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UPSC-CSE

PRELIMS+MAINS
ENGLISH MEDIUM

General Study Paper-3
Part -3

SCIENCE AND TECHNOLOGY

PREFACE

Dear Aspirants, The Presented Notes "UPSC - CSE (PRE + MAINS)" have been prepared by a team of teachers, colleagues and Infusion Notes members who are expert in various subjects. These notes will help the Aspirants to the fullest extent possible in the examination of Civil Services conducted by the **UNION PUBLIC SERVICE COMMISSION (UPSC)**.

Finally, despite careful efforts, there may be chances of some shortcomings and errors in the notes, So your suggestions are cordially invited in Infusion notes.

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countries to develop its own ballistic missiles as well as produce and supply missiles in other key areas of the world. The start of BrahMOS led to the negation of the absolute power held by Western countries.

Achievements of Indian Scientists in Recent time

Manjul Bhargava:

- Manjul Bhargava is the recent addition to the growing list of modern Indian scientists who are making great contributions in the field of Mathematics. Bhargava was recently awarded the Fields medal for his contribution to number theory. In 2015, Manjul Bhargava won the Padma Bhushan, the third-highest civilian award in India.

Shiva Ayyadurai:

- VA Shiva Ayyadurai invented the Email in 1979 as a high school student for the interoffice mail system. Later on, he also came out with EMS, which included email and other programs.

Ashoke Sen:

- Ashoke Sen is one of the few elite scientists in the world who have made original contributions to the subject of String Theory. He won the Fundamental Prize in Physics in 2012 with total prize money of \$3 Million. He was later awarded the Padma Bhushan for his work in 2013.

Abhas Mitra:

- Abhas Mitra is considered the foremost authority in India on subjects of Big bang and black holes. He is also one of the most cited Indian scientists in the world.
- To summarize, Indian scientists have contributed astonishingly to the growth of India. They have augmented the status of India with their scientific achievements and many of the Indian scientists have also received some prestigious international awards as well.
- The discoveries of Indian scientists have been appreciated all over the world. After independence, India has accomplished several great scientific achievements. Indian scientists have shown their courage at a global level and have made India one of the scientific centres of the world. There are many names like Bhabha, A. Sivathanu Pillai, Narinder Singh Kapany, and many more who made a prime position in the scientific field.

CHAPTER - 2

BIOTECHNOLOGY

Biotechnology is the use of biological systems found in organisms or the use of the living organisms themselves to make technological advances and adapt those technologies to various fields.

Biotechnology is the field that exploits living organisms to make technological advances in various fields for the sustainable development of mankind.

The European federation of biotechnology defines it as "The integration of natural science and organisms, cells, parts thereof and molecular analogues for products and services".

Biotechnology is the use of an organism, or a component of an organism or other biological system, to make a product or process for a specific use.

It can include both cutting-edge laboratory techniques and traditional agricultural and culinary techniques that have been practiced for hundreds of years.

Brewing and baking bread are examples of processes that fall within the concept of biotechnology (use of yeast (= living organism) to produce the desired product).

- Such traditional processes usually utilize the living organisms in their natural form (or further developed by breeding), while the more modern form of biotechnology will generally involve a more advanced modification of the biological system or organism.

With the development of genetic engineering in the 1970s, research in biotechnology (and other related areas such as medicine, biology etc.) developed rapidly because of the new possibility to make changes in the organisms' genetic material (DNA) Biotechnology deals with industrial scale production of biopharmaceuticals and biologicals using genetically modified microbes, fungi, plants and animals.

The applications of biotechnology include therapeutics, diagnostics, genetically modified crops for agriculture, processed food, bioremediation, waste treatment, and energy production.

Beer brewing: In beer brewing, tiny fungi (yeasts) are introduced into a solution of malted barley sugar, which they busily metabolize through a process called fermentation. The byproduct of the fermentation is the alcohol that's found in beer. Here, we see an organism – the yeast – being used to make a product for human consumption.

Penicillin: The antibiotic penicillin is generated by certain molds. To make small amounts of penicillin for use in early clinical trials, researchers had to grow up to 500 liters of “mold juice” a week. Here, an organism (mold) was used to make a product for human use – in this case, an antibiotic to treat bacterial infections.

IVF, or in vitro fertilization, is a technique used to help a woman get pregnant. It is when a human egg is fertilised with sperm in a laboratory. IVF is used to treat infertility and some genetic problems.

- **Gene therapy:** Gene therapy is an emerging technique used to treat genetic disorders that are caused by a nonfunctional gene. It works by delivering the “missing” gene's DNA to the cells of the body.
- In gene therapy, biological components from different sources (a gene from humans, a plasmid originally from bacteria) are combined to make a new product.
- **Tissue culture,** a method of biological research in which fragments of tissue from an animal or plant are transferred to an artificial environment in which they can continue to survive and function.
- **Biotechnology** has additional applications in areas such as food production and the remediation (cleanup) of environmental pollution.

Principles of Biotechnology

Genetic Engineering: Techniques to alter the chemistry of genetic materials (DNA and RNA) and to introduce these into host organisms and

thus change the phenotype (observable physical properties of an organism) of host organisms.

Maintenance of Sterile (microbial contamination free) ambience in chemical engineering processes to enable the growth of only desired microbe/eukaryotic cell in large quantities for the manufacture of biotechnological products like antibiotics, vaccines, enzymes, etc.

Genetic Engineering

Genetic Engineering is a technique of manipulating the genome of the organism, to add one or more trait that is not found in organism naturally. Also, called gene manipulation /genetic modification.

Techniques

1. **Isolation of genes:** Desirable sequence of genes is obtained directly from the genome of normal cells or from other cells, which is achieved by cleavage and denaturation. DNA is extracted from cells.
2. **Synthesis of genes:** Various methods are deployed for the same.
3. **Recombinant DNA:** Cutting of DNA molecule at a desired position results in a new gene product which is called as recombinant DNA (r-DNA). The receiving organism is said to be transgenic. Using this technique, we can isolate and clone a single copy of a gene or DNA molecule into an indefinite number of copies all identical.
4. **Gene cloning:** Isolation of gene and reproduction of a single copy of gene or DNA segment into the infinite number of copies all identical is known as gene cloning.

Hazards of Genetic engineering

- If a wrong DNA segment is inserted and it gets expressed, it can cause new diseases in human beings.
- It can be used in biological warfare.
- Genetical modification of existing species/recreation of extinct species can cause disaster
- New strains of bacteria/fauna can come out of the lab which can be hostile to human beings.
- Even in a single species, genetic engineering leads to the elimination of varieties – if some new disease comes up, the entire species may be wiped out.

National Genomic Grid

- Health Minister announced plans of Genomic grid for India-specific cancer research.

- In a move to take cancer research to the next level and make treatment viable for people of different economic classes, the government has plans to set up a National Genomic Grid, which will study genomic data of cancer patients from India.
- The grid to be formed will be in line with the National Cancer Tissue Biobank (NCTB) set up at the Indian Institute of Technology, Madras, and will collect samples from cancer patients to study genomic factors influencing cancer and identifying the right treatment modalities for the Indian population.
- The government plans to set up the National Genomic Grid in the same style with pan-India collection centers by bringing all cancer treatment institutions on board
- The grid will have four parts, with the country divided into east, west, north, and south.

National Cancer Tissue Biobank (NCTB):

- It is a joint initiative of the Department of Science and Technology (DST), Government of India, and Indian Institute of Technology, Madras.
- The NCTB is functioning in close association with the Indian Council for Medical Research (ICMR).
- NCTB, which has the capacity to stock 50,000 genomic samples from cancer patients, already has samples from 3,000 patients. The genomic samples will help researchers to have India-specific studies on cancers.

Color Classification of Branches of Biotechnology:

- **Gold biotechnology or Bioinformatics:** Computational Biology à address biological problems using computational techniques.
- **Red Biotechnology:** Biopharma à relates to medicine and veterinary products.
- **White Biotechnology:** Industrial Biotech à to design more energy efficient, low resource consuming products.
- **Yellow Biotechnology:** Biotech in the Food Industry.

- **Gray Biotechnology:** Environmental applications to maintain Biodiversity.
- **Green Biotechnology:** Emphasizes on Agriculture interests.
- **Blue Biotechnology:** based on use of marine resources.
- **Violet Biotechnology:** deals with law, ethical and philosophical issues of biotechnology.
- **Dark Biotechnology:** associated with bioterrorism and biological weapons.

GENE:

- Gene is the basic physical unit of inheritance.
- It is a part of the DNA in a cell that controls the physical development, behavior, etc. of an individual plant or animal & is passed on from its parents.

GENOME:

- Genome is the complete set of genes or genetic material present in a cell or organisms.
- The human genome is a complex set of instructions, like a recipe book, directing organism growth & development.

GENOMIC ORGANIZATION:

- This refers to the linear order of DNA elements and their division into chromosomes.
- Can also refer to the 3D structure of chromosomes & the positioning of DNA sequences within the nucleus.

CHROMOSOME:

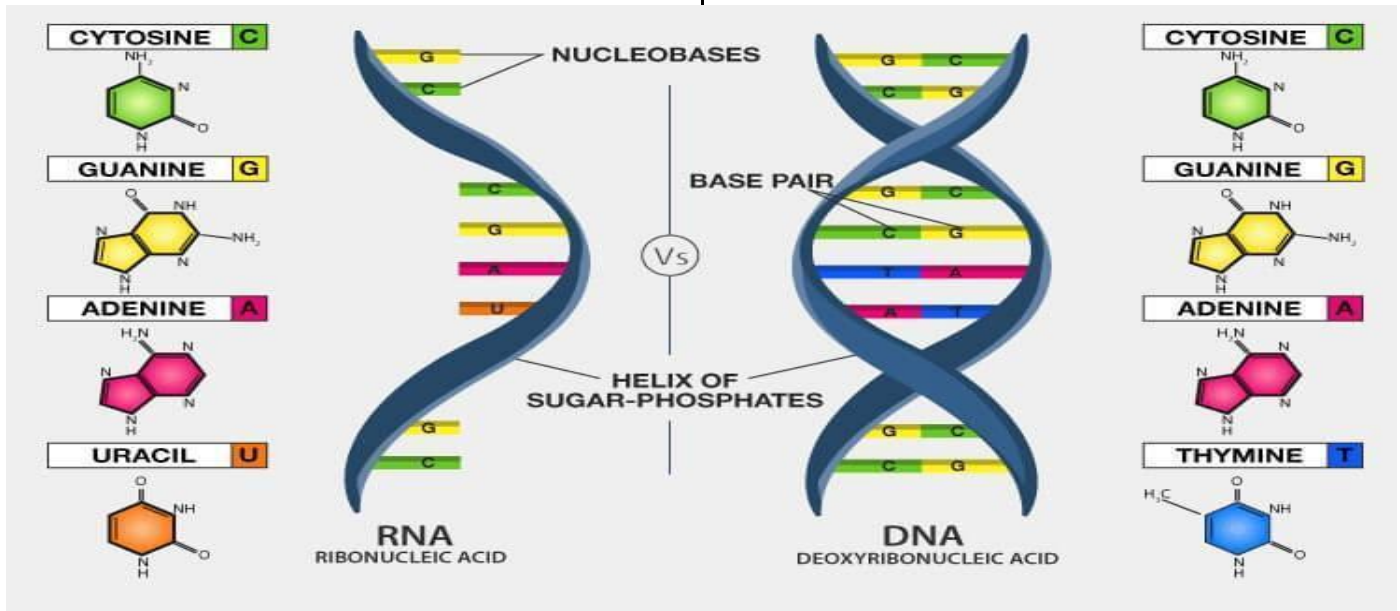
- These Are thread-like structures located inside the nucleus of animal & plant cells.
- Each chromosome is made of protein and a single molecule of Deoxyribose-Nucleic Acid (DNA).
- Chromosomes are a key part of the process that ensures DNA is accurately copied and distributed in the vast majority of cell divisions.
- Changes in the number or structure of chromosomes in new cells may lead to serious problems like: Down Syndrome, Turner Syndrome etc.

DNA and RNA

- DNA contains the sugar deoxyribose, while RNA contains the sugar ribose. The only difference between ribose and deoxyribose is that ribose has one more -OH group than deoxyribose, which has -H attached to the second (2') carbon in the ring.
- DNA is a double-stranded molecule while RNA is a single-stranded molecule.

- DNA is stable under alkaline conditions while RNA is not stable.
- DNA and RNA perform different functions in humans. DNA is responsible for storing and transferring genetic information while RNA directly codes for amino acids and as acts as a messenger between DNA and ribosomes to make proteins.

- DNA and RNA base pairing is slightly different since DNA uses the bases adenine, thymine, cytosine, and guanine; RNA uses adenine, uracil, cytosine, and guanine. Uracil differs from thymine in that it lacks a methyl group on its ring.



Comparison of DNA and RNA

S.No.	DNA	RNA
1.	Deoxyribonucleic acid.	Ribonucleic acid.
2.	It occurs inside the nucleus of cell and some cell organelles but it plants it is present in mitochondria and plant cell.	It is found in cytoplasm of the cell but very little is found inside the nucleus.
3.	It is a double-stranded molecule consisting of a long chain of nucleotides.	It is single-strand helix having shorter chains of nucleotides.
4.	It stores and transfers genetic information to generate new cells and organisms.	It is used to transfer genetic code from nucleus to the ribosomes to make proteins and carries DNA blueprint's guidelines.
5.	It has two nucleotide strands consisting of phosphate group, five carbon sugar (stable deoxyribose 2) and four nitrogen bases.	It is single stranded consisting of phosphate group, five carbon sugar (less stable ribose) and four nitrogen base.
6.	Nitrogen base pairs are Adenine links to Thymine (A-T) and Cytosine links to Guanine (C-G).	Here nitrogen base pairs are Adenine links to Uracil (A-U) and Cytosine links to Guanine (C-G).
7.	DNA is self replicating	It is synthesised from DNA when needed.
8.	The DNA helix geometry is in the form of B and can be damaged by exposure of ultra-violet rays.	The RNA helix geometry is in the form of A. It is more resistant to damage by ultra-violet rays.

- **Agriculture:** Specific genes of bacteria have been used to make crops resistant against insects and pests. It is also useful in the production of livestock with improved quality of meat and milk.

DNA BAR-CODING

Characterizing species of organisms using a short DNA sequence from a standard and agreed-upon position from the genome.

Application

- Identification of plant leaves even in absence of fruit
- Identification of insect larvae
- Identification of products in commerce.

Criticism

- Lack of reliable information above the species level
- Gross oversimplification of the science of taxonomy.

DEOXYRIBONUCLEIC ACID (DNA):

- DNA is an organic chemical that contains genetic information and instructions for protein synthesis.
- DNA is a key part of reproduction in which genetic heredity passed down through DNA from parents to offspring.

RIBONUCLEIC ACID (RNA):

- RNA is a nucleic acid principally involved in the synthesis of proteins, carrying the messenger (ex: mRNA) instructions from DNA, which itself contains the genetic instruction

DIFFERENCES BETWEEN DNA AND RNA:

DNA

- It has a deoxyribose and phosphate backbone having four distinct bases: Adenine, Cytosine, Guanine & Thymine (ACGT).
- Found in cell nucleus and Mitochondria.
- Has 2-deoxyribose.
- Double stranded molecule with long chain of nucleotides.
- Self-replicating.

RNA

- It has a ribose and phosphate backbone with four bases: Adenine, Cytosine, Guanine Uracil (ACGU).
- Found in Cytoplasm, nucleus and Ribosome.
- Has Ribose.
- Single stranded molecule with shorter chain of nucleotides.
- Synthesize from DNA when required.

CELL

- A Cell is defined as smallest, basic unit of life responsible for all life's processes.
- Robert Hooke coined the term Cell in 1665.
- Cells provide structure and support to the body of an organism.
- Cells are of 2 types namely, Prokaryotes & Eukaryotes.

Prokaryotes

- Size of the cell is generally small.
- Nucleus absent.
- It contains a single chromosome.
- Membrane bound cell organelles are absent.
- Cell division takes place by fission or budding.

Eukaryotes

- Size of the cell is generally large.
- Nucleus present.
- It contains more than one chromosome.
- Cell organelles are present.
- Cell division takes place by mitosis and meiosis.

STRUCTURE OF A CELL

A cell consists of three parts:

1. The cell membrane
2. The nucleus, and, between the two,
3. The cytoplasm.

The Cell membrane

- Every cell in the body is enclosed by a cell (Plasma) membrane.
- It maintains the integrity of a cell and controls passage of materials into and out of the cell.
- All materials within a cell must have access to the cell membrane for the needed exchange.

The Nucleus & nucleolus

- The nucleus determines how the cell will function, as well as the basic structure of that cell.
- Threads of chromatin in the nucleus contain Deoxyribonucleic Acid (DNA), the genetic material of the cell.
- The nucleolus is a dense region of ribonucleic acid (RNA) in the nucleus and is the site of ribosome formation.

The cytoplasm

- Cytoplasm is a thick solution that fills each cell and is enclosed by the cell membrane.
- Within the cytoplasm lie intricate arrangements of fine fibers and hundreds or even thousands of miniscule but distinct structures called organelles.

- Each type of organelle has a definite structure and a specific role in the function of the cell.

Organelle and its Function:

Organelle	Function
Nucleus	DNA Storage
Mitochondrion (Power house)	Energy production
Smooth Endoplasmic Reticulum(SER)	Lipid Production; Detoxification
Rough Endoplasmic Reticulum(RER)	Protein production
Golgi apparatus (Cell's Post office)	Made of tubes, vesicles & vacuoles. Protein Modification and material transfer, also involved in the synthesis of Cell wall, Plasma membrane & Lysosomes.
Peroxisome	Lipid Destruction; contains oxidative enzymes
Lysosome (cell's suicide bags)	Protein Destruction
Chromosomes	Determine the sex of an individual
Ribosome	Protein synthesis
Chloroplast (Kitchen of the plant cell)	It contains the pigment Chlorophyll-take part in Photosynthesis.
Vacuole	It helps in Osmoregulation. It stores toxic metabolic waste.

NOTE: Organelles are found only in plant cells.

PLASTID:

- Plastid is a double membrane-bound organelle involved in the synthesis and storage of food.

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- Commonly found within the cells of photosynthetic plants.
 - It is of 3 types: Chloroplasts, Chromoplast & Leucoplast.
 - Chloroplasts:** These are green pigments found in green plant involved in photosynthesis.
 - Chromoplast** provides various colors to the plant like flower, fruit etc. For example, Carotene provides orange color while Carrot & Lycopene in tomatoes provide red color.
 - Leucoplast** is colorless. It stores the food in the form of starch, fat & protein.
- NOTE:** Plastids were discovered and named by Ernst Haeckel, but A. F. W. Schimper was the first to provide a clear definition.

CELL WALL:

- A cell wall is an outer layer surrounding certain cells that is outside of the cell membrane.
- All cells have cell membranes, but generally only plants, fungi, algae, most bacteria, and archaea have cells with cell wall
- The cell wall provides strength and structural support to the cell.

NOTE: Chitin is a polysaccharide that is a main component of fungal cell walls and also of the exoskeletons of certain animals like insects.

DIFFERENCE BETWEEN PLANT AND ANIMAL CELL:

Plant Cell	Animal Cell
Cells are larger in size.	Generally smaller
Cell wall - Present. Made up of Cellulose & Chitin.	Cell wall - Absent.
Plastid present.	Plastid absent.
Centrosome absent.	Centrosome present.
Vacuoles are larger in size.	Vacuole are smaller in size.

STEM CELLS:

- The smallest functional unit of life is called the Cell.
- These cells develop to form tissues which in turn develop to form organs.

- Stem cells are basically undifferentiated, primitive cells which have the potential to develop into many different types of cells like those in muscles, kidney, liver etc.
- Stem cell therapy has shown potential to cure many severe ailments. It is touted as the future of medical treatments.
- They have proved effective in the treatment of blood disorders, immune disorders, metabolic problems, & other organ degenerative diseases.

Growing Human Organs in Animal Body:

Recently Japanese researchers have successfully developed functional mouse kidneys inside rats using stem cells. This could be replicated in Humans.

Source of Stem Cells:

- Bone marrow, Umbilical cord blood, Adipose tissue, Allografts, Amniotic fluid etc.
- Based on Source: Types of stem Cells:
 1. Embryonic Stem Cells (ESCs)
 2. Adult/Somatic stem cells

Adult stem cells include:

- Hematopoietic Stem cells (HSCs), Mesenchymal Stem Cells, Neural stem cells, Epithelial Stem cells, Skin stem cells, Induced pluripotent stem cells.
- Induced pluripotent stem cells (iPS): Scientists create these in a lab, using skin cells and other tissue-specific cells. These cells behave in a similar way to embryonic stem cells, so they could be useful for developing a range of therapies.
- These cells derived from the patient themselves, so are less likely to be rejected.

Cell Potency:

- Refers to the varying ability of stem cells to differentiate into specialized cell types.
- Cells with greatest potency can generate more cell types than lower potency cells.

Hierarchy of Cell Potency:

- **Totipotent Stem Cells:** Stem cells can give rise to any of 220 cell types found in embryos as well as extra-embryonic cells(placenta).
- **Pluripotent Stem Cells:** can give rise to all cell types of body (but not the placenta).
- **Multipotent Stem Cells:** can develop a limited number of cell types in a particular lineage.
- **Unipotent Stem Cells:** give rise to cells of their own type along a single lineage.

DNA Profiling:

- DNA profiling is the process where a specific DNA pattern, called a profile, is obtained from a person or sample of bodily tissue.
- It is a forensic technique in criminal investigations, comparing criminal suspects' profiles to DNA evidence so as to assess the likelihood of their involvement in the crime.
- It is also used in parentage testing, to establish immigration eligibility, and in genealogical and medical research.

Short Tandem Repeats (STRs):

- One of the current techniques for DNA profiling uses polymorphisms called STRs.
- These are regions of non-coding DNA that contain repeats of the same nucleotide sequence. Ex: GATA GATA.

Genetic Disorders

- A genetic disorder is a disease that is caused by a change, or mutation, in an individual's DNA sequence.
- These mutations can be due to an error in DNA replication or due to environmental factors, such as cigarette smoke & exposure to radiation, which cause changes in the DNA sequence.
- The three main categories are:
 1. **Single gene disorders:** disorders caused by defects in one particular gene, often with simple and predictable inheritance patterns. Ex: Huntington's disease, Cystic fibrosis.
 2. **Chromosome disorders:** disorders resulting from changes in the number or structure of the chromosomes. Ex: Down's syndrome, which results from an extra chromosome 21.
 3. **Multifactorial disorders (complex diseases):** disorders caused by changes in multiple genes, often in a complex interaction with environmental & lifestyle factors such as diet or cigarette smoke.

Gene Therapy

- Technique to replace defective genes with healthy genes to treat genetic disorders.
- Artificial method that introduces DNA into the cells of human body.
- First developed in 1972, but has limited success.
- Two types of gene therapy: Somatic gene therapy, Germline gene therapy.

- Increased nutritional content of a crop
- **Developing resistance to:**
 1. Abiotic factors like temperature, salinity or herbicide resistance.
 2. Biotic factors like insects.

GM Crops in India:

- Bt cotton, it has two alien genes from the soil bacterium *Bacillus thuringiensis* (Bt) that allows the crop to develop a protein toxic to the common pest pink bollworm.
- Ht-Bt (Herbicide Resistant) Cotton is derived with the insertion of an additional gene, from another soil bacterium, which allows the plant to resist the common herbicide glyphosate.
- In Bt brinjal, a gene allows the plant to resist attacks of fruit & shoot borer.
- In DMH-II Mustard, genetic modification allows cross-pollination in a crop that self-pollinates in nature.
- Across the world, GM variants of maize, canola vs soybean, too, are available.
- Bt Cotton is the only GM crop that is allowed in India from 2002.
- Ht-Bt Cotton is not allowed to be cultivated in India.
- Bt Brinjal has been under an indefinite moratorium on commercial cultivation since 2010 in India.

Regulatory Authorities:

GM Food: FASSI regulates manufacture, storage, distribution, sale & import GM food.
For GM Crops: Genetic Engineering Appraisal Committee (GEAC) under MoEF&CC.

Biotechnology in India:

- The remarkable march of India into the world of biosciences and technological advances began in 1986. (Mr. Rajiv Gandhi period)
- In 1986, a separate Department for Biotechnology, within the Ministry of Science & Technology, Govt was created.
- Vision: "Attaining new heights in biotechnology research, shaping biotechnology into a premier precision tool of the future for creation of wealth & ensuring social justice especially for the welfare of the poor."

- BT has made a huge impact on Indian agriculture, healthcare, industry and environment on one hand, while raising the global standing of India.
- The National Biotechnology Development Strategy (2015-2020) aims to make India a US\$ 100bn Bio-economy by 2025.

BIO-Technology Kisan programme:

- Farmer-centric scheme, by DBT Ministry of Science & Technology.
- Pan India program to stimulate entrepreneurship and innovation in farmers and empower women farmers.
- Aims to understand the problems and provide simple solutions to farmers.

Bio-economy or bio-teconomy:

- It refers to all economic activity derived from scientific & research activity focused on biotechnology.
- It is closely linked to the evolution of the biotechnology industry.

Major initiatives of the National Biotechnology Development Strategy

- Launch four major missions in Healthcare, Food & Nutrition, Clean Energy and Education.
- Create a technology development & translation network across India with global partnership.
- Ensure strategic & focused investment in building the human capital by setting up a Life Sciences & Biotechnology Education Council.

Biotechnology Regulatory Authority of India (BRAI)

- BRAI is a proposed regulatory body to regulate the use of Genetically Modified Organisms (GMOs), as per the provisions of the Bill introduced in the Parliament in 2013.
- BRAI was needed as India had signed the Cartagena Protocol and the Protocol mandates setting up of a Regulatory Body.

Genetic Engineering Appraisal Committee (GEAC)

- The GEAC functions under the MoEF&CC.
- It is responsible for the appraisal of activities involving large-scale use of hazardous microorganisms and recombinants in research & industrial production from the environmental angle.
- Also responsible for the appraisal of proposals relating to the release of GE organisms & products

into the environment including experimental field trials.

- GEAC is chaired by the Special Secretary/Additional Secretary of MoEF&CC and co-chaired by a representative from the Department of Biotechnology (DBT).

Recombinant-DNA (R-DNA) Technology:

- R-DNA is a “genetic engineering” technology used for producing Artificial DNA through the combination of different genetic materials from different sources.
- R-DNA involves several steps in specific sequence such as:
 1. Isolation of DNA,
 2. Fragmentation of DNA,
 3. Isolation of a desired DNA fragment,
 4. Ligation of the DNA fragment into a vector,
 5. Transferring the R-DNA into the host,
 6. Culturing the host cells and extraction of desired products.

Application:

1. In Gene Therapy to correct gene defects.
2. Useful in detecting presence of Human immunodeficiency virus. (ELISA test)
3. Production of Insulin.

DNA MICROARRAY

- In recent years, a new technology, called DNA Microarray, has attracted tremendous interest among biologists.
- This technology promises to monitor the whole genome on a single chip so that researchers can have a better picture of the interactions among thousands of genes simultaneously.
- It is widely believed that thousands of genes and their products (i.e., RNA and proteins) in a given organism function in a complicated and orchestrated way that creates the mystery of life.
- However, traditional methods in molecular biology generally work on a “one gene-one experiment” basis, which means that the throughput is very limited and the “whole picture” of gene function is hard to obtain. Microarray Technology promises to study multiple genes in one experiment.
- Microarrays consist of large numbers of DNA molecules spotted in a systematic order on a solid substrate, usually a slide. The base pairing or

hybridization is the underlying principle of DNA microarray.

- Microarray exploits the preferential binding of complementary single-stranded nucleic acids.
- A microarray is typically a glass (or some other material) slide, onto which DNA molecules are attached at fixed locations (spots).
- There are several names to this technology – DNA arrays, gene chips, biochips, DNA chips, and gene arrays. The DNA microarray technology is used for analyzing the expression of thousands of messenger RNA molecules.

This technique has been used to study the following:

- Tissue-specific genes
- Regulatory gene defects in a disease
- Cellular responses to the environment
- Cell cycle variations.

GEL ELECTROPHORESIS

- Gel Electrophoresis is a technique used to separate DNA fragments according to their size.
- Since DNA fragments are negatively-charged molecules, they can be separated by forcing them to move towards the anode under an electric field through a medium/matrix.
- Nowadays the most commonly used matrix is agarose which is a natural polymer extracted from seaweeds.
- The DNA fragments separate (resolve) according to their size through the sieving effect provided by the agarose gel. Hence, the smaller the fragment size, the farther it moves.
- The separated DNA fragments can be visualized only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation (you cannot see pure DNA fragments in the visible light and without staining)
- The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution.
- The DNA fragments purified in this way are used in constructing recombinant DNA by joining them with cloning vectors.

GENETIC MARKER

- A short sequence of DNA with a known location on chromosome useful to identify cells, individuals or species

● **Focus Areas:**

1. To provide digital infrastructure as a source of utility to every citizen.
2. Governance and services on demand.
3. Digital empowerment of every citizen.

The Nine Pillars of Digital India:

- Broadband Highways.
- Universal Access to Mobile Connectivity.
- Public Internet Access Programme.
- e-Governance: Reforming Government through Technology.
- e-Kranti: Electronic Delivery of Services.
- Information for All.
- Electronics Manufacturing.
- IT for Jobs.
- Early Harvest Programmes.

NATIONAL BROADBAND MISSION (NBM):

- Launched in 2019
- Objective: to provide universal & equitable access to broadband services across the country, especially in rural and remote areas by 2022.
- To increase tower density from 0.42 to 1.0 tower per thousand of the population by 2024.
- To develop 'Broadband Readiness Index (BRI)'.
● Funded by Universal Service Obligation Fund (USOF).

Broadband Readiness Index (BRI): measures the availability of digital communications infrastructure & conducive policy ecosystem within a State/UT.

BHARATNET PROJECT:

- It was launched as the 'National Optical Fiber Network (NOFN)' in 2011 and renamed as Bharat Net Project in 2015.
- Implemented by the Bharat Broadband Network Ltd (BBNL) a Special Purpose Vehicle (SPV) under the Ministry of Communications.
- Objective: to connect all Gram Panchayats with high-speed broadband connectivity to deliver online services.

CHAPTER - 5
CYBERSECURITY

- Cyberspace is the online world of computer networks, especially the Internet.
- Cyber Security protects the cyberspace from the following:

1. Cyber Attacks
2. Damage to Cyberspace
3. Misuse of Cyberspace
4. Economic Espionage

- Malware, or malicious software, is any program or file that is harmful to a computer user.

Types of Malware:

- **Virus:** It can execute itself and spread by infecting other programs or files.
- **Worm:** is a code that replicates itself without a host program.
- **Trojan:** It is a malicious program that is designed to appear as a legitimate program. Once installed Trojans carry out the designed functions. Ex: Event Bot is a mobile banking Trojan.
- **Spyware:** these are designed to spy over people/government sensitive data. Ex: Pegasus.
- **File less Malware:** it doesn't install anything initially, instead, it makes changes to the files that are native to OS. E.g., Astaroth.
- **Adware:** tracks user surfing activity, serves unwanted advertisements, erosion of user's privacy. e.g., Fireball.
- **Rootkits:** gives hackers remote control of a victim's device. E.g. Zacinto.
- **Urban legends:** viral emails that include urban legends usually warn of threat and compel recipients to forward the mails to others.
- **Keyloggers:** monitors users' keystrokes. E.g. Olympic vision
- **BOT** is software capable of compromising the victims' machine and using it for further malicious activities.
- **RANSOMWARE:** is a type of malware that threatens to publish the victim's data or perpetually block access to it unless a ransom is paid. Ex: Maze, Locky & Wanna Cry Ransomware.
- **PHISHING:** is a type of cyber-attack where criminals impersonate legitimate organizations via

email, text message, advertisement or other means to steal sensitive information.

CYBERSECURITY & INDIA:

CERT-IN: Indian Computer Emergency Response Team.

- Established in 2004, CERT-IN functions under the Department Of IT.
- Mandated under the Information Technology Amendment Act 2008 to serve as the national agency in charge of cybersecurity.
- Since 2012, DG of CERT-IN has been called the National Cyber Security Coordinator (NCSC).

NATIONAL CYBERSECURITY POLICY, 2013: To build secure and resilient cyberspace for citizens, businesses and Government.

THE INDIAN CYBER CRIME COORDINATION CENTRE (I4C):

- Established in 2020, under 'Cyber and Information Security (CIS)' division of the Ministry of Home Affairs. HQ: New Delhi.
- The I4C will assist in centralizing cybersecurity investigations, prioritize the development of response tools and bring together private companies to contain the menace.

NATIONAL CRITICAL INFORMATION INFRASTRUCTURE PROTECTION CENTRE (NCIIPC):

- Established under Information Technology Act, 2000 to secure India's critical information infrastructure.
- NCIIPC has broadly identified the following as 'Critical Sectors':
 1. Power & Energy
 2. Banking,
 3. Financial Services & Insurance
 4. Telecom
 5. Transport
 6. Government Strategic & Public Enterprises.

DATA SECURITY COUNCIL OF INDIA:

- It is a not-for-profit premier industry body on data protection in India.
- It has been set up by NASSCOM.

The National Association of Software and Service Companies (NASSCOM)

- NASSCOM is a trade association of Indian Information Technology (IT) and Business Process Outsourcing (BPO) companies.
- Established in 1988, as a non-profit org.
- Focused on building the architecture integral to the development of the IT, BPO sector through policy advocacy.
- This initiated a program called '10,000 Startups' in 2013.

DATA LOCALIZATION:

- Data localization is a concept that the personal data of a country's residents should be processed & stored in that country.
- It may restrict flow entirely or allow for conditional data sharing or data mirroring (in which only a copy has to be stored in the country).

RELATED INFORMATION

- In 2018 RBI directed payment system providers to store entire payments data in a system only in India.
- **CLOUD** (Clarifying Lawful Overseas Use of Data) Act of US seeks to de-monopolize control over data from US authorities & allows tech companies to share it with foreign governments.
- General Data Protection Regulation (GDPR) of the European Union allows cross-border movement of data but requires the destination country to have stringent cyber-security rules.

DATA PROTECTION & INDIA:

- Currently, India does not have a dedicated legal data protection framework.
- But, some provisions under different acts protect data in general. These include the CopyRight Act 1957, IT Act 2000, & the Consumer protection Act 2015 etc.,
- In 2018, N. Srikrishna committee constituted to look after data protection provisions in India.
- The Personal Data Protection Bill, 2019 which was introduced in Lok Sabha in this regard is yet to become an Act.

DIGITAL SIGNATURE CERTIFICATES (DSC):

- DSC are the digital equivalent (that is electronic format) of physical or paper certificates.

- Certificates serve as a proof of identity of an individual.
- DSCs can be presented electronically to prove identity, to access information or services on the Internet or to sign certain documents digitally.

Digital Quality of Life Index 2020

- Prepared by Surfshark, a virtual private network (VPN) provider based in the British Virgin Islands
- It seeks to rank countries on internet affordability & quality, electronic infrastructure, security and government.
- **Top 3 countries:** Denmark à Sweden à Canada
- India ranked 57 out of 85 countries.

Spectrum Auction

What is Spectrum?

- The word spectrum refers to a collection of various types of electromagnetic radiations of different wavelengths.
- Spectrum or airwaves are the radio frequencies on which all communication signals travel.
- In India, the radio frequencies are being used for different types of services like space communication, mobile communication, broadcasting, radio navigation, mobile satellite service, aeronautical satellite services, defense communication, etc.
- Radiofrequency is a natural resource but unlike other resources, it will deplete when used. But it will be wasted if not used efficiently.
- The spectrum allocated to Indian telecom operators is most crowded and inadequate to accommodate the usage by 650 million mobile subscribers as on date. This has affected the quality of customer service and resulted in poor voice quality, call drop, and undelivered messages of mobile services in India.

What is the mobile spectrum?

- Mobile or cellular spectrum is that part of the whole electromagnetic spectrum which is used by the Indian government to offer mobile services. Hence the name "Mobile Spectrum".
- Generally, the following frequencies are used for this purpose – 800 Mhz (for CDMA), 900 Mhz (for 2G) & 1800 Mhz (for 3G/4G).
- But technically any frequency band can be used for any purpose. Like 900 Mhz frequency can be used to deliver 3g Services also.

Agencies allocating Spectrum

- For international purposes, the spectrum is allocated by the world body called the International Telecommunication Union (ITU).
- For domestic purposes, it is done by the Wireless Planning and Coordination (WPC) Wing of the Ministry of Communications, created in 1952, is the National Radio Regulatory Authority responsible for Frequency Spectrum Management, including licensing and caters for the needs of all wireless users in the country. It issues licenses to operate wireless stations.

What is the Reserve Price?

- It is the minimum amount set by the government from which the auction starts i.e. it is the starting amount or base price from which the auction starts.

Why is the spectrum auction done?

- Spectrum is a scarce resource. It needs to be managed efficiently.
- Also, the spectrum can't be used by many people. It has to be allocated to some persons who can manage the services under it. Hence it is auctioned.
- Government auctions it because the spectrum is a resource & the ownership rights for it are vested in the Government of India. It is not private property. So, the government auctions it.
- Also, a lot of revenue is generated by selling the spectrum. That money can be used for developmental programs in India.

Reasons for superiority of 900 Mhz and 1800 Mhz band

- According to the laws of Physics, for any wave, the higher the frequency of the wave, the lesser will be the distance traveled by it. So naturally, frequencies of 900 Mhz will cover more distance than the frequencies of 1800 Mhz & hence mobile operators are more interested in the 900 Mhz frequency.
- More investment needed by the companies who buy the 1800 Mhz frequency spectrum: the 1800 Mhz frequency has poor coverage than the 900 Mhz frequency. So, for matching the existing coverage mobile operators have to install additional base stations (i.e. mobile towers) to give the same effect as the frequencies under 900 Mhz.
- Also, hardware equipment required for carrying out the operation of 1800 Mhz frequency is costly. The main reason behind it is that the 900 Mhz frequency band has been in use for mobile

of technology being used by your mobile. A recharge voucher meant for GSM mobiles can't work for CDMA mobiles & vice versa.

S.No.	Parameter	CDMA	GSM
1.	Stands for	Code Division Multiple Access	Global System for Mobile Communication
2.	Storage Type	Internal Memory	SIM (Subscriber identity module) Card
3.	Global Market share	25%	75%
4.	Dominance	Dominant standard in the US	Dominant standard worldwide except the US
5.	Network	There is one physical channel and a special code for every device in the coverage network. Using this code, the signal of the device is multiplexed, and the same physical channel is used to send the signal.	Every cell has a corresponding network tower, which serves the mobile phones in that cellular area.
6.	International roaming	Less Accessible	Most Accessible
7.	Frequency band	Single (850 MHz)	Multiple (850/900/1800/1900 MHz)
8.	Network service	Handset specific	SIM specific. User has the option to select the handset of his choice.

What is GPRS?

GPRS is a system used to transmit data at speeds of up to 60 Kbits per second and is a battery-friendly way to send and receive emails and to browse the internet but in these days of broadband connectivity, it will be seen as slow by some.

What is EDGE?

EDGE (Exchanged Data rates for GSM Evolution) is a recent development based on the GPRS system and has been classified as a '3G' standard due to the fact that it can run at up to 473.6 Kbits per second. If a smartphone is EDGE compliant it can be used for heavy mobile data transmission such as receiving large email attachments and browsing complex web pages at great speed.

What is HSDPA?

HSDPA (High-Speed Downlink Packet Access) is a technology-based 3G network which can support speeds of up to 7.2 Mbits per second. In reality, you will most likely get a top speed of around 3

Mbits but this is useful for mobile TV streaming and other high-end data transmissions. To use HSDPA your phone must be able to support the technology and of course, you will need to be located within range of a cell site that has been upgraded to offer the service.

What is HSPA (Plus)?

- This is an evolution of the HSPA (HSDPA & HSUPA) standard and allows for faster speeds. The maximum download speed allowed by the standard is 168 Mbit/s although in reality networks that support HSPA (plus) will offer 21 Mbit/s downloads. This is because the existing 3G network architecture operators that would have deployed and made compatible were never designed to handle such massive bandwidth.
- The operators need additional spectrum to improve the quality of services. The Government should formulate a spectrum policy that will promote efficient use of spectrum by developing market incentives and differential pricing of spectrum in

congested areas. An open and transparent auction format will ensure that the government realizes the best price for spectrum as per the market forces and at the same time the telecom operators minimize and efficiently use the spectrum.

OPTICAL FIBRE Technology

- Fibre-optic communication is a method of transmitting information from one place to another by sending pulses of light through an optical fiber. The light forms an electromagnetic carrier wave that is modulated to carry information.
- Fibre is preferred over electrical cabling when high bandwidth, long-distance, or immunity to electromagnetic interference is required.
- Optical fibre is made up of semiconducting materials and usually has a cylindrical structure. In the inner core, there is the material of higher refractive index than in the outer core resulting in Total Internal Reflection (TIR).

Free-Space optical communication (FSO)

Free-space optical communication (FSO) is an optical communication technology that uses light propagating in free space to wirelessly transmit data for telecommunications or computer networking. "Free-space" means air, outer space, vacuum, or something similar. This contrasts with using solids such as optical fiber cable.

It is a Line of Sight (LOS) technology. It consists of an optical transceiver at both ends to provide full duplex (bidirectional) capability.

It is capable of sending up to 1.25 Gbps of data, voice, and video communications simultaneously through the air.

Advantages: low initial investment, flexible network that delivers better speed than broadband, security due to line of sight operation, etc.

Challenges: misalignment errors, geometric losses, background noise, weather attenuation losses and atmospheric turbulence.

Radio-frequency identification (RFID)

Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically-stored information.

Passive tags collect energy from a nearby RFID reader interrogating radio waves. Active tags have

a local power source (such as a battery) and may operate hundreds of meters from the RFID reader. Unlike a barcode, the tag need not be within the line of sight of the reader, so it may be embedded in the tracked object. RFID is one method for Automatic Identification and Data Capture (AIDC).

RFID can be used in a variety of applications, such as:

- The electronic key for RFID based lock system
- Access management
- Tracking of goods
- Tracking of persons and animals
- Toll collection and contactless payment
- Machine-readable travel documents
- Smart Dust (for massively distributed sensor networks)
- Airport baggage tracking logistics
- Timing sporting events
- Tracking and billing processes

RFID provides a way for organizations to identify and manage stock, tools, and equipment (asset tracking), etc. without manual data entry.

RFID is used for item-level tagging in retail stores. In addition to inventory control, this provides both protection against theft by customers (shoplifting) and employees ("shrinkage") by using electronic article surveillance (EAS), and a self-checkout process for customers.

Yard management, shipping and freight, and distribution centers use RFID tracking. In the railroad industry, RFID tags mounted on locomotives and rolling stock identify the owner, identification number, and type of equipment and its characteristics. This can be used with a database to identify the lading, origin, destination, etc. of the commodities being carried.

BIG DATA

Big data is a term used to refer to the study and applications of data sets that are so big and complex that traditional data-processing application software is inadequate to deal with them. Big data challenges include capturing data, data storage, data analysis, search, sharing, transfer, visualization, querying, updating, information privacy, and data source.

There are a number of concepts associated with big data: originally there were three concepts: volume, variety, velocity. Other concepts later attributed to

big data are veracity (i.e., how much noise is in the data) and value.

Big data can be described by the following characteristics:

- **Volume** – The quantity of generated and stored data. The size of the data determines the value and potential insight, and whether it can be considered big data or not.
- **Variety** – The type and nature of the data. This helps people who analyze it to effectively use the resulting insight. Big data draws from text, images, audio, video; plus it completes missing pieces through data fusion.
- **Velocity** – In this context, the speed at which the data is generated and processed to meet the demands and challenges that lie in the path of growth and development. Big data is often available in real-time.
- **Veracity** – The data quality of captured data can vary greatly, affecting the accurate analysis.

Applications–

Government –Big data is being increasingly used by the government in policy formation. The use and adoption of big data within governmental processes allow efficiencies in terms of cost, productivity, and innovation, but does not come without its flaws.

International development –Research on the effective usage of information and communication technologies for development (also known as ICT4D) suggests that big data technology can make important contributions but also present unique challenges to International development. Advancements in big data analysis offer cost-effective opportunities to improve decision-making in critical development areas such as health care, employment, economic productivity, crime, security, and natural disaster and resource management.

Manufacturing– A conceptual framework of predictive manufacturing begins with data acquisition where different types of sensory data are available to acquire such as acoustics, vibration, pressure, current, voltage, and controller data. The vast amount of sensory data in addition to historical data construct big data in manufacturing. The generated big data acts as the input into predictive tools and preventive strategies such as Prognostics and Health Management (PHM).

Healthcare– Big data analytics has helped healthcare improve by providing personalized medicine and prescriptive analytics, clinical risk intervention and predictive analytics, waste and care variability reduction, automated external and internal reporting of patient data, standardized medical terms, and patient registries and fragmented point solutions.

Education– A McKinsey Global Institute study found a shortage of 1.5 million highly trained data professionals and managers and a number of universities including the University of Tennessee and UC Berkeley, have created master's programs to meet this demand. Private boot camps have also developed programs to meet that demand, including free programs like The Data Incubator or paid programs like General Assembly.

Media–

- Targeting of consumers (for advertising by marketers)
- Data capture
- Data journalism: publishers and journalists use big data tools to provide unique and innovative insights and infographics.

Insurance– Health insurance providers are collecting data on social “determinants of health” such as food and TV consumption, marital status, clothing size and purchasing habits, from which they make predictions on health costs, in order to spot health issues in their clients. It is controversial whether these predictions are currently being used for pricing.

Internet of Things (IoT)

Big data and the IoT work in conjunction. Data extracted from IoT devices provides a mapping of device interconnectivity. Such mappings have been used by the media industry, companies, and governments to more accurately target their audience and increase media efficiency. IoT is also increasingly adopted as a means of gathering sensory data, and this sensory data has been used in medical, manufacturing, and transportation contexts.

End-to-end encryption (E2EE)

End-to-end encryption (E2EE) is a system of communication where only communicating users can read the messages. In principle, it prevents

CHAPTER-17

NON-RENEWABLE SOURCES OF ENERGY

Sources of energy

Conventional		Non conventional
Conventional non-renewable energy	Conventional renewable energy	1. Solar energy 2. Hydro power 3. Wind energy 4. Nuclear energy 5. Hydrogen energy 6. Geothermal energy 7. Bio gas 8. Tidal energy 9. Bio-fuel
Mostly fossil fuels found under the ground. Coal, oil, natural gas etc. are the examples.	Mostly non-fossil fuels seen above the ground. Fire wood, cattle dung from vegetable wastes, wood charcoal etc. are the examples.	

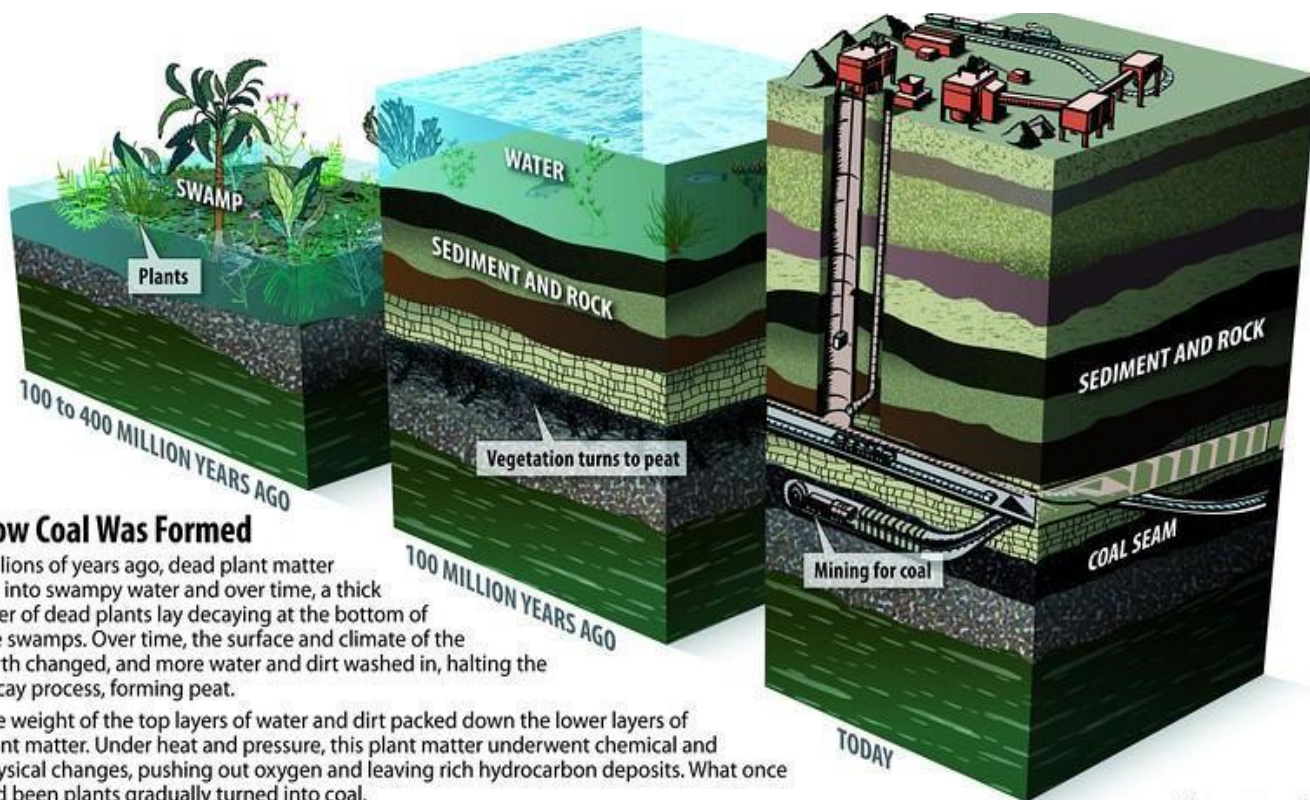


- Fossil fuels represent stored solar energy captured by plants in the past geological times.
- Coal, petroleum and natural gas are called fossil fuels, as they are the remains of prehistoric plants, animals and microscopic organisms that lived millions of years ago.
- During the Carboniferous period 275-350 million years ago, conditions in the world were suitable for formation of large deposits of fossil fuels.

Coal

- Coal is formed from plants and vegetation buried, 'in situ' or drifted in from outside to a place, which got covered by deposits of sediments.
- Coal is a solid fossil fuel and a sedimentary rock composed primarily of carbon. There are three basic grades of coal: i) lignite (brown coal), ii) bituminous (soft coal) and iii) anthracite (hard coal).

Formation of coal



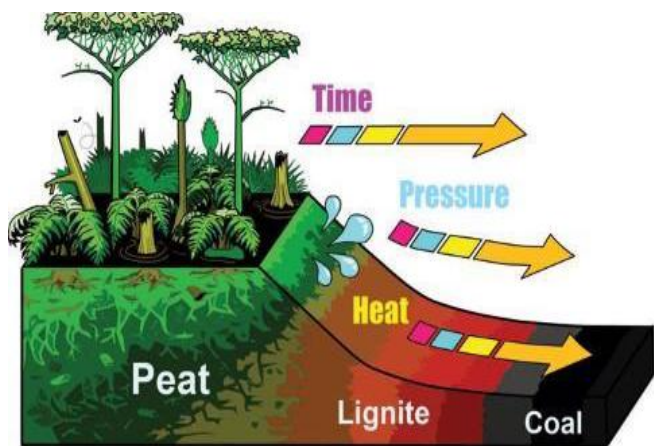
How Coal Was Formed

Millions of years ago, dead plant matter fell into swampy water and over time, a thick layer of dead plants lay decaying at the bottom of the swamps. Over time, the surface and climate of the Earth changed, and more water and dirt washed in, halting the decay process, forming peat.

The weight of the top layers of water and dirt packed down the lower layers of plant matter. Under heat and pressure, this plant matter underwent chemical and physical changes, pushing out oxygen and leaving rich hydrocarbon deposits. What once had been plants gradually turned into coal.

Coal can be found deep underground (as shown in this graphic), or it can be found near the surface.

Note: not to scale



- Coal is the result of plant material that grew in freshwater swamps approximately three hundred million years ago.
- As this plant material died and accumulated, peat also called peat bog was formed.
- Since the plant material accumulated under water, in the swamps decay was inhibited due to lack of oxygen.
- Oceans inundated many of the areas of peat and sediments from the sea were deposited, over the peat.
- The weight of these sediments and the heat of the earth gradually changed the composition of the peat bog and coal was formed.

- Today peat also is used as a source of fuel in some parts of the world though its high water content makes it a low-grade fuel.
- Peat is changed into coal after many centuries of being compressed by the weight of sediments. It first changes into a low-grade coal known as lignite (brown coal).
- The percentage of carbon in the lignite is higher than in peat. Continued pressure and heat from the earth changes lignite and bituminous soft coal.
- If the heat and pressure were great enough then anthracite coal (hard coal) would be formed which has the highest heat and carbon content.
- Accordingly, energy content is greatest in anthracite coal and lowest in lignite.
- The sulphur content of coal is important because burning low sulphur coal emits less sulphur dioxide (SO₂) so it is more desirable as a fuel for power plants.

Problems with Coal Mining

- Coal is the most abundant fossil fuel on earth, but there are problems associated with its mining, transportation and use.
- Coal is mined from both (i) surface mines, and (ii) underground mines.

Surface mining

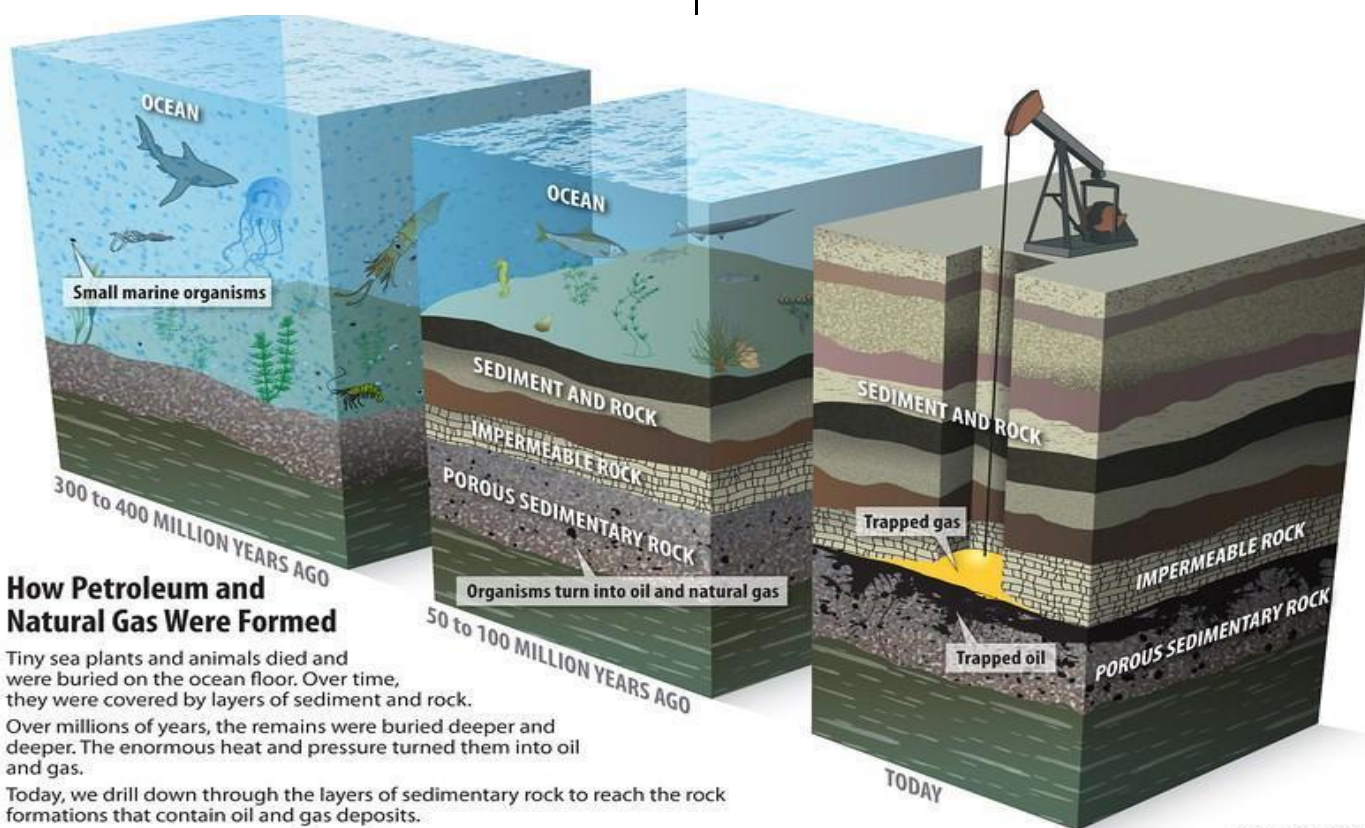
- Surface mining disrupts and drastically changes the natural landscape and destroys the natural vegetation and the habitat of many species, some of which may already be endangered.
- Mining operations, involving digging, blasting, removal of rocks and soil lying over the coal seam, cause serious problems of air and noise pollution.
- Surface mining may also cause soil erosion and silt loading (the discharge of silts into streams) and canals that disrupt and pollute the aquatic ecosystems as well as ground water in places where aquifers are located near or associated with coal seams.

Underground mining

- Underground mining may cause collapse or land subsidence in the mining areas during or after mining operations are over.
- In case of some mines acid mine drainage from the mine waste pollutes long stretches of streams.
- Coal bed methane in underground mines causes fires.

Apart from these problems, burning of coal in thermal power plants for generation of electricity and in industry is the prime source of air pollution.

Petroleum Or Mineral Oil



How Petroleum and Natural Gas Were Formed

Tiny sea plants and animals died and were buried on the ocean floor. Over time, they were covered by layers of sediment and rock.

Over millions of years, the remains were buried deeper and deeper. The enormous heat and pressure turned them into oil and gas.

Today, we drill down through the layers of sedimentary rock to reach the rock formations that contain oil and gas deposits.

Note: not to scale

- Oil and gas were formed from the remains of plants and animals that once lived in the sea.
- For over millions of years these remains remained buried under mud and rock under great pressure and at high temperatures.
- Under these conditions marine biomass gradually changed into oil and gas.
- Oil and gas are primarily found along geologically young tectonic belts at plate boundaries, where large depositional basins are more likely to occur.
- Petroleum or crude oil (oil as it comes out of the ground), is a thick dark liquid consisting of a mixture of hundreds of combustible hydrocarbons

along with small amounts of sulphur, oxygen and nitrogen impurities. It is also known as conventional oil or light oil.

- Deposits of crude oil and natural gas are usually trapped together under the sea floor or earth's crust on land.
- After it is extracted, crude oil is transported to a refinery by pipelines, trucks or ships (oil tanker).
- In refineries oil is heated and distilled to separate it into components with different boiling points. The important components are gases, gasoline, aviation fuel, kerosene, diesel oil, naphtha, grease and wax and asphalt.

- Some of the products of oil distillation are called petro-chemicals which are used as raw material for the manufacture of pesticides, plastics, synthetic fibers, paints and medicines etc.

Natural Gas

- Natural gas, primarily consisting of methane, is often found above reservoirs of crude oil.
- The natural gas is a mixture of 50 to 90% by volume of methane (CH_4), the simplest hydrocarbon.
- It also contains small amounts of heavier gaseous hydrocarbons such as ethane (C_2H_6), propane (C_3H_8) and butane (C_4H_{10}) and also small amounts of highly toxic hydrogen sulphide (H_2S).
- Natural gas is formed through geological processes similar to the processes of crude oil formation described earlier except the organic material gets changed to more volatile hydrocarbons than those found in oil.
- Almost every oil well produces liquid petroleum along varying amounts of natural gas. However, there are large gas deposits without any liquid petroleum being associated with them.

Conventional natural gas

- It lies above most reservoirs of crude oil. These deposits can be tapped/used only through pipelines.
- But the natural gas that comes out along with oil is often looked as unwanted by product and is burned off.

Unconventional natural gas

- It is found by itself in other underground reservoirs. So far it is very expensive to get natural gas from such unconventional sources but technology is being developed to extract the gases economically.
- When a natural gas field is tapped, propane and butane gases, present in natural gas, are liquefied and removed as liquefied petroleum gas (LPG).
- LPG is stored in pressurized tanks or cylinders for use as cooking gas. At a very low temperature natural gas can be converted to liquefied natural gas (LNG).
- Natural gas is used as a source of carbon used in the tyre industry. When natural gas is strongly heated, then methane gets decomposed to form carbon and hydrogen.
- The carbon thus formed is called carbon black and used as filler in the manufacture of tyres.

Problems associated with oil and gas

- Methane being a major component of natural gas, happens to be a greenhouse gas and its leakage contributes to global warming.
- Extraction of oil and gas may cause sinking of land or subsidence.
- Another major problem in the past with onshore oil wells has been brine (salt water). Typically, for every barrel of oil production ten barrels of brine are also extracted.
- In early days the brine was simply discarded into nearby streams or on the soil. Today most brine is reinjected into the well. However, brine can contaminate fresh water aquifers if the casing lining the well is missing or corroded.
- About half of the oil that contaminates the ocean comes from natural seepage from offshore deposits.
- 20% of the oil contaminating the ocean comes from oil wells, blowouts, pipeline breaks and tankers.

Nuclear Energy Sources

- Radioactive minerals are used to generate nuclear energy through high technological methods.
- There are two methods which can be used to release energy from radioactive minerals:
 1. **Nuclear fission** – In this process, the nucleus of a heavy atom namely of uranium ($\text{U } 235$) or plutonium ($\text{P}239$) breaks apart into smaller fragments, releasing an enormous amount of energy.
 2. **Nuclear fusion** – In this process, small nuclei like those of isotopes of hydrogen, namely deuterium and tritium fuse or join together to form heavier nuclei, releasing vast amounts of energy.

Nuclear fission

- Radioactive mineral, which generates nuclear energy through fission, may be considered a non-renewable alternative source of energy as it is an ore and is found in limited quantities.
- Nuclear fission occurs because the atom of radioactive minerals contains nuclei that are unstable and break or split apart releasing energy.
- Whenever a neutron strikes a nucleus of U-235 , energy is released, krypton and barium are produced, and several neutrons are released.
- These new neutrons may strike other atoms of U-235 to produce a chain reaction.

प्रिय दोस्तों, अब तक हमारे नोट्स में से विभिन्न परीक्षाओं में आये हुए प्रश्नों के परिणाम देखने के लिए क्लिक करें - ↓ (Proof Video Link)

RAS PRE. 2021 - <https://shorturl.at/qBJ18> (74 प्रश्न, 150 में से)

RAS Pre 2023 - <https://shorturl.at/tGHRT> (96 प्रश्न, 150 में से)

UP Police Constable 2024 - <http://surl.li/rbfyn> (98 प्रश्न, 150 में से)

Rajasthan CET Gradu. Level - <https://youtu.be/gPqDNlc6UR0>

Rajasthan CET 12th Level - <https://youtu.be/oCa-CoTFu4A>

RPSC EO / RO - <https://youtu.be/b9PKj14nSxE>

VDO PRE. - <https://www.youtube.com/watch?v=gXdAk856Wl8&t=202s>

Patwari - <https://www.youtube.com/watch?v=X6mKGdtXyu4&t=2s>

PTI 3rd grade - https://www.youtube.com/watch?v=iA_MemKKgEk&t=5s

SSC GD - 2021 - <https://youtu.be/2gzzfJyt6vl>

EXAM (परीक्षा)	DATE	हमारे नोट्स में से आये हुए प्रश्नों की संख्या
MPPSC Prelims 2023	17 दिसम्बर	63 प्रश्न (100 में से)
RAS PRE. 2021	27 अक्टूबर	74 प्रश्न आये
RAS Mains 2021	October 2021	52% प्रश्न आये





whatsapp - <https://wa.link/v3yx0t> 1 web.- <https://shorturl.at/JLQRY>

RAS Pre. 2023	01 अक्टूबर 2023	96 प्रश्न (150 में से)
SSC GD 2021	16 नवम्बर	68 (100 में से)
SSC GD 2021	08 दिसम्बर	67 (100 में से)
RPSC EO/RO	14 मई (1st Shift)	95 (120 में से)
राजस्थान S.I. 2021	14 सितम्बर	119 (200 में से)
राजस्थान S.I. 2021	15 सितम्बर	126 (200 में से)
RAJASTHAN PATWARI 2021	23 अक्टूबर (1st शिफ्ट)	79 (150 में से)
RAJASTHAN PATWARI 2021	23 अक्टूबर (2 nd शिफ्ट)	103 (150 में से)
RAJASTHAN PATWARI 2021	24 अक्टूबर (2 nd शिफ्ट)	91 (150 में से)
RAJASTHAN VDO 2021	27 दिसम्बर (1 st शिफ्ट)	59 (100 में से)
RAJASTHAN VDO 2021	27 दिसम्बर (2 nd शिफ्ट)	61 (100 में से)
RAJASTHAN VDO 2021	28 दिसम्बर (2 nd शिफ्ट)	57 (100 में से)
U.P. SI 2021	14 नवम्बर 2021 1 st शिफ्ट	91 (160 में से)
U.P. SI 2021	21 नवम्बर 2021 (1 st शिफ्ट)	89 (160 में से)
Raj. CET Graduation level	07 January 2023 (1 st शिफ्ट)	96 (150 में से)
Raj. CET 12th level	04 February 2023 (1 st शिफ्ट)	98 (150 में से)
UP Police Constable	17 February 2024 (1 st शिफ्ट)	98 (150 में से)





& Many More Exams like UPSC, SSC, Bank Etc.

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Approx. 483+ students selected in different exams. Some of them are given below -

Photo	Name	Exam	Roll no.	City
	Mohan Sharma S/O Kallu Ram	Railway Group - d	11419512037002 2	PratapNag ar Jaipur
	Mahaveer singh	Reet Level- 1	1233893	Sardarpura Jodhpur
	Sonu Kumar Prajapati S/O Hammer shing prajapati	SSC CHSL tier- 1	2006018079	Teh.- Biramganj, Dis.- Raisen, MP
N.A	Mahender Singh	EO RO (81 Marks)	N.A.	teh nohar , dist Hanumang arh
	Lal singh	EO RO (88 Marks)	13373780	Hanumang arh
N.A	Mangilal Siyag	SSC MTS	N.A.	ramsar, bikaner

	MONU S/O KAMTA PRASAD	SSC MTS	3009078841	kaushambi (UP)
	Mukesh ji	RAS Pre	1562775	newai tonk
	Govind Singh S/O Sajjan Singh	RAS	1698443	UDAIPUR
	Govinda Jangir	RAS	1231450	Hanumang arh
N.A	Rohit sharma s/o shree Radhe Shyam sharma	RAS	N.A.	Churu
	DEEPAK SINGH	RAS	N.A.	Sirsi Road , Panchyawa la
N.A	LUCKY SALIWAL s/o GOPALLAL SALIWAL	RAS	N.A.	AKLERA , JHALAWAR
N.A	Ramchandra Pediwal	RAS	N.A.	diegana , Nagaur

	Monika jangir	RAS	N.A.	jhunjhunu
	Mahaveer	RAS	1616428	village- gudaram singh, teshil-sojat
N.A.	OM PARKSH	RAS	N.A.	Teshil- mundwa Dis- Nagaur
N.A.	Sikha Yadav	High court LDC	N.A.	Dis- Bundi
	Bhanu Pratap Patel s/o bansi lal patel	Rac batalian	729141135	Dis.- Bhilwara
N.A.	mukesh kumar bairwa s/o ram avtar	3rd grade reet level 1	1266657	JHUNJHUN U
N.A.	Rinku	EO/RO (105 Marks)	N.A.	District: Baran
N.A.	Rupnarayan Gurjar	EO/RO (103 Marks)	N.A.	sojat road pali
	Govind	SSB	4612039613	jhalawad

	Jagdish Jogi	EO/RO Marks)	(84 N.A.	tehsil bhinmal, jhalore.
	Vidhya dadhich	RAS Pre.	1158256	kota
	Sanjay	Haryana PCS	96379 	Jind (Haryana)

And many others.....

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