children in Tamil Nadu are child labourers?
3. Name three states that are not mentioned in the pie-chart and have a lower percentage of child labour.
4. Which state has 2.49 lakh children working as child labourers?
5. Name two states that have less than 1 lakh working children.



Data Source: Census, 2011

References: <https://labour.gov.in/childlabour/census-data-child-labour>

## OUR CLASS WILL STUDY THE HISTORY OF RADIO

**The History of Radio**

- The history of radio can be traced through the lives of these people:
  - Maxwell
  - Hertz
  - Heavyside
  - Marconi
  - DeForest
  - Armstrong
  - Farnsworth
  - Sarnoff



Standing on the beach in 1895, Marconi and Sarnoff experimenting with the wireless code signal across a room. (Read our book, The History of Radio, for the story of the wireless code signal and the wireless code signal.)

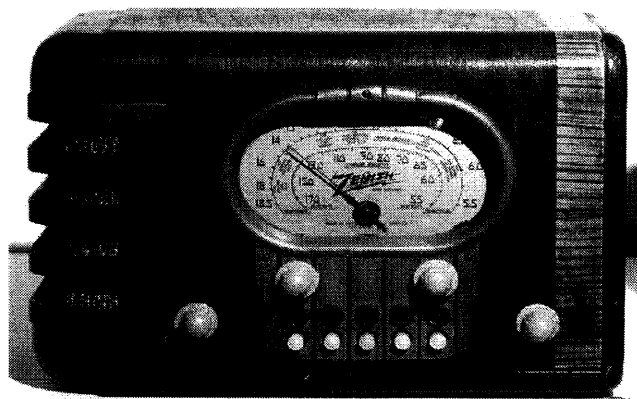
### Pre Reading: Vocabulary Enrichment

**Portable** – able to be easily carried

**Broadcast**- the act of transmitting sound or images by radio or television

**Compete**- strive to gain or win something by defeating or establishing superiority over others

The development of the telegraph and the telephone led eventually to the search for a way to communicate without wires. In 1865, James Clerk Maxwell thought that such communication could be possible through a layer of the atmosphere called the ether. In 1888, A German, Heinrich Hertz, proved that this theory was correct. He transmitted a wireless code signal across a room. In 1883-1884, Thomas Edison discovered the principle of the vacuum tube but did not know any application for it at that time.



Nicolas Tesla is the inventor of the wireless radio. However, Guglielmo Marconi did design a practical application for this invention. In 1901, he sent the first wireless message across the Atlantic Ocean. It was the Morse Code letter, S. This invention would soon **compete** with the undersea telegraph cables.

In 1900, Reginald Fessenden developed an electrolytic detector which could be used for the transmission of voices. He thought Marconi's vision for wireless communication was too limited. Along with Lee de Forest, he formed other wireless companies. They looked for new ideas to compete with Marconi's wireless transmission of code only. Marconi used the 'spark' technology.

Fessenden thought that wave technology could be used to transmit voice and music. He wanted to develop wireless telephony. By 1900, he developed a rotary spark transmitter. It could carry a voice for one mile. When sending a voice signal, the audio signal is first placed onto the radio frequency wave and then removed at the other end. Originally, the sound was not very clear. He thought a cleaner radio wave would make the voice clearer. He then developed a high-speed alternator instead of the rotary spark technology.

Fessenden partnered with a scientist from General Electric Company to create such an alternator. In December 1906, he could send voice and music several miles. DeForest also made some **broadcasts** of music and voice in 1907. He then developed a three-element vacuum tube called an audion. A new era for radio began.

In 1909, because of wireless communication, 1500 passengers were saved from drowning when the *Republic* sank. Other ships in the area were notified and provided rescue help. However, when the *Titanic* struck an iceberg in 1912, the wireless system in use showed fatal flaws. Interruption occurred from other radios which blocked communication with ships which might have come to the rescue of the *Titanic*. The Wireless Act of 1912 set standards for radio operations. During World War I, all non-governmental radio stations were shut down. The U.S. Navy took over radio.

The Radio Corporation of America was founded after the war by General Electric Company. It took over the Marconi Wireless Telegraph Company. In 1920, Westinghouse Corporation of Pittsburgh started a radio station just for entertainment. The first station was KDKA. Hundreds of new stations followed, as well as government regulation and licensing. Since AM radio experienced a lot of atmospheric noise, FM (frequency modulation) radio began. Transistor radios exploded in the 1950's. They became the mobile device for everyone. By 1979, most radio listening was to FM.

Satellite-digital radio came along in 2000-2001. Most radio stations today 'stream' their programming on the internet. MP3 **portable** digital devices which store music now are competing with radio music.

**TASK 1** Read the passage and answer the questions given below

1) Which of the following was the first radio station in the United States?

A: KDKA                      B: KOBG    C: KPAD    D: KPVC

2) Who is considered to be the inventor of wireless radio?

A: Thomas Edison B: Guglielmo Marconi C: Nicolas Tesla D: Reginald Fessenden

3) Who discovered the principle of the vacuum tube?

A: Guglielmo Marconi B: Thomas Edison C: Nicolas Tesla D: Reginald Fessenden

4) Which of the following radio companies was founded after WWI?

A: American Radio Company                      B: Radio Company of America  
C: United States Radio Company                      D: Radio Corporation of America

5) In which of the following cities did the first radio station begin?

A: Boston    B: New York              C: Pittsburgh              D: Cleveland

6) When is the World Radio Day celebrated?

A: 14<sup>th</sup> March    B: 13<sup>th</sup> February    C: 20<sup>th</sup> March    D: 13<sup>th</sup> March

**TASK 2** Speaking Activity:

- ↓ Students will select a topic that is of relevance to their subject and speak for 2 minutes before the class

**TASK 3** Listening:

- ↓ Listen to a Radio interview that will be played to you by the teacher and answer the questions relating to the interview

**UNIT V****Pythagorean Theorem and its application in GPS****Construction and Video game**

Learn the new words and their meanings

**Triangle****a plane figure with three straight sides and three angles**



|                 |  |
|-----------------|--|
| Hypotenuse      | the longest side of a right-angled triangle, opposite the right angle.   |
| Geometry        | the branch of mathematics concerned with the properties and relations of points, lines, surfaces, solids, and higher dimensional analogues.                  |
| Navigation      | The process or activity of accurately ascertaining one's position and planning and following a route   |
| GPS             | Global Positioning System, an accurate worldwide navigational and surveying facility based on the reception of signals from an array of orbiting satellites. |
| Semi Circle     | a half of a circle or its circumference.   |
| Data            | information processed or stored by a computer. This information may be in the form of text documents, images, audio clips, software program                  |
| Solar Physicist | Specializing in the study of the Sun.  |
| Video games     | an electronic game that involves interaction with a user interface to generate visual feedback on a two- or three-dimensional video display                  |

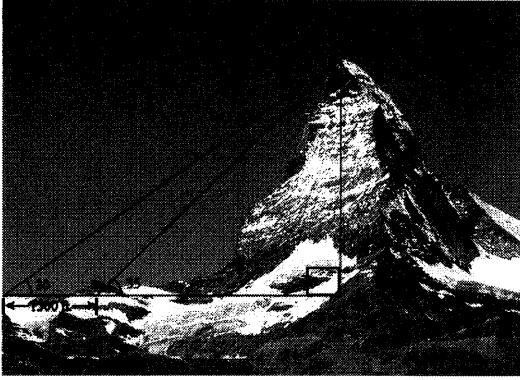
### Pre Reading activity

1. What is the Pythagorean theorem?
2. Can you give a brief history of the formulation of the Pythagoras Theorem?
3. Do you know where the principles of the Pythagorean theorem are used?
4. What is the name of the navigation system developed by India?
5. How many of you use Google maps?

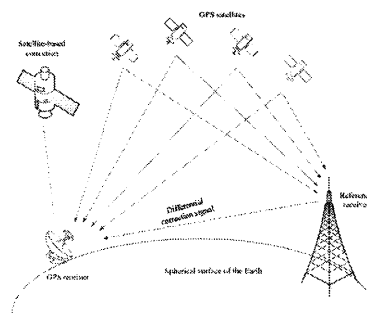
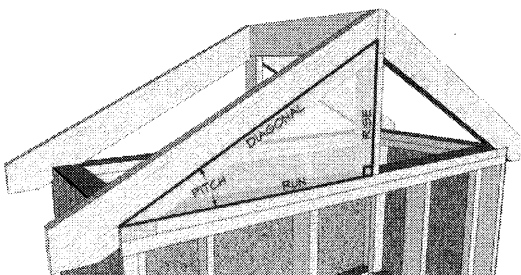
We study science for understanding the practical applications of it. Ancient Greek philosopher and mathematician Pythagoras identified that the square on the hypotenuse of a right-angled triangle is equal in area to the sum of the squares on the other two sides. The Pythagorean Theorem introduces the relationship between the two sides of a triangle that make the right angle and the long side or hypotenuse that connects them. The square of each of the legs added together will equal the square of the hypotenuse. The Pythagorean Theorem states that for any right triangle, the sum of the squares of the two legs is equal to the square of the hypotenuse.

Pythagoras's theorem has many practical applications directly associated with our everyday life like construction, Global Positioning System (GPS), data transfer, and Video games. In construction, it is useful in laying foundations for buildings by measuring the

right length and width. If the string lengths were measured correctly, the corner opposite the triangle's hypotenuse will be a right angle, so the builders will know that they are constructing their walls on the right lines. This theorem is useful in erecting proper beams to support the roof and to calculate the area of the roof. Architects and engineers extensively use the principles of this theorem for laying the foundation, constructing staircases and roofs.

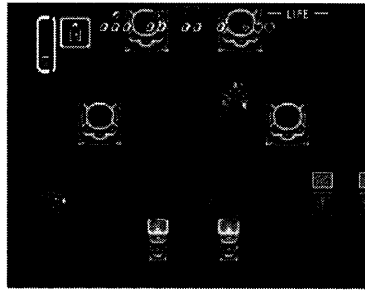


It will be surprising to know that this theorem functions as the basic principle of one of the most advanced inventions in human history, the navigation system. Now many countries have their navigation systems. The GPS of the United States America, GLONASS of Russia, Galileo of the European Union, BeiDou of China, QZSS of Japan, and NavIC of India are the operational navigation systems in the world today. These navigation systems guide aircraft, ships, and other vehicles accurately to reach their destination. In navigation, the Pythagorean theorem helps to calculate the distance between two points. The satellites orbiting the entire globe transmitting positioning and timing data all through the day. Navigation in three dimensions is the basic function of navigations systems used around the world. Navigation receivers in the aircraft, ships, and ground vehicles supply data to control systems over radio signals. The GPS of the USA is the most famous navigation system used almost all over the world. It uses a constellation of earth-orbiting satellites to send and receive data. Any navigation system uses signals from three different satellites to calculate the distance by performing triangulation activity. Navigation systems help in precise positioning and movement of objects. An Aircraft will use its altitude and its distance from destination to identify the right place to begin a descent to the airport. Navigation systems are used for military purposes in the past but now they are provided to all, hence we can use our smartphone to find out a destination or calculate distance.



Navigation and positioning systems are also useful for cartographers and makes their work in calculating distances between various places or calculating the steepness of mountains an accurate one. Cartographers calculate the numerical distances by the process of surveying before creating a map. To survey the uneven terrain is, surveyors use ways to take measurements of distance and height systematically. The principles of the Pythagorean theorem contribute to creating maps with accurate details of the terrain and distance between places.

Video games are quite popular nowadays, it will be surprising to many to know that even game developers use the principles of the Pythagorean theorem in creating the games. The movement of the objects in a game and boundaries for the movement of objects are determined by the principles of this theorem. The distance between two moving objects, the player and the enemy, and their speed are calculated employing the principles of the theorem.



When it comes to the transfer of data through the internet , the data is imagined to be pointed in space by the Computer programmers and Pythagoras's theorem is a way of calculating the right location of these points. It is also helpful in verifying that there is no corruption in the transmission of data which makes error-free downloading of information possible. This principle helps to create technology by which people listen to online music and watch videos. Pythagoras theorem, a statement in geometry, invented thousands of years ago remains to be the basis of technology used by engineers, architects, cartographers, aviators, sailors, computer programmers, and solar physicists. In the present day, TV sizes are measured on the diagonal, one can identify which size of the TV is suitable for a room using the principles of the theorem.

### Activity I. Word Search

Choose the correct definition of these words and expressions in italics in the context they are used in the text

1. useful in *erecting* proper beams to support...
  - (i) put together and set upright
  - (ii) stand straight
  - (iii) create
2. this theorem *functions* as the basic principle...
  - (i) celebrations
  - (ii) acts or works
  - (iii) a mathematical terminology
3. use its *altitude* and its distance...
  - (i) a settled way of thinking or feeling about something
  - (ii) height from the sea level
  - (iii) time traveled

### Activity II. Understanding Contextual the Usage of Words

Read the text and fill in the gaps with the following words

|                     |        |            |                     |
|---------------------|--------|------------|---------------------|
| Telescope           |        |            | length of the slope |
| Pythagorean theorem | Height | Hypotenuse | right angles        |

The Pythagorean theorem states that with a right-angled triangle, the sum of the \_\_\_\_\_ of the two sides that form the right angle is equal to the square of the third, long side, which is called the \_\_\_\_\_.

One of the classic uses of the Pythagorean theorem is in laying the foundations of buildings. To make a rectangular foundation, you need to make \_\_\_\_\_. But how can you do that? When you have the length and width, you can use \_\_\_\_\_ it to make a precise right angle. A theorem is a great tool for solving distance between two points and creating symmetrical designs in games like Minecraft.

It's also useful to cartographers, who use it to calculate the \_\_\_\_\_ of hills and mountains. A surveyor looks through a \_\_\_\_\_ toward a measuring stick a fixed distance away, so that the telescope's line of sight and the measuring stick form a right angle. Since the surveyor knows both the height of the measuring stick and the horizontal distance of the stick from the telescope, he can then use the theorem to find the \_\_\_\_\_ that covers that distance, and from that length, determine how steep it is.

The same principles can be used for navigation. For instance, a plane can use its \_\_\_\_\_ above the ground and its distance from the destination airport to find the correct place to begin a descent to that airport.

### Activity III. Reading Comprehension

**Read the third paragraph of the text and answer the questions given below**

1. What is a navigation system?

.....

2. What is the name of the navigation system developed by India?

.....

3. How is the navigation system useful for an aircraft?

.....

4. How does the Pythagorean theorem help in navigation?

.....

5. How does a navigation system work?

.....

**Activity IV: Speaking**

The navigation system is one of the most advanced inventions in Human history. Think about this sentence and share your views with him/her. Talk to your friends about the validity of the statement. Note down points. Report your views to the class when your teacher asks you.

.....  
.....  
.....  
.....

**Activity VI. Think and Write**

Have you ever used maps to locate a place? Write your experiences

.....  
.....  
.....  
.....



## New words and concepts

|            |  |
|------------|--|
|            | the act of transferring something from one place to another.             |
| Deep space | starts from a distance of 2 million kilometers from the Earth's surface. |
| Rovers     |  |
| Landers    | robotic devices that descend onto a planet.                              |



### Pre Reading Activity

What do you know about satellites?

How is space technology useful to us?

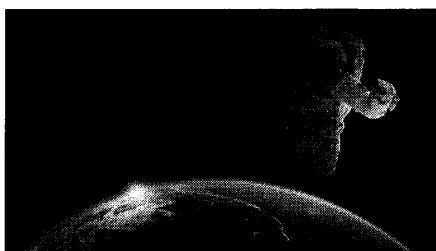
How do we get signals for our Dish Antennas?



Humans have a great fascination for space and attempted to explore it for a long period of time. During the later part of the 20th century, the man was able to overcome the force of gravity and developed rockets that can reach orbital velocity. This invention of space vehicles that can attain escape velocity paved the way for space exploration. During world war II the Germans developed missiles with a range of 200 miles. Immediately after the world war both the then Soviet Union and the USA began their missile and space programmes and competed for superiority in the space. The Soviet Union tasted success initially as it achieved both the milestones of launching the first satellite in 1957 and sending a human being to orbit earth in 1961. The USA stunned the world by its moon landing missions when astronaut Neil Armstrong in 1969 became the first human being to land in the moon. During the beginning of the 1970s satellites were used primarily for military purposes. Deep space exploration became the focus of the space powers as many satellites and robotic spacecraft were sent to explore the planets like Mars, Venus, Jupiter, and Saturn. Americans launched and deployed 'Sky Lab' the first space station which has altered the modes of deep space exploration. The 1980s marked the emergence of a new era in space technology when satellites were used to transmit television programmes and telecommunication signals. Satellites begin to influence human life in unprecedented ways as they played a pivotal role

in communication, remote sensing, and earth observation. In a way, satellites contributed immensely to the communication revolution and it continues to contribute to the evolution of communication systems.

The reusable space shuttles enhanced the possibilities of interplanetary missions and sending orbiters, landers, and rovers to various planets. Some rovers landed in asteroids and brought back material to earth. The world has witnessed *the significance* of satellites and space technology during the Gulf war, where the allied forces enjoyed the advantage of space science in gathering information about troop movements, possible missile attacks, and precise navigation. The progress of the war clearly indicated the dominance of the allied forces and the huge difference found was the advanced space technology.



The end of the cold war marked the end of competition between the USA and the USSR in space. America and Russia along with other countries established an international space station, a research laboratory in space that collects data that contributes immensely to our understanding of the origin and evolution of galaxies, planets, and other cosmological elements. Earth-orbiting satellites provide important services like weather forecasting, resource management, and telecommunication. They also offer indispensable help in positioning and navigation.

**Activity I:** Write about some of the great achievements of the Indian Space Research Organisation?

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**Activity II:** Listen to the following paragraph as it is read aloud and answer the questions given below:

In many places on our planet, we experience severe disasters like earthquakes, tsunamis, and cyclones resulting in loss of life, loss of wealth, and, in some cases, the destruction of decades of progress made by countries and their valuable cultural heritage. India has earthquake problems periodically in certain regions. The U.S. Japan, Turkey, Iran, and many other countries also suffer due to earthquakes. Earthquakes and tsunamis are sub-terrain

phenomena and predicting this from space observations would be a great challenge. Space scientists of multiple nations should work together to use satellite deep penetration images to predict the earthquake or shock wave propagation. Other possibilities are a precise geodynamic measurement of strain accumulation by satellite to detect pre-slip, and electromagnetic phenomena prior to final rupture. The focus must be on earthquake forecasting with an adequate warning so that people can move to safer areas. Space technology can also be used for forecasting and modeling of volcanic eruptions, landslides, avalanches, flash floods, storm surges, hurricanes, and tornadoes.

(Reference:

[https://www.bu.edu/csp/Conferences/Space\\_Exploration/Day1/Presentations/Kalam\\_Space%20Exploration%20and%20Human%20Life.pdf](https://www.bu.edu/csp/Conferences/Space_Exploration/Day1/Presentations/Kalam_Space%20Exploration%20and%20Human%20Life.pdf))

**Fill in the blanks.**

1. Earthquakes and tsunamis are \_\_\_\_\_ phenomena.
2. Space scientists should work \_\_\_\_\_.
3. The focus must be on earthquakes \_\_\_\_\_.

**Give the synonym from the passage for the following words.**

1. picture. \_\_\_\_\_
2. predict \_\_\_\_\_
3. sufficient \_\_\_\_\_

Give the antonym from the passage for the following words

1. Single. -----
2. Experience -----.
3. Invaluable -----.

Fill in the blanks with the missing letter.

1. I \_ C EA E
2. V \_ C \_ \_ M
3. M \_ T \_ \_ N

Activity III. Listen to the passage and write on the uses of Space technology.

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Activity IV:

Keywords: Identify the keywords and write down them as the passage is being read.

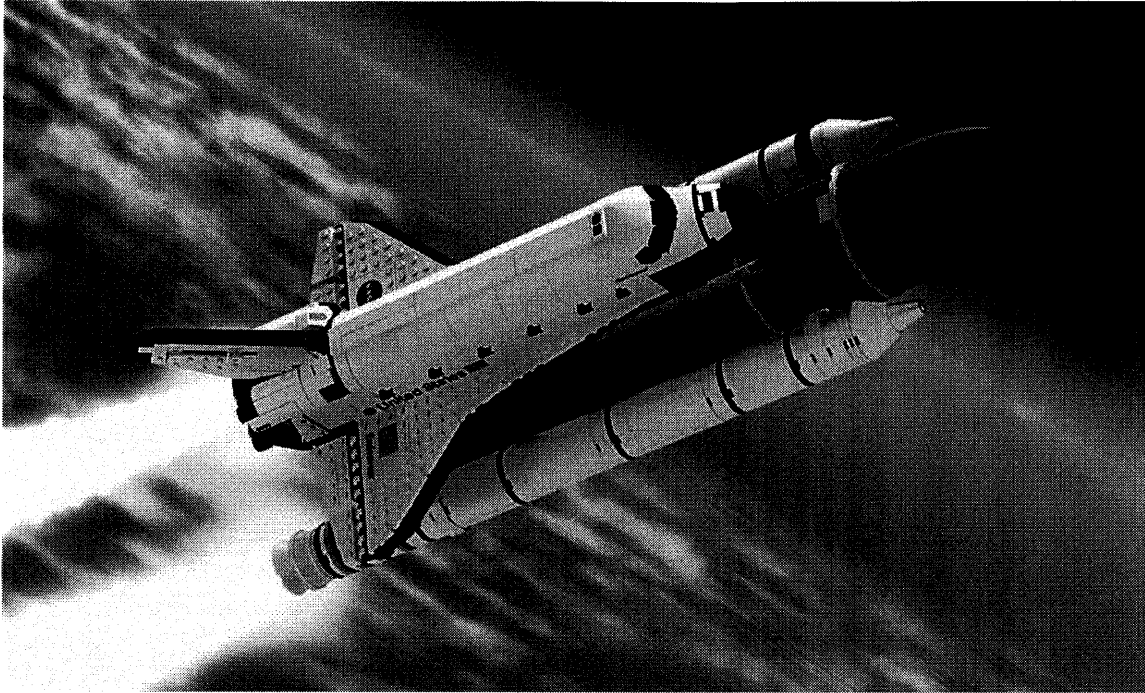
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

ACTIVITY V: Speaking Activity

Speak on the following topics

1. Describe any physical object that is related to your subject.
2. What are the benefits of space technology to the layman?
3. Discuss in a group the uses and abuses of GPS.

Activity VI: Relate to the following pictures and Speak for Two minutes.



Activity VI: Watch this Video, 'India's Space Odyssey' in YouTube

<https://www.youtube.com/watch?v=WEKzNH09Vqs>

What are the major successes of the Indian Space programme?

1.....

2.....

3.....

### New words or Concepts Introduced

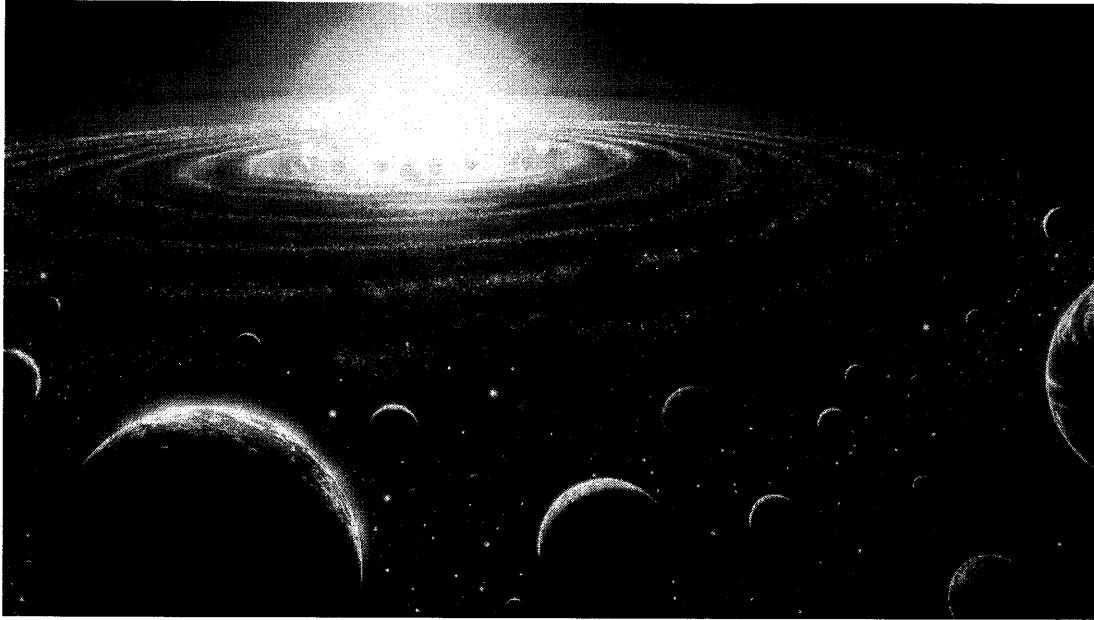
|                       |  |
|-----------------------|--|
| Big Bang theory       | explanation about how the universe began.  |
| Multiverse            | hypothetical group of multiple universes   |
| Large-scale structure | patterns of galaxies and matter on scales much larger than individual galaxies or groupings of galaxies.                               |
| Steady-state          | an unvarying condition in a physical process, a theory that the universe is eternal and maintained by the constant creation of matter. |
| Dark energy           | a new kind of dynamical energy fluid or field, something that fills all of space   |
| Singularity           | a location in spacetime where the gravitational field of a celestial body is predicted to become infinite                              |
| Reionization          | the process that caused the matter in the universe to reionize after the lapse of the "dark ages"                                      |
| Helium                | colourless, odourless, tasteless, non-toxic, inert, monatomic gas  |
| Atom's nuclei         | Extremely small elements Containing more than 99.9% of the mass of an atom and are ten thousand times smaller than an atom!            |
| Cosmos                | Universe   |

#### Pre Reading Activity

- Who invented the big bang theory?
- What is the big bang theory?
- How did the Big Bang start?
- How fast is the universe expanding?

The Big Bang Theory is a comprehensive account of the expansion of the universe or an

explanation as to how the universe began. The Belgian priest and professor of Physics, Georges Lemaître was the first to suggest the big bang theory as a cosmological model for the universe in the 1920s. Many scientists have offered theories in which a single point of infinite density and



finite time is accounted for the origin of the universe and its expansion. The Big Bang Theory suggests that the expansion started before 14 billion years from a state where the universe was compressed into a single point. This expansion of the matter and energy in the universe is called the big bang. However, the process of expansion still continues. Studies reveal that the universe was an extremely hot, small, and dense super force. It had no stars, atoms, form, or structure and was called a “singularity.” According to the reports of NASA, the surrounding temperature in the first second of expansion was about 10 billion degrees Fahrenheit (5.5 billion Celsius) and the density of energy was extreme for the first 10 to 43

seconds. Theoretical physics is still unable to provide a clear explanation of what was happening. The cosmos did contain fundamental particles such as neutrons, electrons, and protons, and these particles were pooled or decayed as the universe got cooler. Theories on the existence of “multiverse” are also prominent where some scientists suggest that our observable universe is just one among many. Like bubbles lying side by side, different universes would coexist in the “multiverse” model.

The Big Bang Theory is supported by strong empirical evidence that makes it universally accepted. However, the scientific community was divided between the Big Bang and its rival, a steady-state model for much of the 20th century. The characteristics of the initial state of the universe in extreme density and temperature can be calculated using the laws of physics. Big bang theory offers an explanation for the initial expansion of the universe and observes phenomena such as the abundance of light elements, the CMB, large-scale structure, and Hubble’s law. Hubble’s law in physical cosmology detects that galaxies move away from Earth at velocities proportional to their distance or in other words, the further they are the faster they move away from Earth. It is confirmed by scientists that the abundance of helium is a key prediction of the big bang. It was cool enough during the first second of expansion for the remaining matter to merge into protons and neutrons, the particles of atom’s nuclei. In the first three minutes, protons and neutrons amassed into hydrogen and helium nuclei. Hydrogen was 75 percent of the matter of early universe and helium was 25 percent, a key factor leading to the big bang.

Scientists believe that the expansion began with every fragment of energy jammed into an extremely tiny point. The universe is still expanding at an accelerating pace. The source of acceleration is thought to be propelled by a force called dark energy that repels gravity. It covers 68 percent of the universe’s total matter and energy. But dark energy is still ambiguous to explain. The first star of the universe unleashed light capable enough to once again strip electrons from neutral atoms, a key chapter of the universe called reionization.



**Activity I:** What do you understand about the origin of the universe from the above text? Write in your own words.(100-200)

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## Activity II. Conceptual Understanding

Match these terms with the concepts

| S.No | Terms           | Concepts  | Answer |
|------|-----------------|---|--------|
| 1    | Galaxy          | the small, dense region consisting of protons and neutrons at the center of an atom                         |        |
| 2    | Cosmology       | the observation that galaxies are moving away from the Earth at velocities proportional to their distance   |        |
| 3    | Big bang theory | the scientific study of the large scale properties of the universe as a whole                               |        |
| 4    | Density         | A single point of very high temperature and infinite density  |        |
| 5    | Singularity     | A measure of mass per volume  |        |
| 6    | Hubble's law    | the universe began as just a single point, then expanded to grow as large as it is right now                |        |
| 7    | Proton          | A subatomic particle with a negative electric charge  |        |
| 8    | Electron        | A subatomic particle with no electric charge  |        |
| 9    | Neutron         | A subatomic particle with a positive electric charge  |        |
| 10   | Atomic nuclei   | a huge collection of gas, dust, and billions of stars and their solar systems, all held together by gravity |        |

### Activity III

Read the text and fill in the gaps with the following words

|         |        |        |             |
|---------|--------|--------|-------------|
| Finite  | Brane  | proton | fusing      |
| galaxie | large- | light  | reionizatio |

The beginning of our universe would have been nice and \_\_\_\_\_ . The cyclic model posits that our universe consists of 11 dimensions, only four of which we can observe (three of space and one of time). Our four-dimensional part of the universe is called a \_\_\_\_\_ (short for membrane). Just after inflation, the universe was likely filled with hot, dense plasma. But by around 1 microsecond (10 to the minus 6 seconds) or so, it had cooled enough to allow the first \_\_\_\_\_ and neutrons to form, researchers, think. In the first three minutes after the Big Bang, these protons and neutrons began together, forming deuterium \_\_\_\_\_ (also known as heavy hydrogen). Deuterium atoms then joined up with each other, forming helium 4. Over time, stars gravitated together to form \_\_\_\_\_, leading to more and more \_\_\_\_\_ structure in the universe. Planets coalesced around some newly forming stars, including our own sun. And 3.8 billion years ago, life took root on Earth. Once the universe's first stars ignited, the \_\_\_\_\_ they unleashed packed enough punch to once again strip electrons from neutral atoms, a key chapter of the universe called \_\_\_\_\_ .

### Activity IV: Word Search

Find a word in the following paragraph of the text that means the same as the words and phrases are given below

The Big Bang Theory is supported by strong empirical evidence that makes it universally accepted. However, the scientific community was divided between the Big Bang and its rival, a steady-state model for much of the 20th century. The characteristics of the initial state of the universe

in extreme density and temperature can be calculated using the laws of physics. Big bang theory offers an explanation for the initial expansion of the universe and observes phenomena such as the abundance of light elements, the CMB, large-scale structure, and Hubble's law. Hubble's law in physical cosmology detects that galaxies move away from Earth at velocities proportional to their distance or in other words, the further they are the faster they move away from Earth.

1. Verifiable by observation - -----
2. Observable fact or event - -----

3. Plenty. - -----

4. Corresponding - -----

5. Features - -----

**Activity V.**

Read the above paragraph and find five words

1.-----

2.-----

3.-----

4.-----

5.-----

**Activity VI: Write a summary of the paragraph given above.**

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## Read the following News article:

By Reality Check team  
**BBC News**



**The 5G mobile network has been switched on in some UK cities and has led to questions about whether the new technology poses health risks. So what are the concerns, and is there any evidence to back them up?**

### **What's different about 5G?**

As with previous cellular technologies, 5G networks rely on signals carried by radio waves - part of the electromagnetic spectrum - transmitted between an antenna or mast and your phone. We're surrounded by electromagnetic radiation all the time - from television and radio signals, as well as from a whole range of technologies, including mobile phones, and natural sources such as sunlight. 5G uses higher frequency waves than earlier mobile networks, allowing more devices to have access to the internet at the same time and faster speeds. These waves travel shorter distances through urban spaces, so 5G networks require more transmitter masts than previous technologies, positioned closer to ground level.

### **What are the concerns?**

The electromagnetic radiation used by all mobile phone technologies has led some people to worry about increased health risks, including developing certain types of cancer. In 2014 the World Health Organization (WHO) said that "no adverse health effects have been established as being caused by mobile phone use".

However, the WHO together with the International Agency for Research on Cancer (IARC) has classified all radiofrequency radiation (of which mobile signals are a part) as "possibly carcinogenic". It has been put in this category because "there is evidence that falls short of being conclusive that exposure may cause cancer in humans". Eating pickled vegetables and using talcum powder are classed in the same category. Alcoholic drinks and processed meat are in a higher category because the evidence is stronger.

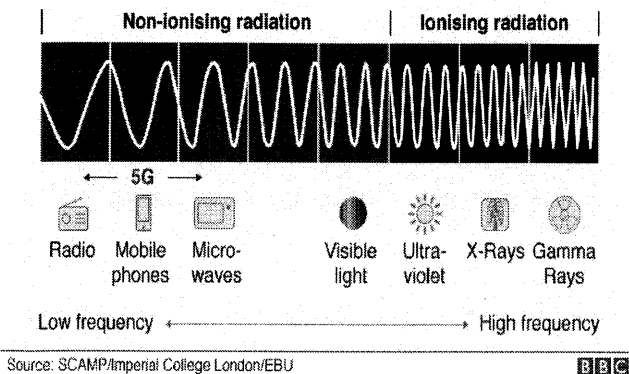
A toxicology report released in 2018 by the US Department of Health, and pointed to by those expressing safety concerns, found that male rats exposed to high doses of radiofrequency radiation developed a type of cancerous tumour in the heart. For this study, rats' whole bodies were exposed to radiation from mobile phones for nine hours a day every day for two years, starting before they were born. No cancer link was found for the female rats or the mice studied. It was also found that rats exposed to the radiation lived longer than those in the control group.

A senior scientist on the study said "exposures used in the studies cannot be compared directly to the exposure that humans experience when using a cell phone", even for heavy users. Dr. Frank De Vocht, who helps advise the government on mobile phone safety says "although some of the research suggests a statistical possibility of increased cancer risks for heavy users, the evidence to date for a causal relation is not sufficiently convincing to suggest the need for



precautionary action". However, there is a group of scientists and doctors who have written to the EU calling for the rollout of 5G to be halted.

### Where 5G fits in the electromagnetic spectrum



### Radio waves are non-ionising

The radio waveband - used for mobile phone networks - is non-ionising, "which means it lacks sufficient energy to break apart DNA and cause cellular damage," says David Robert Grimes, physicist and cancer researcher.

Higher up the electromagnetic spectrum, well beyond those frequencies used by mobile phones, there are clear health risks from extended exposure. The sun's ultra-violet rays fall within this harmful category and can lead to skin cancers.

There are strict advisory limits for exposure to even higher energy radiation levels such as medical x-rays and gamma rays, which can both lead to damaging effects within the human body. "People are understandably concerned over whether they might elevate their risk of cancer, but it's crucial to note that radio waves are far less energetic than even the visible light we experience every day," says Dr. Grimes. "There is no reputable evidence," he says "that mobile phones or wireless networks have caused us health problems."

### Should we be worried about 5G transmitter masts?

5G technology requires a lot of new base stations - these are the masts that transmit and receive mobile phone signals. But crucially, because there are more transmitters, each one can run at lower power levels than previous 4G technology, which means that the level of radiation exposure from 5G antennas will be lower. The UK government guidelines on mobile phone base stations say radiofrequency fields at places normally accessible to the public are many times below guideline levels.

### What about heating dangers?

Part of the 5G spectrum permitted under international guidelines falls within the microwave band. Microwaves generate heat in objects through which they pass. However, at the levels used for 5G (and earlier mobile technologies) the heating effects are not harmful, says Prof Rodney Croft, an adviser to the International Commission on Non-Ionizing Radiation Protection (ICNIRP). "The maximum radio frequency level that someone in the community could be exposed to from 5G (or any other signals in general community areas) is so small that no temperature rise has been observed to date."

### Limits to exposure

The UK government says "while a small increase in overall exposure to radio waves is possible when 5G is added to the existing network, the overall exposure is expected to remain low". The frequency range of the 5G signals being introduced is within the non-ionising band of the electromagnetic spectrum and well below those considered harmful by the ICNIRP. "The exposure that 5G will produce has been considered in great depth by ICNIRP, with the restrictions set well below the lowest level of 5G-related radio frequency that has been shown to cause harm," says Prof Croft.

The WHO says electromagnetic frequency exposures below the limits recommended in the ICNIRP guidelines do not appear to have any known consequence on health. (<https://www.bbc.com/news/world-europe-48616174>)

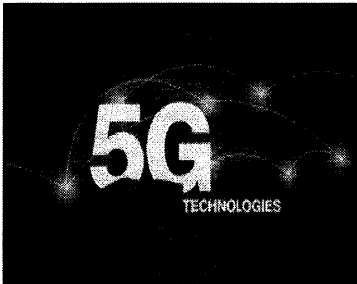
### b. Refer to the following news articles in connection with the previous article.

1. How 5G differs from previous network technologies:

<https://semiengineering.com/how-5g-differs-from-previous-network-technologies/>

2. Prominent scientists warn that 5G could pose health hazards: <https://www.thehindubusinessline.com/info-tech/scientists-caution-government-to-go-slow-on-5g-roll-out/article28737197.ece>
3. '5G is unlikely to cause health concerns': <https://www.downtoearth.org.in/interviews/science-and-technology/-5g-is-unlikely-to-cause-health-concerns--63698>
4. 5G Features and Benefits- Intel: <https://www.intel.com/content/www/us/en/wireless-network/5g-benefits-features.html>

**Activity 1 Critically reflect your ideas on the following topic in the form of an essay based on your previous readings.**



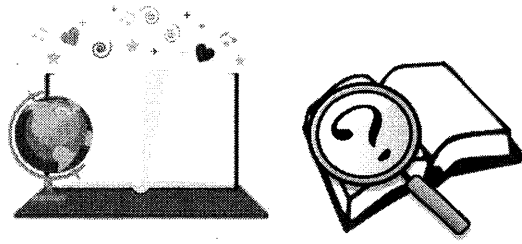
1. The Advantages and the Dis-advantages of 5G Network Technology.

**Activity 2 Reading:**

**Words given in the table are related to various fields. Identify the discipline to which they belong to and circle them in different colours.**

|                 |               |               |
|-----------------|---------------|---------------|
| Air             | Hack          | Alchemy       |
| Binary          | Curve         | Counting      |
| Firewall        | Atomic weight | Byte          |
| Difference      | Atom          | Base          |
| Plane           | ellipse       | Equilateral   |
| Cloud computing | Calorie       | Bus           |
| Deflagration    | Linear        | Debug         |
| Firmware        | Dynamic       | Bronze        |
| Encryption      | Buffer        | Flash drive   |
| Polygon         | Nano          | Integer       |
| Billion         | Negative      | Obtuse        |
| Charge          | Inverse       | Atomic radius |





## **READ, IMAGINE, INNOVATE**

The following books and channels are recommended for you to widen and expand your learning experience:

### **Books:**

1. Isaac Assimov – *I, Robot* (film also available)
2. Isaac Assimov – *The Last Question*
3. Antoine De Saint Exupery – *The Little Prince*
4. Philip K. Dick – *Do Androids Dream of Electric Sheep?*
5. Stephen Hawking – *A Brief History of Time*

### **Channels/Videos:**

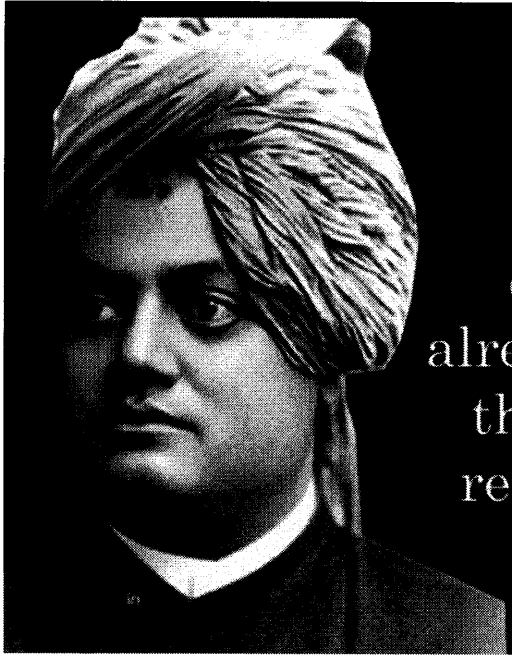
Discovery Channel

National Geographic Channel

Kurzgesagt (videos on YouTube)

Joe Scott (videos on YouTube)

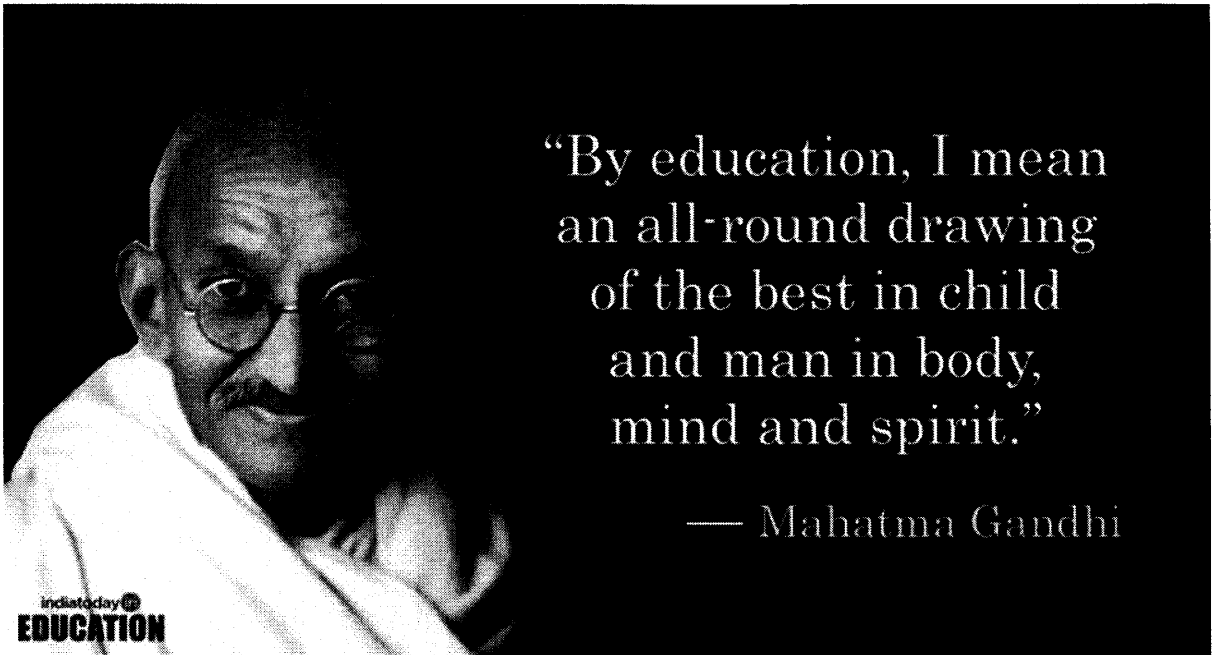




“Education is the  
manifestation  
of perfection present  
already in man. Divinity is  
the manifestation of the  
religion already in man.”

— Swami Vivekananda



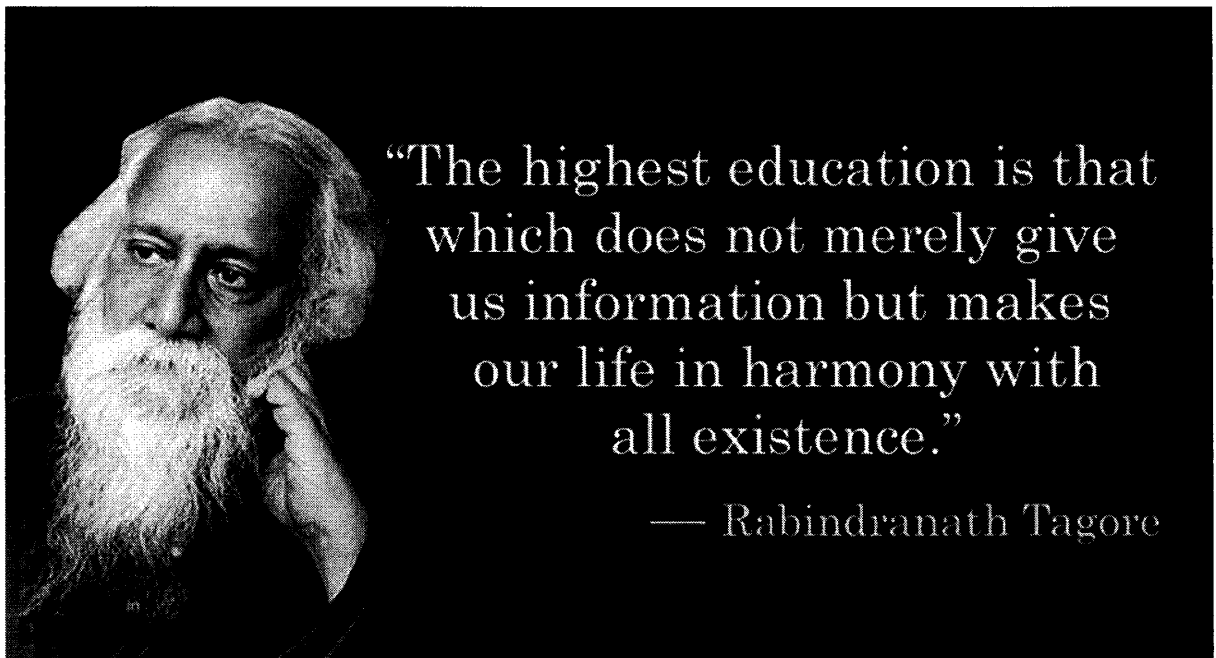


“By education, I mean  
an all-round drawing  
of the best in child  
and man in body,  
mind and spirit.”

— Mahatma Gandhi

indiatoday  
**EDUCATION**



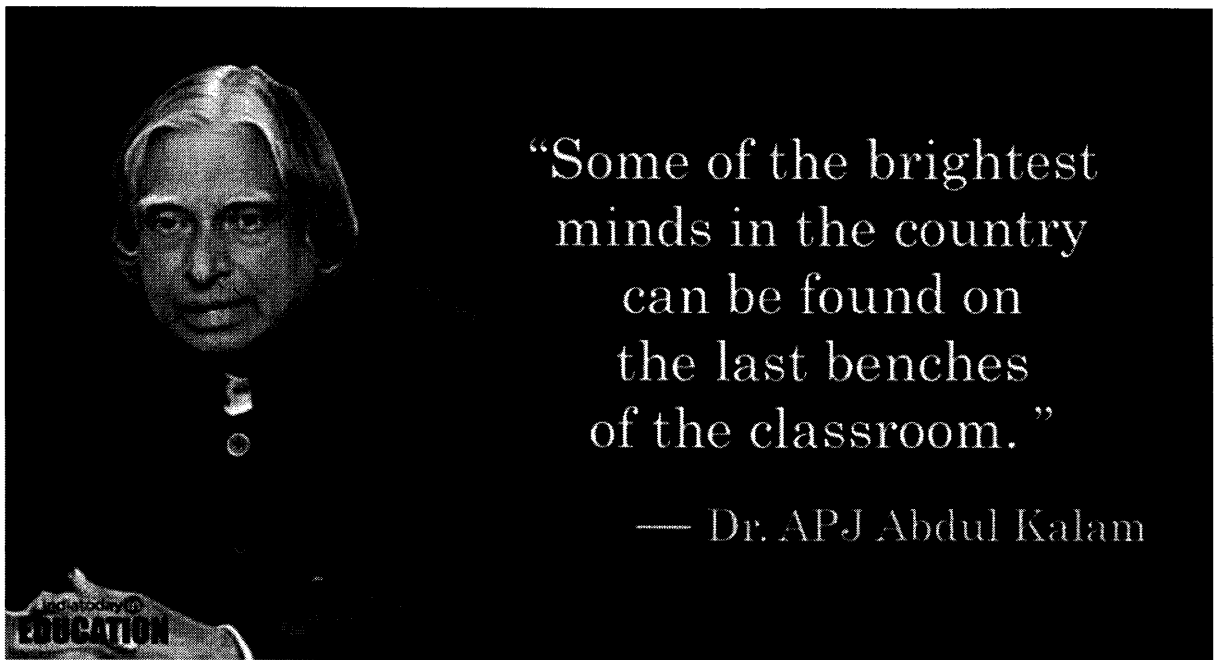


“The highest education is that which does not merely give us information but makes our life in harmony with all existence.”

— Rabindranath Tagore







“Some of the brightest  
minds in the country  
can be found on  
the last benches  
of the classroom.”

— Dr. APJ Abdul Kalam

EDUCATION

