

NCERT

Important Concepts

1. Kelvin: -273.16° C.
2. Homogenous mixture: Also called solution, it has uniform composition throughout. Eg. salt in water.
3. Colloids: Relatively large solute particles (called dispersed phase) are distributed throughout the solvent like medium (called dispersing medium).
4. Tyndall effect: The colloid particles are 1μ in diameter and can't be seen with naked eyes but can scatter light.
5. Lavoisier: Father of chemical science as he gave the law of conservation of mass in chemical reaction.
6. Dalton: He said all matter is composed of atoms.
7. Avogadro's constant: 6.022×10^{23} .
8. Empirical formula vs Molecular formula: NH_2 is empirical formula. N_2H_4 is molecular formula.
9. JJ Thomson: Discovered electron. Through his cathode ray tube experiments he found $e/m = 2000$ is constant for all gases and cathode rays have negative charge.
10. Phosphorescence: Material irradiated with light continues to emit light even when light source is turned off. Radium.
11. Electron Affinity: Energy released when an electron is gained by a neutral atom.
12. Cations are +ve charged and anions are -ve charged.
13. Electronegativity: The tendency of an atom in a molecule to attract the bonding pair of electrons towards itself is called electronegativity.
14. Oxidation / Reduction: Loss of electron is oxidation and gain of electron is reduction.
15. G: 6.673×10^{-11} .
16. Geotropism: Due to gravity, plant roots growing downwards and stem upwards irrespective of the seed orientation.
17. Thermal expansion: $\Delta L / L \propto \Delta T$.
18. Boiling point: It is the temperature at which the pressure of liquid is same as atmospheric pressure. So if pressure is lowered boiling point comes down. Pressure cookers increase the pressure over the liquid surface and increase the boiling point.
19. Vitamin solubility: A, D, E, K are fat soluble while B, C are water soluble.
20. Coal types: Peat (27%) < lignite (30%) < Bituminous (80%) < Anthracite (95%) carbon content. Coal gas is a mixture of CH_4 , CO, H_2 .

Models of Atom

JJ Thomson

1. Electrons are scattered throughout the volume of atom. Electrons not orbiting.

Rutherford

1. Nucleus @ centre and electrons orbiting around. But the problem is charged particles when accelerated lose energy and should fall to the nucleus.
2. Neutron is one proton+electron combined.

N Bohr Model

1. Seeds of quantum physics. He said things behave differently on atomic scale. Charged accelerated particles don't lose energy.
2. Electrons revolve in fixed orbit. They absorb / emit fixed quantum of energy to reach next orbit.

Chemical Bonding

Electrostatic Bonds

Properties

1. They are hard solids and have high melting and boiling points.
2. They are only soluble in polar solvents.
3. They are poor conductors in solid form (since ions not free to travel as they are bound) but good conductors in liquid form (since ions free to move).

Covalent Bonds

1. As 2 atoms draw closer, their potential energy falls due to attraction between nucleus and the electron of other atoms. But as they draw closer than desired limit, both nuclei start repelling each other and potential energy jumps.
2. Electrostatic bond can be seen as a covalent bond where the electron lies almost entirely with one atom due to force of attraction.

Keppler's Laws

1. The line joining the planet and the sun sweeps equal areas in equal time.
2. The cube of the mean distance of the planet from the sun is proportional to the square of the time period.

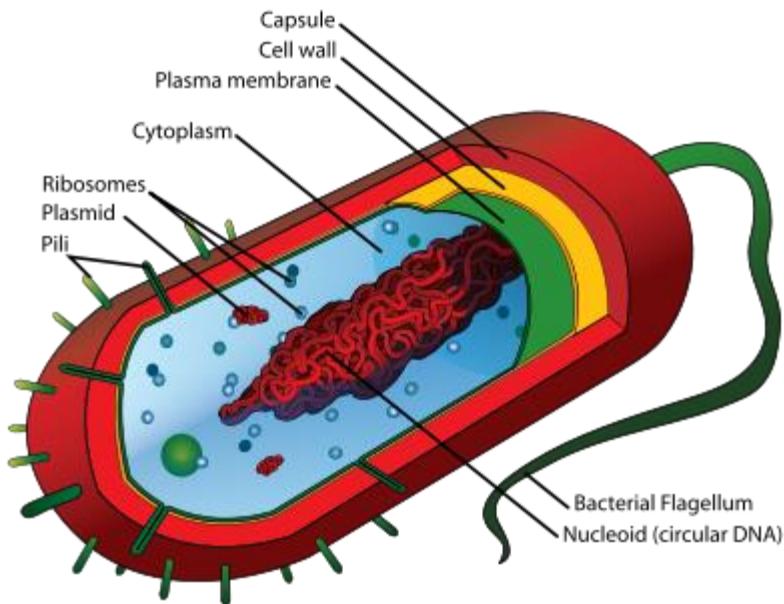
Waves

1. For a pendulum, $T = 2\pi \sqrt{l/g}$.
2. Mechanical wave propagates via transfer of energy in the medium particles. Kinetic energy gets converted into potential energy and vice versa. For physical wave propagation the medium must have inertia, elasticity, uniform density and minimum frictional force
3. When a longitudinal wave travels there occur points of compression (highest density) and rarefaction (lowest density).
4. Sound: Speed of sound depends on nature of the medium, pressure, temperature, humidity (increase with increase in humidity), salinity. Hearing aids are designed to reflect the sound waves into a funnel like structure which increases their amplitude. Sound boards are used in large halls. The speaker is placed at the focus of a concave sound board which reflects it parallelly in the hall. The gap between two sound waves should be at least 0.1s for our ears to distinguish them as 2 and not as a contiguous stream. Sound velocity is 344 m/s which means minimum distance of the obstacle from the source of the sound should be 17.2 m for us to hear the echo distinctly.
5. Ultrasound: It produces a soothing massage effect on the affected joints. It also gets reflected from the boundaries of 2 materials having almost same density. So it can be used

to take pictures inside body. Minute particles suspended in the liquid through which the ultrasonic wave travels tend to lump together and settle down making ultrasounds useful in manufacturing photographic films.

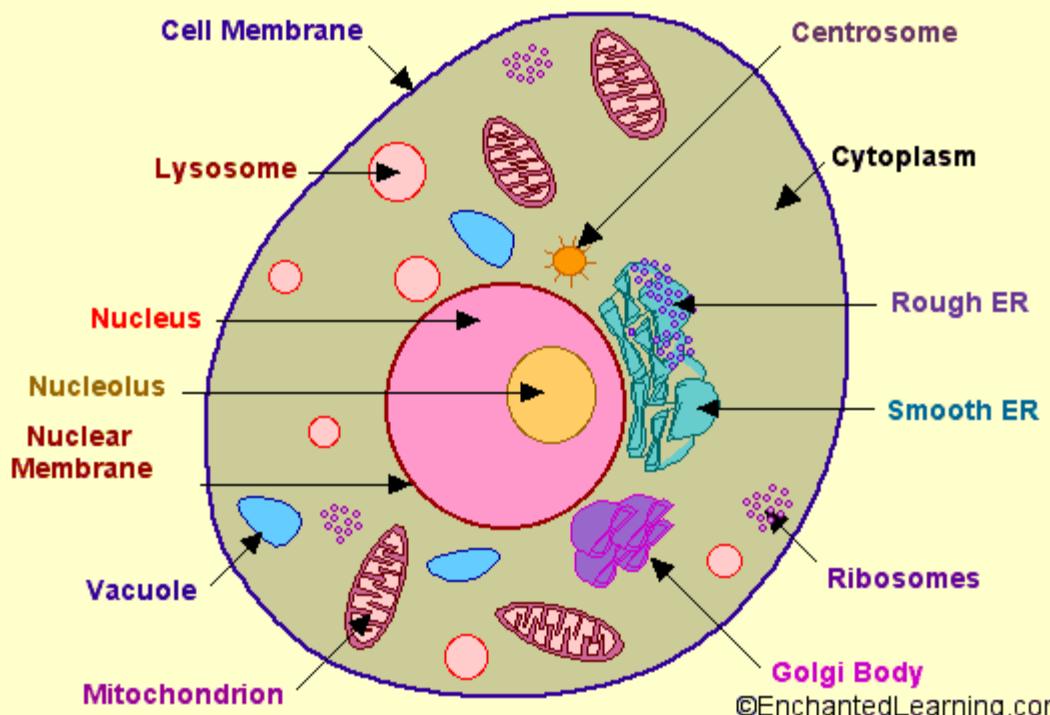
Cells

Prokaryotic cells vs Eukaryotic cells

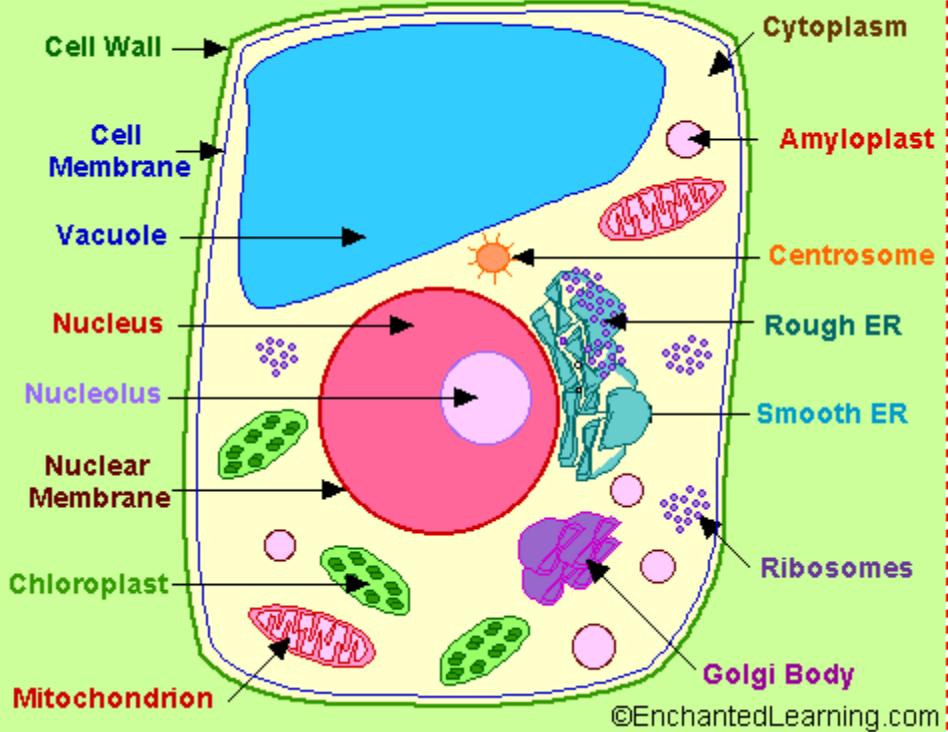


1. Prokaryotic cells are usually independent, while eukaryotic cells are often found in multicellular organisms.
2. Prokaryotes don't have a well defined nucleus (no nuclear membrane, no nucleolus, no DNA) while eukaryotes have.
3. Prokaryotes have no membrane bound cell organelles (mitochondria, ER, vacuoles, lysosome, plastids) while eukaryotes have all.
4. Prokaryotes have single chromosome while eukaryotes have multiple chromosomes.
5. Cell division is via fission or budding (no mitosis) in prokaryotes while eukaryotes have mitosis or meiosis.

Cross-Section of an Animal Cell



Cross-Section of a Plant Cell



Cell Structure

1. **Cell membrane:** It is made up of lipids and proteins and its main job is to separate the protoplasm (cytoplasm + nucleus) from outside world and to regulate the movement of molecules in and out of the cell. In plants and prokaryotes it is usually covered by a cell wall. Cellulose is the main component of the cell wall.

2. Cell nucleus: It is present in eukaryotes only. It is separated from the cytoplasm via a double layered semi-permeable membrane called nuclear membrane (which regulates the movement of molecules in and out of nucleus). It has chromatin material (DNA) which is an intertwined mass of thread like structures and nucleolus (RNA) which is responsible for protein synthesis in cytoplasm.
3. Cytoplasm: It is the remaining part of the cell apart from nucleus.
4. Mitochondria: These are rod shaped organelles which are responsible for production of energy (hence called power plants of the cell). They contain enzymes for cellular respiration which break down the glucose and stores energy in form of ATP molecules. They have double membrane - the outer membrane is smooth while the inner membrane is folded into finger like structure to increase the surface area.
5. Endoplasmic reticulum: It is present in eukaryotes only. It is the site for the production of proteins (rough ER) and lipids (smooth ER). Rough ER contain ribosomes. These proteins and lipids may either work to create cell structures or to function as enzymes (works inside the cell) and hormones (secreted out of the cell).
6. Golgi apparatus: It is present in eukaryotes only. It packages the lipids and proteins formed by ER and dispatches them to intracellular and extracellular targets.
7. Ribosomes: They are large complex molecules responsible for formation of proteins using messenger RNA as a template in a process known as translation.
8. Lysosomes: They are found in eukaryotes only. They contain powerful enzymes capable of breaking up organic material like foreign bacteria present inside the cell (hence called digestive bags). They also remove worn out cell organelles to make way for the new ones or sometimes the entire cell (hence also called suicide bags). They have thick membranes.
9. Plastids: They are found in plant cells only. They are like mitochondria in structure though with no inner finger like membrane. *Leucoplasts* are colorless plastids used for forming and storing starch or oil drops. *Chromoplasts* are pigmented plastids of varying color out of which *chloroplast* is the green colored plastid responsible for photosynthesis. Other colored chromoplasts give characteristic colors.
10. Centrosomes: They are found in animal cells only, in plants their work is done by polar caps. They are composed of two centrioles, which separate during cell division and help in the formation of the mitotic spindle.
11. Vacuoles: Vacuoles store food and waste. Some vacuoles store extra water. They are often described as liquid filled space and are surrounded by a membrane and give turgidity and rigidity to the plants. Some cells, most notably *Amoeba*, have contractile vacuoles, which can pump water out of the cell if there is too much water.

DNA vs RNA

1. DNA is an intertwined mass of thread like structures which is present in form of condensed chromosomes and contains hereditary information. RNA helps in protein synthesis in the cytoplasm.
2. RNAs are small and less complex compared to DNAs.

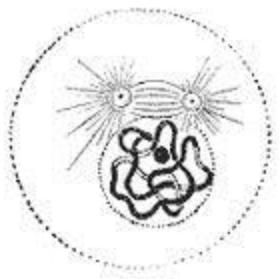
Chromosomes and Genes

1. Chromosomes are the condensed form of DNA. They contain genes which are segments of DNA. A gene is the functional unit of a chromosome.

Cell Division

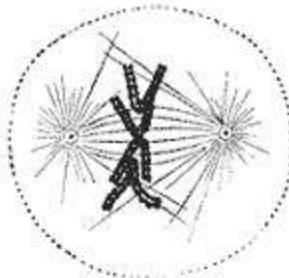
Mitosis

1. Prophase: Nucleolus disappears, chromosomes can still be seen as thin thread like structures containing 2 identical chromatids. Nuclear membrane also begins to break down and by the end of this phase, it disappears. The 2 objects above the nucleus are the

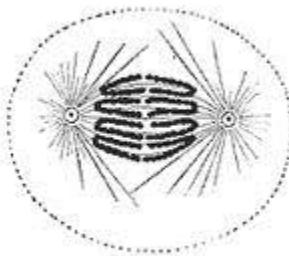


centrioles of the centrosome.

2. Metaphase: A spindle like structure appears in the middle of the cell (as two centrioles migrate to the poles and generate the spindle). Chromosomes are shortened and now arrange along the equator of the spindle and their centers (called centrometer where both chromatids are joined) are attached to the spindle fibers.

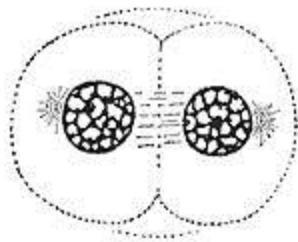


3. Anaphase: Centrometer of each chromosome splits. Each chromatid gets a centrometer of its own (at the point where it is attached to the spindle). After the split both move towards the either poles as the spindle fibers contract back to the centrioles. Towards the end, the cell begins to constrict in the middle.



4. Telophase: The daughter chromosomes have reached the poles and begin to create the thread like structures. Nuclear membrane and nucleolus reappears and spindle disappears.

Cytoplasm is divided by constrictions (a process called cytokinesis). By the end 2 new cells



are formed.

Meiosis

1. **Prophase:** It is same as mitosis except that in meiosis, 2 homologous chromosomes come together and join. Their chromatids overlap and cross. Then the same process as mitosis (with half the number of chromosomes now and hence called haploid instead of diploid).
2. Meiosis has meiosis 1 and meiosis 2. With this difference meiosis 1 is identical to mitosis and meiosis 2 is exactly identical to mitosis. Thus at the end of the meiosis division, 4 daughter cells are produced.

Tissues

Plant Tissues

Meristematic tissues / Meristems

1. They are present only in the growing regions like shoot tip, root tip and cambium (responsible for growth in thickness). They divide continuously helping the plant grow throughout its life.
2. They have thin cell walls and don't have any intercellular spaces.
3. They don't have any vacuoles and the cytoplasm is dense and nucleus is large.

Permanent tissues

1. **Parenchyma:** Their job is to store and assimilate food, to maintain mechanical strength (by providing turgidity) and to store wastes. They are living tissues and have large vacuoles, dense cytoplasm. Chlorophyll containing parenchyma are called chlorenchyma.
2. **Collenchyma:** Their job is to provide mechanical support and elasticity to the plant. They have thin cell walls but have thick corners where multiple cells meet (due to presence of cellulose / pectin). Intracellular spaces are absent. They manufacture sugar and starch when the cells have chloroplasts.
3. **Sclerenchyma:** They are dead tissues devoid of protoplasm and with thick cell walls. They are long pointed cells with no intercellular space and their job is to give mechanical support to the plant.

Protective tissues

1. They are present in the outermost layer and their layer is one cell thick. They are composed of cork cells which are dead and have no intercellular spaces. Their cell walls are thickened to avoid the loss of water, they don't catch fire easily.

Vascular tissues

1. **Xylem:** Their job is to carry water and dissolved mineral salts from roots to other parts and they are tubular in shape. They also give mechanical strength to plants.

2. Phloem: Their job is to carry food from leaves to other parts and they are also tubular in shape.

Animal Tissues

Epithelial tissue

1. It is the covering tissue and forms skin and exposed parts of mouth, alimentary canal, lungs.

Their main job is protection and controlling movement of water and nutrients.

Muscle tissue

1. Striated / voluntary muscle: Muscle contraction / movement takes place via contractile proteins present inside their cells. They are long cylindrical and multi-nucleated with nuclei located at the surface.
2. Unstriated / involuntary muscle: They are found within the walls of organs like stomach, intestine, bronchi etc. They are long pointed and each cell has only one nucleus.
3. Cardiac muscle: Each cell has one / two nuclei situated in the centre. They are cylindrical and branched.

Connective tissue

1. Cartilage: Semi-hard and found at the tip of nose and external ear.
2. Tendons and ligaments: Tendons connect muscles to bones while ligaments connect bones to bones.

Digestive System

Types of Nutrition

1. Saprophytic nutrition: Organisms obtaining their nutrients from dead and decaying organic matter. E.g. bacteria and fungi. Such organisms are called saprophytes.
2. Holozoic nutrition: Taking nutrition via ingestion. E.g. amoeba, humans.

Photosynthesis

1. Even artificial light can be used by plants for photosynthesis. Only visible light (mostly blue and red) is used in photosynthesis. Rate of photosynthesis increases at lower intensities of light. Also since photosynthesis uses enzymes, its rate initially increases with temperature but declines after a point. It also increases with water as under water deficient conditions the stomata remain closed to reduce transpiration which interferes with the CO₂ exchange. And the rate of photosynthesis also increases with CO₂ concentration up to a level beyond which it has no impact.
2. CO₂ for photosynthesis enters through the stomata in the leaves. Aquatic plants use CO₂ dissolved in water. When the amount of CO₂ released in respiration equals amount needed for photosynthesis, it is called *compensation point*.
3. Photosynthesis has 2 stages - (a) light dependent or light reaction in which the chlorophyll molecule first gets activated by the light and emits electrons. These electrons convert ADP into ATP which serves as a source of energy for the dark phase. Photolysis (breakup of water into H⁺, O₂ and e⁻) also takes place in light reaction and the released H⁺ ion reduces NADP to NADPH which is also used in dark reaction. (b) light independent or dark reaction in which the ATP and NADPH (produced in light reaction) convert the CO₂ into carbohydrate in the chloroplast.

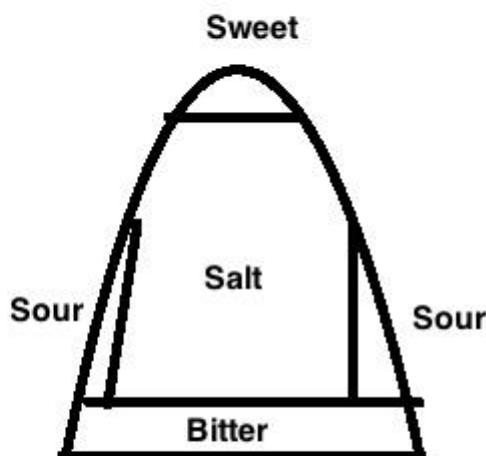
Pharynx and Trachea

1. Pharynx is the common portion of oral cavity and nasal cavity lying before the trachea.
2. Trachea is the wind pipe which has a cartilage called *epiglottis* which is a flap like structure which closes the trachea when food bolus is ingested.

Oesophagus

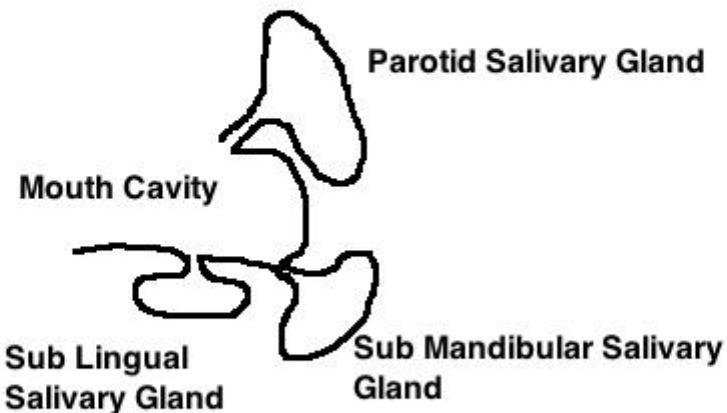
1. Peristalsis: The process of alternate constrictions and relaxations of muscles in oesophagus which pushes the food bolus downwards.

Tongue & Teeth



1. The lower incisors are the teeth which grow first in children.
2. Enamel, fluorine, dental caries: It is made of hydroxyapatite salts of calcium phosphate and calcium carbonate. Fluorides promote calcium phosphate deposition thereby making teeth strong. Absence of fluorides leads to softening of teeth as less enamel is generated making it prone to dental caries. Excess of fluorides leads to brownish discolouration of teeth called teeth mottling. Dental caries result from action of bacteria found in plaque. Plaque is a film of saliva + carbohydrate rich / sugar rich food on the teeth. It provides a breeding ground for bacteria which decomposes carbohydrates into lactic acid which in turn decomposes the enamel.

Salivary Glands



1. Salivary glands are always paired glands. Saliva flow is ~ 1 - 1.5 L per day. It contains 99.5% water and rest has some minerals like Na, K, HCO₃⁻, Cl⁻ etc. Its pH is between 6 - 7 i.e. slightly acidic due to presence of HCO₃⁻ and Cl⁻. Enzymes present are lysozyme (helps in destroying the cell walls of bacteria, usually present in tears, mother's milk and egg white) and ptyalin / salivary amylase (digests starch partially into maltose).
2. Parotid gland: The largest is parotid which secretes the enzyme ptyalin (salivary amylase). Mumps is a viral infection of parotid gland causing inflammation, pain, fever, lessened salivation.
3. Sub-mandibular gland: It produces lysozyme.
4. Sub-lingual gland: It is the smallest. It produces lysozyme.

Stomach

1. Sphincter: It is a ring of muscles present at the entry and exit of stomach to prevent back movement of food. The upper sphincter is called cardiac sphincter (prevents movement of food back into oesophagus) and the lower sphincter is called pyloric sphincter (prevents movement of food from duodenum to stomach).
2. Protein digestion: Stomach secretes gastric juices (containing HCl taking the pH to 1-2) from branched and tubular glands present in its inner surface, churns the foods and breaks the proteins (it secretes an enzyme pepsinogen which converts into pepsin in the presence of HCl and breaks the protein partially into peptones) and propels it into the small intestine.

HCl in addition to providing optimum environment for activation of pepsinogen and breaking proteins into peptones also kills the bacteria present in the food. The mere thought of appetizing food can lead to secretion of gastric juice.

3. Fats: Gastric juice also contains gastric lipase which partially breaks down fats.
4. Vitamin B-12: Gastric juice also contains intrinsic castle factor which binds vitamin B-12 and helps in its absorption in the small intestine.
5. Gastrin hormone: It increases the secretion of HCl and pepsinogen in the stomach. It also causes increased movement of stomach muscles to facilitate movement of food.

Compound Stomach in Ruminants

1. Reticulum is the 2nd stomach and is the place where food is stored before coming back to the mouth.
2. Abomasum is the 4th stomach and is the real stomach. Rumen is the 1st stomach and has symbiotic bacteria which help in digestion of cellulose.

Small Intestine

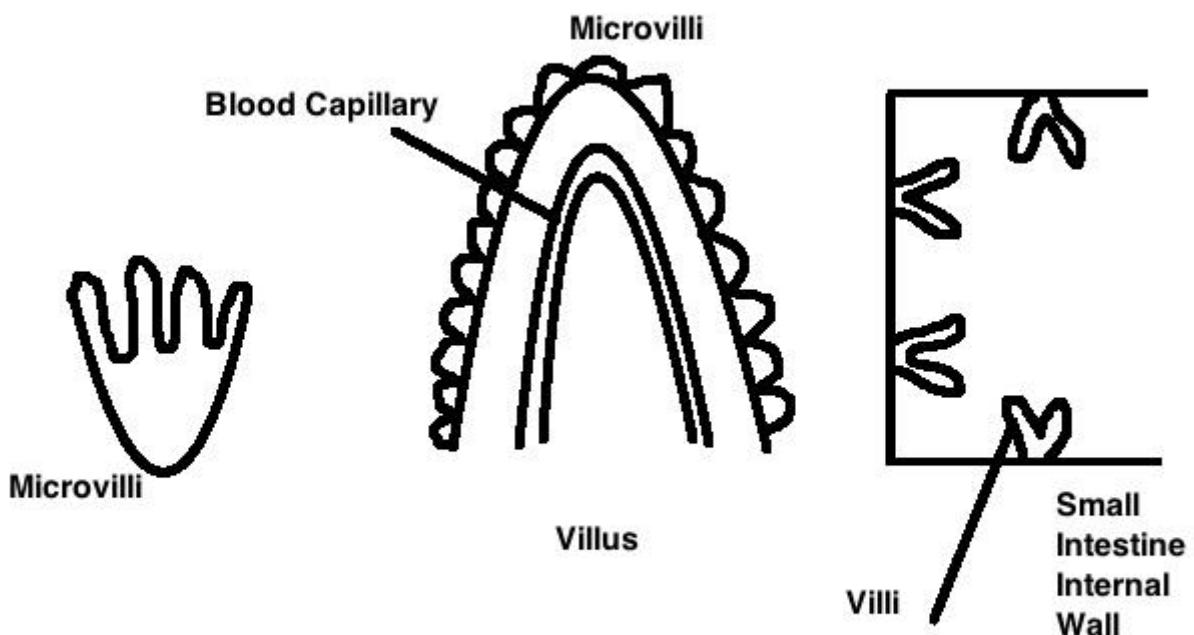
Duodenum

1. Bile from liver: Its pH is 8 and it contains bile salts (for emulsifying fats i.e. to break them into small droplets so as to increase the surface area), NaHCO_3 (to provide a basic medium), bilirubin (bile pigment containing dead RBCs) and water. Bile has no enzyme and is stored normally in gall bladder.
2. Pancreatic juices from pancreas: Its pH is 8.8. It has carbohydrate digesting enzymes (pancreatic amylase which breaks starch into maltose), fat digesting enzymes (pancreatic lipase converting emulsified fat into mono glyceride) and protein digesting enzymes (trypsin which breaks peptone into dipeptide), NaHCO_3 .

Jejunum

1. Intestinal juices from small intestine: Its pH is 8.3. It contains maltase (breaking maltose into glucose), lactase (breaking lactose into glucose), sucrase (breaking sucrose into glucose + fructose), dipeptidase (breaking dipeptide into amino acids), intestinal lipase (breaking mono glyceride into fatty acids + glycerol).

Absorption inside small intestine



1. Villi and micro-villi increase the surface area for absorption. Stomach is a poor absorber and only small amounts of water and alcohol takes place in stomach. Major absorption takes place in small intestine.
2. The molecules of water, amino acids, glucose and minerals are absorbed in blood capillaries while fatty acids, glycerol are absorbed in the lymph capillaries.

Active Absorption

1. Takes place via application of energy and is against the laws of osmosis. All the mineral ions are absorbed by the body in this fashion.

Large Intestine

Caecum and Vermiform Appendix

1. These are vestigial organs i.e. no use in humans except for vermiform appendix being a part of protective lymphoid tissue. In other animals they usually break down cellulose.

Colon

1. Vitamin synthesis: It contains symbiotic bacteria (like e-coli) which synthesize some of B complex vitamins like B-1, B-2 and B-12 and also vitamin K (needed for blood clotting).
2. Absorption of water and electrolytes.

Diarrhea

1. It is caused by inflammation of large intestine where water and electrolyte absorption is affected.

Liver

Functions

1. Urea synthesis: It breaks down amino acids into ammonia and then converts them into urea to be excreted via kidneys.
2. Blood clotting: It forms the prothrombin and fibrinogen proteins which help in blood clotting. It also forms heparin which is an anti-clotting substance in the blood.
3. RBCs: It forms the RBCs in a fetus. Also produces bilirubin for removal of dead RBCs.
4. Storage of vitamins: It stores fat soluble vitamins like A and D, iron and water soluble vitamins like B-12. That is why the deficiency symptoms are seen only after severe deficiency.
5. Detoxifying agent: Any toxic substance in the body gets detoxified in liver only.

Respiratory System

Glycolysis

1. Respiration is a 2 stage process (aerobic or anaerobic). After the 1st stage in both forms pyruvate or a 3 carbon molecule is formed in the cytoplasm of the cell. This process is called glycolysis and takes place in cytoplasm.

Anaerobic Respiration

1. Muscle fatigue: It is caused when due to lack of O₂, lactic acid is formed from pyruvate via anaerobic respiration in skeletal muscles.
2. In RBCs also lactic acid is formed as they contain no mitochondria. In yeasts ethanol is formed which is used in fermentation.

Respiration in Plants

1. All parts of the plants respire individually. There is no transport of gases from one part to other unlike animals. Plant respiration rate is much slower than that of animals.
2. Roots take up O₂ present between the soil particles (that is why plants die in water logged soils) by the process of diffusion through the root hair. Similarly CO₂ exchange also takes place via diffusion. Older portions of roots which don't have any root hair exchange gases via *lenticels* which are the tiny openings in the dead cell layer covering old roots.

Respiration in Some Animals

1. Earthworms exchange gases via skin. Frogs breath via both skin and lungs. Insects do it via air tubes or trachea. These trachea branch into tracheoles which reach every cell.

Nasal Cavity

1. Apart from filtering the air, it also brings it to the body temperature. It also aids in sense of smell.

Vocal Chords

1. They are present in larynx. In men vocal chords are long leading to deeper sound.
2. Trachea is the wind pipe which has a cartilage called *epiglottis* which is a flap like structure which closes the trachea when food bolus is ingested.

CO₂ Transportation

- ~70% is transported as HCO_3^- combined with Hgb. The formation of H_2CO_3 from H_2O and CO_2 is catalyzed by a zinc based enzyme. ~23% is transported in direct combination with Hgb. ~7% is transported in a diffused state in plasma.

Lung Volumes

- Total lung capacity (TLC): This is the maximum capacity of lung. $\text{TLC} = \text{VC} + \text{RV}$. ~6 L.
- Vital capacity (VC): This is the maximum amount of air that can be expelled from lungs after a forced expiration following a forced inspiration. $\text{VC} = \text{IRV} + \text{TV} + \text{ERV}$. ~4.5 L. It shows how much of air is actually being used up in respiration via blood. People in hilly areas have more VC.
- Residual volume (RV): This is the air still present in the lung alveoli even after the most forceful expiration. ~1.5 L.
- Tidal volume (TV): It is the volume of air inhaled in a normal inspiration. ~0.5 L.
- Inspiratory reserve volume (IRV): Additional air which can be inhaled (beyond the tidal volume) in a most forceful inspiration. ~3 L.
- Expiratory reserve volume: Additional air which can be exhaled (beyond the tidal volume) in a most forceful expiration following a normal inspiration. ~1L.
- Dead space: It is the volume of inhaled air which never reaches the alveoli. It remains trapped in trachea, bronchus, pharynx, nasal cavity etc. It also includes air in the non functional alveoli. ~150 mL.
- Alveoli air: It is the volume of air which participates in the gaseous exchange process via alveoli. ~350 mL.

Asthma

- It is an allergy which leads to inflammation of trachea or bronchi. This leads to their contraction and also secretion of mucus by the epithelial cells leading to blockage.

Emphysema

- It is an abnormal and permanent enlargement of alveoli where the walls separating them breakdown and they fuse. Generally seen in smokers. Heart in such cases has to pump more blood and it can lead to heart failures.

Control over Respiration

- When the concentration of HCO_3^- ion increases, the residual H^+ ion stimulates the chemosensitive area of medulla which triggers the action of removing excess CO_2 .

Circulatory System

Blood

- It has a pH of 7.4 i.e. slightly alkaline.
- Packed cell volume: Blood cells together constitute ~45% of blood volume. This is called packed cell volume. Remaining 55% is plasma.
- Plasma: It contains 90% water + 7-8% proteins like prothrombin (stimulates blood coagulation), fibrinogen (stimulates blood coagulation), albumin (maintains water concentration in blood and its deficiency causes kwashiorkor), globulin (helps in synthesis of antibodies which are themselves called immunoglobulin) and some inorganic salts. Ig M

is the first antibody. Ig G is the most abundant one and replaces M and remains permanently in blood. Ig E indicates presence of allergy and Ig A is present in mother milk, saliva and tears. Heparin is a natural anti-coagulant in blood while Na and K are artificial anti-coagulants as they combine with Ca in the blood to make it unavailable for clotting.

4. Erythrocyte (RBC): Normal concentration is 5 mm / μ l. People living in higher altitude have higher RBCs. Normal RBCs are biconcave lens shaped without any nucleus.
5. Thrombocyte (platelets): They are smallest size and occur only in blood of mammals.
6. Leucocyte (WBC): Their concentration in blood is the least (6 - 8 K / μ l). During the times of infections the concentration increases. Pathological increase in leucocytes leads to leukemia. They are formed in bone marrow, spleen, thymus (located in neck and produces t-cells), lymph nodes. Neutrophils are the 1st line of defence. Acidophils and Basophils protect body from allergic conditions. Monocytes are largest WBCs and engulf bacteria. Lymphocytes are of 2 types - t cells and b cells.

Blood Clotting

1. As blood flows out, platelets secret a substance called thromboplastin. In the presence of Ca and thromboplastin, prothrombin protein gets converted into thrombin. Thrombin acts as a catalyst to convert fibrinogen protein into fibrin which is the insoluble product forming the mesh to which RBCs get entangled and clot.

Hemophilia

1. It is a hereditary condition where the blood cannot clot due to absence of blood clotting protein.

Blood Groups

1. Blood has antigens (A, B) and anti-bodies (a, b). A mismatch leads to clumping in blood blocking capillaries and fatal. A if reacts with a leads to clumping while B leads to clumping if it reacts with b. So blood group A has antigen A and antibody b. Blood group B has antigen B and antibody a. Blood group AB has both antigens A and B and no antibody. Blood group O has no antigen and both a and b antibodies.
2. AB has no antibody. So it can receive blood from anybody but can give blood to only AB. O has no antigen so it can give blood to anybody but can receive blood from only O. A can receive blood from O and A and can give blood to A and AB. B can receive blood from O and B and can give blood to B and AB.
3. Another factor is the Rh factor. Most people are Rh+ while some are Rh-. A Rh- mother can lose her baby if the baby has Rh+ blood.

Heart

1. Diastole: This is the condition when all cardiac muscles are relaxed.
2. Systole: This is the condition when cardiac muscles contract.

Structure

1. The 2 upper chambers are called atria and lower are called ventricles. Atria receive blood from veins while ventricles pump blood into arteries. There are valves between ventricles and atria.

- In the diastole condition (all 4 muscles relaxed), blood from large veins (vena cava) pours into the right atrium. This is the deoxygenated blood. Then the right atrium contracts and pushes the blood into the right ventricle. Next the right ventricle contracts and pushes the deoxygenated blood into the lungs via pulmonary artery. After the blood gets oxygenated into the lungs, it fills into left atrium via pulmonary vein. Left atrium contracts and pushes the blood into the left ventricle. Finally left ventricle contracts and pushes the blood into the aorta (largest artery). The contraction of both left and right atria is simultaneous and so is the contraction of both ventricles so there are only 2 heart beats.

Lymphatic System

- Lymph contains lymphocytes (B and T cells). It flows only in one direction i.e. tissues to heart. It bathes the cells and lies outside them and so is called extracellular fluid.

Circulatory System in Plants

- Xylem: It is of 2 types - (a) Tracheids which are dead cells with thick cell walls and large cavity inside. They are long, spindle shaped. Water and nutrients pass through these cavities. (b) Vessels which are long, tubular and are dead cells. Flowering plants have both vessels and tracheids or only vessels while non-flowering plants have only tracheids. It is the evaporation of water from leaf stomata which creates a suction pulling more water from the roots.
- Phloem: They are living cells and are called sieve tubes. The nutrients are transported in an aqueous solution and the process is called translocation.

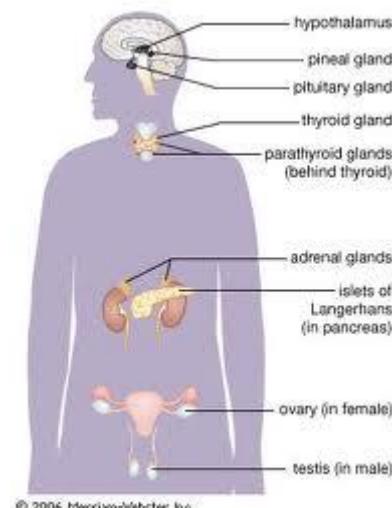
Excretion System

- Each kidney is made of excretory units called nephrons. Each nephron has blood capillaries passing through it (coming from renal arteries and carrying impure blood). Blood is filtered via osmosis.

Dialysis

Control and Coordination

Endocrine Glands



- Hypothalamus: It regulates the secretion of hormones from pituitary gland.

2. Pituitary gland: It secretes - (a) growth hormone which regulates development of bones and muscles. (b) Trophic hormones which regulate secretion of hormones from other endocrine glands like adrenal, thyroid, ovaries, testes. (c) Prolactin which regulates function of mammary gland. (d) Vasopressin which regulates the water and electrolyte balance in the body (process called osmoregulation). (e) Oxytocin which stimulates contraction of involuntary (smooth) muscles and helps in child birth and lactation.
3. Thyroid gland: It secretes thyroxin which regulates metabolism of carbohydrates, fats and proteins.
4. Parathyroid gland: It secretes parathyroid hormone which regulates blood calcium and phosphate.
5. Adrenal gland: It secretes adrenalin which regulates blood pressure, heart rate and carbohydrate metabolism.
6. Pancreas: It secretes insulin which lowers blood glucose level and glucagon which increases blood glucose level.

Control and Coordination in Plants

1. This function is done by phytohormones in plants. The movement of plant in a particular direction is called tropism. Geotropism, phototropism and chemotropism (movement towards a chemical stimulus) are examples. Nastic movement is the plant movement which is neither towards the stimulus nor away from it. For example the touch me not plant.
2. Photoperiodism: Flowering and seed germinating activities are guided by presence of light. This process is called photoperiodism and is regulated by a pigment called phytochrome.

Human Nervous System

1. Sensory and motor nerves: Nerves passing signal from sensory organs (receptors) to brain are called sensory nerves. Nerves which pass signal back from brain to organs are called motor nerves.
2. Photoreceptors, phonoreceptors and olfacto receptors: Photoreceptors are sensory organs sensitive to light. Phonoreceptors are organs sensitive to sound. Olfacto receptors are for smell.
3. Nerve cell: A nerve cell has 3 parts - (a) Dendrites which receive the nerve impulse and carry it to cell body. (b) Axons which carry the nerve impulse from cell body to synapse. (c) Synapse which carry the nerve impulse to the dendrites of another nerve cell.

Brain

1. Protection of brain: It is inside a box (called cranium) in the skull. It has 3 protective membranes (called meninges) and a fluid (called cerebrospinal fluid) flows in the membranes which protects the brain from mechanical shocks.
2. Cerebrum: It contains sensory areas which receives the information from receptors. It also contains motor areas from where impulses are sent. It is divided into left and right cerebrum.
3. Cerebellum: It regulates coordination and balance of body.
4. Medulla oblongata: It regulates swallowing, coughing, sneezing and vomiting.
5. Pons: It regulates respiration.

Spinal Chord

1. It is also enclosed by meninges. It has the autonomic nervous system which controls the functioning of internal organs like heart, blood vessels, involuntary muscles, glands, uterus. The autonomic nerves are always paired and further subdivided into - (a) sympathetic nerves which produce action, and (b) parasympathetic nerves which inhibit action.

Reproduction

Fission

1. Binary fission (1 into 2) takes place in amoeba, paramecium etc. Plasmodium show multiple fission (1 into many).

Budding

1. A bulge (called bud) emerges on the body as a result of repeated mitotic divisions. It is observed in yeast and hydra. If from a bud, another bud emerges and so on, it is called chain budding and is seen in yeast.

Spores

1. It is the most common method present in fungi and bacteria. Initially a structure called sporangium develops which contains a nucleus. The nucleus is further subdivided into many and gets some cytoplasm. Eventually a spore develops and bursts open and all new cells are released under favorable conditions.

Regeneration

1. It is the ability of organisms to regenerate a lost body part and is used by some to multiply. They divide their body into multiple parts and each part grows into a full fledged organism. Examples are hydra and spirogyra (an algae).

Layering

1. A part of the stem is pulled and buried in the soil with the tip of it remaining above the soil. It remains attached to the parent plant but gradually develops roots and system of its own. Examples are strawberry.

Vegetative Propagation

1. New plants start to emerge on the leaves, roots, stems of the old plants. Examples are bryophyllum (the money plant) which develops from leaves.

Grafting

1. 2 parts of different plants are joined together such that their cambium (middle growth tissue) are in contact. Eventually they unite and grow together as one plant. The plant that is grafted on the other plant is called scion while the old plant is called stock. Citrus fruit plants are grafted. Using this technique a very young plant can be made to flower and produce fruits when planted on a mature plant.

Parthenogenesis

1. In some lower vertebrates and plants an ovum can generate an offspring without fertilization.

Tissue Culture

1. Propagation of plants in a synthetic medium. The medium contains all the favorable conditions and nutrients. Initially a tissue is introduced which grows into a callus. The callus is then taken and placed in different media for differentiation and further growth.

Flowers

1. Stamens (comprising of anther and filament) are the male part while carpel (comprising of stigma, style and ovary) are the female part. The filament and style are the long tubular structures. Anthers produce pollen grains. Each pollen grain has 2 gametes. Ovary produces ovules and each ovule has one egg. Once the pollen grain is deposited on stigma it starts to form a pollen tube which begins to extend from the stigma to the ovary through the style. Inside the ovule it releases the gametes and once fertilization takes place the ovary develops into a fruit.
2. One of the gamete fertilizes an ovule (called syngamy) and the other fertilizes two polar nuclei (called triple fusion). Thus 2 fusions take place inside the embryosac and this is called double fertilization.

Humans

1. In females each ovary is connected to uterus via a fallopian tube. During the cycle, a fallopian tube develops into a mature follicle and surrounds an egg which is subsequently released from the respective ovary (the process is called ovulation). While the follicle matures, the inner wall of the uterus thickens to prepare for a potential fertilization. When fertilization doesn't take place, it sheds the inner wall. The process of ovulation takes place in the middle of the menstrual cycle.
2. The fertilization takes place in the fallopian tube and after fertilization the zygote moves down and attaches itself to the uterus wall (process called implantation). Placenta is the special tissue which develops between the uterus and the zygote.
3. Commencement of menstruation is called menarche while termination is called menopause.

Diaphragm

Cervical Caps

Intrauterine Contraceptive Devices

Diseases

Trichomoniasis

Heredity and Evolution

1. Mendel's experiments: He proposed presence of 2 copies of the 'factors' controlling every character displayed. When pea with 2 different characters are crossed the next generation shows only one characteristic. But the successive generation shows both characteristics.
2. Haploids and diploids: Paired chromosomes are called diploids, unpaired are called haploids.

Technologies

The 'Bio Argo' floats will include additional sensors for dissolved oxygen, nitrate, chlorophyll, dissolved organic matter, and particle scattering. Photo: Bloomberg

Melbourne: Bio robotic floats armed with revolutionary new sensors will be launched in the Indian Ocean as part of a new India-Australia research partnership to identify the causes and

impacts of marine heat waves.

The Argo floats are a network of 3600 free-floating sensors, operating in open ocean areas that provide real-time data on ocean temperature and salinity, a statement released by Commonwealth Scientific and Industrial Research Organisation (CSIRO) said on Wednesday.

The new 'Bio Argo' floats, to be launched in mid 2014, will enhance the already successful Argo float technology to measure large-scale changes in the chemistry and biology of marine ecosystems below the Indian Ocean's surface, it said.

The 'Bio Argo' floats will include additional sensors for dissolved oxygen, nitrate, chlorophyll, dissolved organic matter, and particle scattering.

They will target specific gaps in our understanding of Indian Ocean ecosystems of immediate concern to India and Australia, such as the Bay of Bengal and the waters of north Western Australia.

The pilot project led by CSIRO in collaboration with Indian National Institute of Oceanography (CSIR-NIO) and Indian National Centre for Ocean Information Services, will improve the understanding of cause and effect in the Indian Ocean's climate and ecosystems, said [Nick Hardman-Mountford](#), Marine Biophysics team leader at CSIRO.

"By studying the Indian Ocean in this detail, we can investigate the origin and impact of marine heat waves like the one that devastated the coral reefs and fisheries off north Western Australian in 2011 and improve our prediction of them in the future," Mountford said.

According to CSIR-NIO Director, [Wajih Naqvi](#), the novel technological innovation will give researchers from both countries a new understanding of the Indian Ocean.

"We expect the technology being utilised in this project to provide new insights into the bio geochemistry of the Indian Ocean and how it is being impacted by human activities," Naqvi said.

"By combining the research capabilities of India and Australia we will see an improved ability to predict and prepare for global climate change, as well as better conservation of marine biodiversity," said [Nick D'Adamo](#) said head of the Perth Programme Office supporting UNESCO's Intergovernmental Oceanographic Commission (IOC) .

The \$1 million project was funded in part by the Australian government under the Australia-India Strategic Research Fund.

3G

- 3G networks are built to handle the needs of today's wireless users, with faster data-transmission speeds, greater network capacity and more advanced network services.
- 3G technology was also known as CDMA Wireless technology.
- It is the first wireless technology that provides broadband-speed Internet connection on mobile phones.
- The main advantage of 3G networks over 2G networks is speed.
- Technically, the main difference that distinguishes 3G technology from 2G technology is the use of packet switching rather than circuit switching for data transmission.
- Later 3G technology began to be implemented, namely High-Speed Downlink Packet Access (HSDPA).

4G

- The objective of 4G is to become a fully IP-based system, much like a modern computer network.
- The supposed speeds for 4G will be higher than 3G, and can provide Internet speeds up to 1 GBPS.
- One of the main ways in which 4G differs technologically from 3G is that circuit switching will be eliminated, and an all-IP network will be implemented in its place.
- 4G will be able to overcome the problems of weak network strength and should provide a much wider network, making sure that the users get high-speed connectivity anytime anywhere.

GOLD NANOPARTICLES

- Using bio-resources, scientists from the Indian Institute of Chemical Technology (IICT), Hyderabad, have synthesised eco-friendly gold nanoparticles which could be used as carriers for delivering anti-cancer drugs and also for diagnosing the disease.
- Developed from leaf extracts, the biocompatible nanoparticles have shown promising results and inhibited cancer cells proliferation in lung and breast cancer cell lines. In the first instance, they have used leaves of Bhringaraj (Eclipta alba), a herbal plant.
- While gold nanoparticles could be developed by chemical methods, the inherent problem in that approach was of toxicity. But here they have used a green chemistry approach. It is environmental-friendly because the solvent we are using is water. It is a simple, clean, efficient and low-cost method.

- The gold nanoparticle was bio-compatible, easy to synthesise and multiple cancer drugs could be loaded. It could reduce the toxicity of the anti-cancer drug, increase its efficacy and ensure better retention of the drug in the blood system. When conjugated with gold

ANTI-SUPERSTITION AND BLACK MAGIC ORDINANCE

- The Maharashtra government cleared an ordinance enforcing the anti-superstition measures.
- The Bill has proposed that those indulging in black magic or cashing in on people's superstitions be jailed for up to seven years.
- It also sought to ban a range of practices including animal sacrifice and magical remedies to cure ailments.

ANALYSIS

- Public outrage over the brutal slaying of renowned rationalist Narendra Dabholkar finally forced the Maharashtra government's hand in clearing an ordinance against superstition and black magic. Based on a bill that Dabholkar championed for almost 20 years, it could be the first such legislation in India.
- The ordinance is a path-breaking one in a country which lionises godmen and is steeped in obscurantism. It seeks to curtail superstitious practices which are "misused to exploit people" or cause them "financial or physical harm."
- The ordinance, which will have to be ratified by the State Assembly, seeks to ban a range of superstitious practices including "black magic," displaying so-called miracles to earn money, or insisting that mantras, not medicines, will cure critical injuries like snakebites.
- Also, assaulting and humiliating people under the guise of exorcising ghosts, and the sexual exploitation of women after claiming supernatural powers will also be banned.
- Complaints are to be probed by trained policemen and can even be lodged by third parties not involved in an exploitative ritual.
- While inculcating a scientific temper is one of the Constitution's Fundamental Duties vide Article 51 A (h), seeking to regulate personal faith and beliefs is always tricky.
- Many saw it as an impediment to the freedom of religion and feared it would even ban poojas where the priest was paid for his services. Or painful, self-inflicted religious practices. Pontiffs felt vulnerable to complaints by motivated individuals. There were concerns that religious pilgrimages would be monitored, even stopped.
- But these fears are unfounded. The ordinance targets forced and exploitative practices, not those that are voluntary or that do not take a physical or financial toll on people. Chanting mantras on a personal level to ward off evil spirits will not constitute an offence. But forcing an expensive, exorcism ritual could attract a complaint.
- Weeding out motivated complaints and distinguishing a forced ritual from a voluntary one will be a serious challenge. Yet, ensuring that a law which opposes a society's entrenched beliefs is actually enforced is perhaps the greater challenge.

Graphene

- Graphene is one of the crystalline forms of carbon, alongside diamond, graphite, carbon nanotubes and fullerenes. In this material, carbon atoms are arranged in a regular hexagonal pattern.
- Graphene can be described as a one-atom thick layer of the layered mineral graphite.
- High-quality graphene is very strong, light, nearly transparent, and an excellent conductor of heat and electricity.
- Its interaction with other materials and with light, and its inherently two-dimensional nature, produces unique properties.

Project Loon

- Project Loon is a research and development project being developed by Google with the mission of providing Internet access to rural and remote areas.
- It is a network of balloons travelling on the edge of space, designed to connect people, help fill coverage gaps, and bring people back online after disasters.
- Project Loon balloons float in the stratosphere, twice as high as airplanes and the weather.
- They are carried around the Earth by winds and they can be steered by rising or descending to an altitude with winds moving in the desired direction.
- People connect to the balloon network using a special Internet antenna attached to their building.
- The signal bounces from balloon to balloon, then to the global Internet back on Earth.

Hummingbird

- Google announced a major search algorithm release called Hummingbird.
- This release is basically a platform that enables Google to better handle "conversational" search queries. For example "What's the closest place to buy the iPhone 5s to my home?"

Bioplastic

- A company called Metabolix has devised a new way to manufacture its product plastic by growing grass.
- Scientists have managed to turn a type of grass called switchgrass into tiny plastic factories in the lab.
- They did this by engineering the plants to contain three bacterial genes that are responsible for the production of a compound called polyhydroxybutyrate (PHB).
- The plants grow to produce not just fibres of glucose but also PHB.
- The kind of bioplastic Metabolix produces can be used for credit cards or containers of consumer products.

Why it matters?

- The main reason the eco-friendly bioplastic industry has not picked up is because it has always been expensive to make.
- This technique is different because: one, it uses switchgrass which is a perennial crop with high biomass and not of particular value to our food supply anyway; and two, it's cheaper to make than other techniques. Once scientists succeed in enhancing their rate of production, bioplastics may start giving fossil fuel plastics serious competition.

Lethal Autonomous Robots(LARs)

- LARs are weapon systems that, once activated, can select and engage targets without further human intervention.
- They have not yet been deployed in wars or other conflicts, but the technology to produce them is very much in reach.
- It's just a matter of taking the human decision-maker out of the hurly-burly of the immediate "kill loop" and leaving the firing decision to algorithms.
- A lethal autonomous robot can aim better, target better, select better, and in general be a better asset with the linked ISR [intelligence, surveillance, and reconnaissance] packages it can run.

Why is it in news?

- According to United Nations "Killer robots" that could attack targets autonomously without a human pulling the trigger pose a threat to international stability and should be banned before they come into existence.
- Machines lack morality and as a result should not have life and death powers over humans.

Robo Raven

- Robo Raven is a robotic drone that flies like a real bird.
- Small robotic birds are showing lots of promise for tasks such as monitoring the environment and conducting surveillance.
- But one current drawback they have is the amount of time they are able to stay aloft. Because of the birds' light weight and small size, the tiny batteries used to power them deplete in just a few minutes.
- Robo Raven micro air vehicle (MAV) incorporates solar panels in its wings.
- While the solar panels do not yet produce enough energy to power Robo Raven III in flight (they produce around 3.6 Watts while Robo Raven needs around 30 Watts to fly), they are effective in charging the MAV's batteries when it is stationary.

SmartBird

- SmartBird is an autonomous ultralight unmanned aerial vehicle created by Festo's Bionic Learning Network with an emphasis on better aerodynamics and manoeuvrability.
- The natural wingbeat of a bird was emulated by using bionics technology to decipher bird flight.
- Based on the flight of a herring gull, Smartbird differs from previous flapping wing attempts in that it can take off, fly and land by itself.
- Its wings not only beat up and down, but deliberately twist. This is done by an active torsion mechanism, which provides both lift and propulsion.

Lithium-ion Battery

- A lithium-ion battery (sometimes Li-ion battery or LIB) is a member of a family of rechargeable battery types in which lithium ions move from the anode to the cathode during discharge and back when charging.
- Li-ion batteries use an intercalated lithium compound as the electrode material, compared to the metallic lithium used in non-rechargeable lithium battery.
- Lithium-ion batteries can be dangerous under some conditions and can pose a safety hazard since they contain, unlike other rechargeable batteries, a flammable electrolyte and are also kept pressurized.
- This makes the standards of these batteries high, and it consists of many safety features. There have been many reported accidents as well as recalls done by some companies.

(In News: Li-ion battery is in the news because of two incidents in the Boeing 787 Dreamliner aircraft. There was a fire in one aircraft parked in the airport and in the other smoke was detected after take-off. The US Federal Aviation Administration issued a directive to ground these planes and the National Transportation Safety Board is doing a complete investigation. Other countries, including India followed suit and grounded these planes at a considerable financial loss.)

Nanowire Battery

- A nanowire battery is a lithium-ion battery with a stainless steel anode covered in silicon nanowires.
- It replaces the traditional graphite anode.
- Silicon, which stores ten times more lithium than graphite, offers the potential for increased energy density, thus reducing the mass of the battery.
- The large surface area further increases the anode's power density, allowing for fast charging and current delivery.

Blind Quakes

- A blind thrust earthquake is an earthquake along a thrust fault that does not show signs on the Earth's surface, hence the designation "blind".
- Such faults, being invisible at the surface, have not been mapped by standard surface geological mapping.

-
-
- Sometimes they are discovered as a by-product of oil exploration seismology; in other cases their existence is not suspected.
 - Although such earthquakes are not amongst the most energetic, they are sometimes the most destructive, as conditions combine to form an urban earthquake which greatly affects urban seismic risk.

WIMPs

- In astrophysics, weakly interacting massive particles or WIMPs, are hypothetical particles serving as one possible solution to the dark matter problem.
- These particles interact through the weak force and gravity, and possibly through other interactions no stronger than the weak force.
- Because they do not interact through electromagnetism they cannot be seen directly, and because they do not interact through the strong nuclear force they do not interact strongly with atomic nuclei.
- This combination of properties gives WIMPs many of the properties of neutrinos, except for being far more massive and therefore slower.

Carbon Aerogel

- An **ultra-light substance** produced by china which has a **density of 0.16 milligrams per cubic centimetre** i.e. one sixth of that of the air.
- Being claimed as **lightest man-made material ever produced** is composed of **granite and carbon nanotubes**.
- One of the materials with **biggest oil absorption capacity** and can absorb up to 900 times their own weight.
- Despite its fragile appearance, carbon aerogel is **excellent in elasticity**.
- The substance is akin to **carbon sponge in structure** and is expected to play an **important role in pollution control** such as oil spill control, water purification and even air purification.
- In addition to pollution control, carbon aerogel is expected to become an ideal material for **energy storage insulation, catalytic carrier and sound-absorption**.

Bi-Fi

- The Bi-Fi network is a **new form of cellular communication** that could eventually lead to tissue regeneration.
- Stanford University scientists have developed a new way for cells to communicate in a network they're calling "Bi-Fi" -- **or a biological Internet**.
- The secret behind the new Bi-Fi network is a **virus called M13**.
- M13 prepares genetic messages within a host and sends them out to other cells without harming them.
- More specifically, M13 makes itself comfortable within a host, uses **DNA strands to package genetic messages and wraps the whole package in proteins** that it creates.
- These **messages are then sent to other cells, where the outer protein layer allows the message to "infect" the receiving cells. The DNA message is then released inside.**

Communications

3D television/3D Display

Importance Level: important: will be asked in near future

- 3D television (3DTV) is television that conveys depth perception to the viewer.
- Most modern 3D television sets use an active shutter 3D system or a polarized 3D system and some are autostereoscopic (without the need of glasses).
- The stereoscope was first invented by Sir Charles Wheatstone in 1838
- It showed that when two pictures are viewed stereoscopically, they are combined by the brain to produce 3D depth perception.
- Stereoscopic 3D television was demonstrated for the first time on 10 August 1928 by John Logie Baird (Inventor of TV)

Technologies:

- There are several techniques to produce and display 3D moving pictures.
- The basic requirement is to display offset images that are filtered separately to the left and right eye.
- Two strategies have been used to accomplish this:
 - have the viewer wear eyeglasses to filter the separately offset images to each eye,
 - or have the light source split the images directionally into the viewer's eyes (no glasses required).
- Common 3D display technology for projecting stereoscopic image pairs to the viewer include

With filters/lenses:

- Anaglyph 3D - with passive color filters
- Polarized 3D system - with passive polarization filters
- Active shutter 3D system - with active shutters
- Head-mounted display - with a separate display positioned in front of each eye, and lenses used primarily to relax eye focus

3 also called

Active 3D:

- It works by openly presenting the image intended for the left eye while blocking the right eye's view, then presenting the right-eye image while blocking the left eye, and repeating this so rapidly that the interruptions do not interfere with the perceived fusion of the two images into a single 3D image.

1, 2 also called

Passive 3D:

- To present stereoscopic images and films, two images are projected superimposed onto the same screen or display through different polarizing filters. The viewer wears low-cost eyeglasses which contain a pair of different polarizing filters. As each filter passes only that light which is similarly polarized and blocks the light polarized in the opposite direction, each eye sees a different image.

Without lenses: Autostereoscopic displays, sometimes referred to commercially as Auto 3D

Others: Few new technologies are developed

3D-ready TV

3D-ready TV sets are those that can operate in 3D mode (in addition to regular 2D mode).

Health effects

- Some viewers have complained of headaches and eyestrain after watching 3D films.
- Motion sickness, in addition to other health concerns, are more easily induced by 3D presentations.
- There have been several warnings, especially for the elderly
- There are primarily two effects of 3D TV that are unnatural for the human vision: crosstalk between the eyes, caused by imperfect image separation, and the mismatch between convergence and accommodation, caused by the difference between an object's perceived position in front of or behind

Autostereoscopic Displays

Importance Level: important: will be asked in near future

- Autostereoscopy is any method of displaying stereoscopic images (perception of 3D depth) without the use of special headgear or glasses on the part of the viewer. Because headgear is not required, it is also called "glasses-free 3D" or "glassesless 3D".

In News:

- You can now enjoy 3D movies on TV without those vexing 3D glasses, thanks to a new technology being developed in Germany.
- The 3D movies currently available on Blu-ray are based on two different perspectives — two images, one for each eye.
- However, autostereoscopic displays need five to 10 views of the same scene (depending on the type). In the future, the number will probably be even more.

Chemical Computer

- A chemical computer, also called reaction-diffusion computer, BZ computer (stands for Belousov-Zhabotinsky computer) or gooware computer is an unconventional computer based on a semi-solid chemical "soup" where data are represented by varying concentrations of chemicals.
- The computations are performed by naturally occurring chemical reactions.
- The simplicity of this technology is one of the main reasons why it in the future could turn into a serious competitor to machines based on conventional hardware.
- A modern microprocessor is an incredibly complicated device that can be destroyed during production by no more than a single airborne microscopic particle.

DNA Computer

- DNA computing is a form of computing which uses DNA, biochemistry and molecular biology, instead of the traditional silicon-based computer technologies.
- DNA computing, or, more generally, biomolecular computing, is a fast developing interdisciplinary area.

-
-
- DNA computing is fundamentally similar to parallel computing in that it takes advantage of the many different molecules of DNA to try many different possibilities at once.

Quick Response Code

- Quick Response Codes are a type of two-dimensional barcode that can be read using smartphones and dedicated QR reading devices, that link directly to text, emails, websites, phone numbers and more. One may have even got to this site by scanning a QR code.

Why more useful than normal barcode?

- The reason why they are more useful than a standard barcode is that they can store (and digitally present) much more data, including url links, geo coordinates, and text.
- The other key feature of QR Codes is that instead of requiring a chunky hand-held scanner to scan them, many modern cell phones can scan them.

Near-Field Communications (NFC)

- Near field communication (NFC) is a set of standards for smartphones and similar devices to establish radio communication with each other by touching them together or bringing them into proximity, usually no more than a few inches.
- Present and anticipated applications include contactless transactions, data exchange, and simplified setup of more complex communications such as Wi-Fi.
- Communication is also possible between an NFC device and an unpowered NFC chip, called a "tag".
- NFC standards cover communications protocols and data exchange formats, and are based on existing radio-frequency identification (RFID) standards.

Digital Equaliser Programme (DEP)

- American India Foundation's Digital Equalizer (DE) program is a computer-aided learning program that is bridging the education and digital divide in India, and preparing tens of thousands of children to compete in the digital economy.
- Its methodology is providing computers, software, Internet access and training to children and teachers in underprivileged schools across India.

Open Library Project

- Open Library is an online project intended to create "one web page for every book ever published" Created by Aaron Swartz, among others.
- Open Library is a project of the non-profit Internet Archive and has been funded in part by a grant from the California State Library and the Kahle/Austin Foundation.

Why is it in news?

- Aaron Swartz was co-founder of the social news Web site Reddit and activist who fought to make online content free to the public.
- He hanged himself weeks before he was to go on trial on accusations that he stole millions of journal articles from an electronic archive in an attempt to make them freely available.

Mobile HD voice

- Mobile HD voice is high quality voice service which enables high quality voice calls as it cuts down the background noise often heard on a regular call.

Optical Lattice Clock

- Researchers from the Paris Observatory have demonstrated that a new type of atomic clock is so precise and stable that it could provide a new international standard of time.
- Our current systems, called caesium fountains, expose clouds of caesium atoms to microwaves to get them to oscillate. But the new ones use light to excite strontium atoms.
- In these clocks scientists use laser beams. Laser beams oscillate much faster than microwave radiation, and in a sense can divide time in much shorter intervals so can measure time more precisely.
- Optical lattice clocks lose just one second every 300 million years and is more accurate than the current atomic clock that we all set our watches by.

Ion Clock

- An ion clock is also in development and is currently even more accurate than optical lattice clocks.
- It loses one second every few billion years but as it relies on a single ion, is not considered dependable enough for commercial use.

Rex

- World's first bionic man, comprising artificial organs, synthetic blood, robotic limbs and a human face.
- He can speak and listen, too. His parts aren't designed to work together, but each one either is, or soon could be, part of a living human being.

HO41 Superbug

- A new sexually-transmitted superbug- antibiotic-resistant strain of gonorrhoea HO41 - could ultimately prove to be even more deadly than AIDS.
- The superbug- gonorrhoea strain HO41 which was discovered in Japan two years ago, is found to be more aggressive and affects more people quickly.
- It can cause septic shock and death in a matter of days.

Brain-Computer Interface (BCI)

- A brain-computer interface (BCI), often called a mind-machine interface (MMI), or sometimes called a direct neural interface, is a **direct communication pathway between the brain and an external device**.
- BCIs are often directed at assisting, augmenting, or repairing human cognitive or sensory-motor functions.
- Researchers at Brown University have succeeded in creating the first wireless, implantable, rechargeable, long-term brain-computer interface.

How it works?

- Our brains are filled with neurons, individual nerve cells connected to one another by dendrites and axons.
- **Every time we think, move, feel or remember something, our neurons are at work.**
- That work is carried out by small electric signals that zip from neuron to neuron as fast as 250 mph.
- The **signals are generated by differences in electric potential carried by ions on the membrane** of each neuron.
- Although the paths the signals take are insulated by something called myelin, **some of the electric signal escapes.**
- Scientists can detect those signals, interpret what they mean and use them to direct a device of some kind.

Bone Ossification Test

- **Bone Ossification** is the process of formation of new bone by cells called osteoblasts.
- By the age of 25 years nearly all bones are completely ossified in humans.
- Ossification test is a guess work based on the fusion of joints in the human body b/w birth and age 25.
- If all joints are fused the person must be of 25 yrs of age or older.
- As per experts that there can be an error of about 2 years in the age determined by the ossification test, but it is still more reliable than ascertaining the age on mere appearance basis.

Electronic Intensive Care Unit (eICU)

- An Electronic Intensive Care Unit (eICU) is a form of **telemedicine** that uses state of the art technology to provide an additional layer of critical care service.
- An eICU may also be referred to as a **tele-ICU**.
- An eICU support center can provide care to patients in **multiple hospitals**.
- The goal of an eICU initiative is to optimize clinical expertise and facilitate 24-hour-a-day care by ICU caregivers, whether the caregivers are down the hall from the patient that's being monitored or in another city.

How it works?

- The remote hospital is connected to the **Central Command Centre**, where specialists offer expert advice.
- Critinext equipment is wired to the devices in the local hospital's ICU, ventilator pumps, patient monitors and the local health information system, if any.
- Equipment captures critical data relating to a patient at the local hospital, digitises close to 100-data points and transmits all information to the Central Command Centre real time.
- With this, a doctor sitting in the super-speciality hospital can do as much as the medical personnel in the local hospital.

Antiretroviral therapy

- Antiretroviral therapy (ART) is treatment of people infected with human immunodeficiency virus (HIV) using anti-HIV drugs.
- The standard treatment consists of a combination of at least three drugs (often called "highly active antiretroviral therapy" or HAART) that suppress HIV replication.
- Three drugs are used in order to reduce the likelihood of the virus developing resistance.
- ART has the potential both to reduce mortality and morbidity rates among HIV-infected people, and to improve their quality of life.

Science, Technology and Innovation Policy (STI) 2013

- Government unveiled the Science, Technology and Innovation Policy (STI) 2013.
- The STI Policy seeks to send a signal to the Indian scientific community, both in the private and public domain, that science, technology and innovation should focus on faster, sustainable and inclusive development of the people.
- It aims to bring all the benefits of Science, Technology & Innovation to the national development and sustainable and more inclusive growth.
- It seeks the right sizing of the gross expenditure on research and development by encouraging and incentivizing private sector participation in R & D, technology and innovation activities.
- The policy also seeks to trigger an ecosystem for innovative abilities to flourish by leveraging partnerships among diverse stakeholders and by encouraging and facilitating enterprises to invest in innovations.
- It also seeks to bring in mechanisms for achieving gender parity in STI activities and gaining global competitiveness in select technological areas through international cooperation and alliances.
- The policy goal is to accelerate the pace of discovery, diffusion and delivery of science led solutions for serving the aspirational goals of India for faster, sustainable and inclusive growth.
- A Strong and viable Science, Research and Innovation system for High Technology led path for India (SRISHTI) are the goal for the STI policy.

The Key features of the STI policy 2013

- Promoting the spread of scientific temper amongst all sections of society.
- Enhancing skills for applications of science among the young from all social sectors.
- Making careers in science, research and innovation attractive enough for talented and bright minds.
- Establishing world class infrastructure for R&D for gaining global leadership in some select frontier areas of science.
- Positioning India among the top five global scientific powers by 2020.
- Linking contributions of Science Research and innovation system with the inclusive economic growth agenda and combining priorities of excellence and relevance.
- Creating an environment for enhanced private sector participation in R &D.
- Enabling conversion of R & D output with societal and commercial applications by replicating hitherto successful models, as well as establishing of new PPP structures.
- Seeking S&T based high risk innovation through new mechanisms.
- Fostering resource optimized cost-effective innovation across size and technology domains.

Salinity Ingress

1. Along the coast, marine water is creeping underground into freshwater aquifers. Called salinity ingress, it is advancing at an unprecedented rate of half a km a year along the 1,125-km-long coastline of Gujarat.
2. The reason is depletion of groundwater reserves in coastal areas.
3. The only solution to salinity ingress rests on replenishing groundwater reserves.

2. He La cells

Biomedical researchers often use human cells to carry out their experiments. Once cell is removed from human body, it dies out very soon or it becomes very difficult to reproduce the cell in laboratory conditions. He La cells are known for their property that they can be reproduced easily in labs and they are almost immortal. He LA cells have become most used human cell for all kind of experiments.

3. CD-4 cells

T cells are important for body immune system. CD-4 cells is one of two types of T cells. CD4 cells don't neutralize any infection but they activate the body response to an infection. The lesser the active CD4 cells in body, more are the chances of catching an infection.

4. CCI- Satellite

Communication centric Intelligence satellite is a spy satellite which is being developed by DRDO. CCI-Sat will be able to capture images & pick up conversations that can be helpful to boost the country surveillance system especially along the border areas. It will be India's first officially declared spy satellite and it may be in orbit in 2014

6. Li-Fi

Li Fi is breakthrough in the field of internet data transmission. Li Fi use visible light as medium to transmit the data in place of radio frequencies used by currently in use Wi-Fi. Experimental data has shown that Li FI are able to transmit data at speed much faster than the WI-Fi. Li-Fi has the advantage of being able to be used in electromagnetic sensitive areas such as in aircraft or nuclear power plants, without causing interference. However, the light waves used cannot penetrate walls which makes Li-Fi more secure relative to Wi-Fi..

10. NEEMO

Neemo stands for NASA Extreme Environment Mission operation. Under this program NASA has created a underwater laboratory to prepare the astronauts, scientists & engineers for the

NASA future space explorations.

8. Cherenkov Telescope Array

Gama ray astronomy has been helpful to get major breakthrough in the field of Astrophysics. CTA is an initiative to create next generation high energy Gama ray instruments that can give more insight about the universe.

1. Tokkamak

Used to confine plasma by magnetic field in a toroid.

Upsalite

is an anhydrous form of magnesium carbonate first reported in July 2013.[1][2] With a surface area of 800 m² per gram, Upsalite is reported to have the highest surface area measured for an alkali earth metal carbonate ever created. It is found to absorb more water at low relative humidities better than the best materials previously available

4.Nalgonda Technique

Defluoridation of water by the Nalgonda technique is a commonly used household process in areas of endemic fluorosis in villages around Nalgonda (Andhra Pradesh, India). It has been developed by the National Environmental Engineering Institute. By doubling the concentrations of alum and lime, water fluoride levels fell significantly ($p<0.001$) in tap water and drinking water while pH levels and other inorganic factors remained unaffected

2.Regenerative Medicines

Regenerative medicine is the process of replacing or regenerating human cells, tissues or organs to restore or establish normal function. Regenerative medicine is the technique where stem cells are used to reproduce cells, tissues, organs in laboratory, so that they can be transplanted for restoration to normal functioning of body.the process is still in its nacent stage but still lungs have been completely grown artificially,the technique hold equally good for production of meat

5.Copyleft

Copyleft in contrast to copyright is the practice of an author/inventor to allow people modify and propagate the product freely. It is generally used in software world and was started by Richard Stallman (GNU project)

Helium 3, one of the most efficient and productive nuclear fuels which has the capacity to reduce the world's electricity woes is sadly, not abundant on this planet. It is the most sought after nuclear fuel because, one ton of He-3 can produce electricity for a billion people for more than a year. This will reduce the pollution levels caused due to coal and will have a positive impact on the environment.

ISRO's Chandrayaan mission had found lots of He-3, trapped in the mineral Titanite on the moon. So, robotic excavations of this precious material from the moon can be the basis of future objectives of lunar missions. Hence, in a way, lunar missions are sought after for this marvellous isotope. But, we still have a long way to go to achieve those goals. The Russian Space Corporation was reported planning to mine lunar He-3 with a permanent base there very soon. The Americans through NASA have announced its intention to establish a permanent base by 2024 and He-3 is betokened as one of the potential reasons. China too, plans to put such initiative by 2017. However getting helium 3 from moon is not an easy task. The quantity estimated is 50 ppb in lunar soils. Therefore it would require mining of millions of tons of lunar soil to collect enough helium 3.

Another problem is to separate helium 3 from lunar soil. Huge temperature is required thus consuming a lot of energy. Transporting helium 3 to Earth will also be a huge task.

Thus on Earth it's very difficult to use it as a fuel; however, it can be used easily in lunar colonies thus reducing the demand of energy by spacecraft in moon and for travelling from moon to Earth.

BioSimilar

Biosimilars, also known as follow-on biologics, are biologic medical products whose active drug substance is made by a living organism or derived from a living organism by means of recombinant DNA or controlled gene expression methods. Cloning of human genetic material and development of in vitro biological production systems has allowed the production of virtually any recombinant DNA-based biological substance for eventual development of a drug. After the expiry of the patent of approved recombinant drugs (e.g. insulin, human growth hormone, interferons, erythropoietin, and more) any other biotech company can "copy" and market these biologics (thus called biosimilars).

Helium 3, as it is non-radioactive and once used in fusion reaction will produce less waste and easier to contain apart from producing huge amounts of energy, that you mentioned. In nuclear fusion the problem is not of energy production as of now but to contain it well..... Helium 3 is

released by sun but out atmosphere does not let helium 3 reach earth, so very negligible resources. But moon does not have any such atmosphere and has abundant resources of energy.

Smart NAV

SmartNav,a product by Natural Point is a reliable and accurate, hands-free mouse alternative that allows complete control of a computer by naturally moving the head.It uses an infrared (IR) camera to track one's head movements.

MUAV Netra

Mini Unmanned Aerial Vehicle Netra is an Indian, light-weight, autonomous UAV for surveillance and reconnaissance operations.It is jointly developed by DRDO and R&DE.The Netra drone is designed to be used in hostage situations, border infiltration monitoring, law enforcement operations, search and rescue operations, disaster management and aerial photography. It can also be used in naxal-affected districts, in border locations across India for surveillance, and for anti-terrorist and counter-insurgency operations in dense forested areas, where it can use its camera payloads to track human activity

KIROBO : Kirobo, a combination of the Japanese words for “hope” and “robot,” is Japan’s first robot astronaut. It reached International Space Station on August 10,2013 along with tons of cargo and supplies. Equipped with voice and facial-recognition technology Kirobo speaks Japanese and its design is said to have been inspired by the Japanese anime character Astro Boy. Kirobo will communicate with Mirata, its twin robot back on Earth, which will also help engineers on ground to troubleshoot any malfunctions that may arise in Kirobo during its mission which will continue into 2014.

ADITYA SATELLITE : ‘Aditya’ would be the first Indian satellite to study the dynamic solar corona, the outermost region of the sun. This fiery region has temperatures of over one million degrees, with raging solar winds that reach a velocity of up to 1000 km a second. The satellite will carry as its payload an advanced solar coronagraph ,costing Rs. 49 cr. which will observe the solar corona with the help of an artificial eclipse that will prevent sunlight from directly entering the instrument, revealing to the telescope only the halo of the corona. The satellite which will be placed in a near-earth orbit of 600 km , is expected to be sent to space by 2015-16.

1. Primary objective of TRIPS – to universalize patent protection by making it an essential element of rules based regime of WTO. It was enacted in 1995. Doha Round gave certain concessions to developing countries mainly in the domain of public health and medicine. E.g. Flexibility in right to invoke compulsory licensing. I'm not sure if it also considered patent protection related to biodiversity products.

Primary objective of CBD – three points which i mentioned earlier. Two protocols signed under it till now – Cartagena protocol on biosafety (2003) and Nagoya Protocol on Access and Benefit Sharing(2010). It deals with patent issues related to biodiversity products and services. . How TRIPS and CBD can mutually exist??

TRIPS and CBD don't overlap except for agriculture. Even in agriculture, any novel process or product innovation, for e.g. transgenic crop by Monsanto, would come under the ambit of TRIPS whereas CBD would involve natural biodiverse products and services.

3. TRIPS stresses on innovation growth by protecting novelty whereas CBD stresses on equitable benefit sharing between communities.

JENVEC

It is a indigenous vaccine produced against Japanese B Encephalitis disease. Vaccine was produced by ppp model between ICMR and Bharat Biotech. It is a vero cell derived inactivated vaccine.

Anti-Doping Administration and Management System(ADAMS)- This is a web based multi-access secure database management system to simplify the tasks of all the stake holders involved in Anti-doping stakeholders. Its various modules addresses key activities of Anti-doping operations like, Athlete whereabouts, TUE management, Test & Result management and lab results module.

Ug99 is a lineage of wheat stem rust which is present in wheat fields in several countries in Africa and the Middle East and is predicted to spread rapidly through these regions and possibly further afield, potentially causing a wheat production disaster that would affect food security worldwide. It can cause up to 100% crop losses and is virulent against many resistance genes which have

previously protected wheat against stem rust. UG means Uganda.

Green nylon is a type of nylon manufactured by replacement of eco friendly adipic acid hitherto adipic acid was manufactured by fossil fuel which was a threat to environment.

BBP is an GOI's initiative to connect all 2.5 lakh gram panchyat by broad band connectivity using optical fibre network

Insight mission is a NASA discovery mission which will place a rover (geophysical lander) on mars to study its internal structure by 2016

India has signed Montreal protocol for emission of green house gases but shale gas extraction will accrue the contamination of methane drastically in long run...India convened COP-11 at Hyderabad for CBD and generated guidelines for protecting biodiversity wrt water and soil. But shale gas exploration has been awarded in those areas where ground water depletion is ever increasing...doing this will further accentuate the ground water table...further studies confirms that use of high pressure water will disturb the natural set up of the rocks thereby infuriating the land order...use of chemicals confirms the intoxication and mix up of other volatile and nonvolatile elements into water, which further escalate the risk to the health of populace living in the adjoining area

Metro Dot

The Metro Dot is a bracelet type transportation card in Braille for the visually impaired. It relays information like your subway station and how many more stations to go before your stop arrives. The bracelet transmits vibrations to let the user know when to get off the train. Through this method information such as the subway destination and how many stops are left can be alerted.

P K Iyenger

Padmanabha Krishnagopala Iyengar was an eminent Indian nuclear physicist. He played a central role in India's nuclear experiments. He was former head of Bhabha Atomic Research

Centre (BARC) and former chairman of Atomic Energy Commission of India. He was awarded with padmabhushan and bhatnagar award

RECOMMENDATIONS FOR TELEVISION RATING AGENCIES

- The Telecom Regulatory Authority of India (TRAI) has released its recommendations on guidelines for television rating agencies.
- In India, television ratings are currently provided by only one agency. The criticism of the current system includes small sample size, inappropriate geographical representation, disproportionate weightage given to certain channels, lack of transparent methodology, potential for manipulation of the respondents, lack of validation of data, and conflicts of interest. Key recommendations are:
 - **Regulation framework:** TRAI recommends that the agencies be regulated through MoIB guidelines. An agency needs to meet the eligibility norms and register with the MoIB to provide ratings.
 - **Eligibility norms:** All agencies should be set up as a company under the Companies Act, 1956 and should have a minimum net worth of Rs 20 crore.
 - **Conflict of interest:** An agency should not engage in consultancy or any other activity which could give rise to conflict of interest. None of its directors should be engaged in the business of broadcasting or advertising.
 - **Methodology:** The ratings should be technology-neutral and representative of the audience. The methodology should be disclosed publicly.
 - **Complaint Redressal:** Each agency should provide options for complaint registration and ensure timely and fair disposal. It should also establish an Appellate Authority.
 - **Audit:** The agency should conduct quarterly internal audits. Further, it should get its rating procedures audited annually by a qualified independent auditor.
 - **Disclosures:** The agency should publicly disclose details about rating methodology, coverage, sample size, conflicts of interest, quality control procedures, rate cards, ownership pattern, audit reports and redressal statistics.

BITCOIN

"bitcoin", a cryptocurrency
nurtured from the ground up by fringe elements of cyberspace
who have fashioned a crypto-currency using cryptography

to control the creation and transfer of money, rather than relying on central authorities. For some time now, money based on fiat currency – money issued by the state – has appeared to be an unreliable store of value. The loss of confidence in a fiat currency-based monetary system has triggered an active quest for alternatives. Created by an anonymous person with the pseudonym

Satoshi Nakamoto (https://en.bitcoin.it/wiki/Satoshi_Nakamoto), Bitcoin is a peer-to-peer decentralised virtual currency that lives entirely on the Bitcoin network – a network of computers running the open-source Bitcoin software. The system lets its users send and receive money, anytime, anywhere, without the help of a financial intermediary.

Additive manufacturing or 3D printing[1] is a process of making a three-dimensional solid object of virtually any shape from a digital model. 3D printing is achieved using an additive process, where successive layers of material are laid down in different shapes.[2] 3D printing is considered distinct from traditional machining techniques, which mostly rely on the removal of material by methods such as cutting or drilling (subtractive processes).

Rapid prototyping

Rapid prototyping

Mass customization

A latest experimental technology system, called WorldKit reportedly turns any surface into a touchscreen by pairing a depth-sensing camera lens with a projector lens.

According to Fox News, WorldKit's aim is to transform all of the surroundings into touchscreens, equipping walls, tables, and couches with interactive and intuitive controls.

The International Telecommunication Union (ITU) had, in this regard called on the European policymakers to have its global Universal Charging Solution (UCS) or mobile charging. The benefits arising out of adoption of the common standard for charging would include a lowering of unit cost of production, through economies of scale and indeed limiting device duplication. This apart, from being a good news for device-makers it is also one for the environment as the limiting of device duplication specifically, is expected to go a long way in solving the problem of e-wastes, considering that as many as 82,000 tonnes of redundant chargers are disposed of each year, the brunt of such massive e-pollution being largely borne by the developing countries.

The ITU-UCS solution expands the application of external power adaptors (EPAs) to the vast majority of mobile devices, encompassing 2G through to 4G mobile phones and other handheld devices including cordless phones, MP3/MP4 players, tablet computers, cameras, wireless headphones, and GPS devices. Adoption of the solution will also help raise device life and reduce Green House Gas (GHG) emissions, it is held.

Google Glass

Concerns

1. One concern is that recording other people will probably get easier. It will give creeps the ability to take invasive photos of women in public without their knowledge. Are these fears overblown? Such concerns were raised from the camera to the binoculars to the mobile-phones when they were invented. But unlike cameras, which must be raised and pointed, Glass may allow users to take photos merely by winking. No wonder bars, casinos and strips clubs are preemptively banning the devices. Google will need to make it extremely obvious when someone is filming or recording.
2. Privacy issues are there about the data it will be generating.
3. Most disconcerting is the integration of glass data stored on cloud, social networks and facial-recognition technology. Imagine, someday soon, a Glass wearer able to call up the Facebook and LinkedIn profile of everyone he sees on a bus, or starts a conversation with, simply by looking at them.

Cells in Mobile Communication

1. A macrocell is a cell in a mobile phone network that provides radio coverage served by a high power tower. High power implies higher amount of radiations are emitted. Macrocells have area larger than microcell. The antennas for macrocells are mounted on rooftops at a height that provides a clear view over the surrounding buildings and terrain. Macrocell base stations have power outputs of typically tens of watts.
2. A microcell is a cell in a mobile phone network served by a low power tower, covering a limited area such as a mall, a hotel, or a transportation hub. A microcell is usually larger than a picocell.
3. Typically the range of a microcell is less than two kilometers wide, a picocell is 200 meters or less, and a femtocell is on the order of 10 meters.

Digital vs Analog

1. In analog technology, a wave is recorded or used in its original form. In digital technology, the analog wave is sampled at some interval, and then turned into numbers that are stored in the digital device. To hear the music, the numbers are turned into a voltage wave that approximates the original wave.
2. The advantage of digital technology is that the recording does not degrade over time. As long as the numbers can be read, you will always get exactly the same wave.

IMEI / MEID Number

1. IMEI or Mobile Equipment Identifiers (MEID) are 15-digit code assigned to a handset and same appears on the operator's network whenever a call is made. Various concerns had been raised over their usage after terrorist attacks in India. Cloning issues in case of CDMA handsets are negligible but it is rampant in case of GSM handsets.

4G

1. To be accepted as proper 4G, data speeds over wireless must be 100 Mbps for mobile and 1 Gbps for stationary communication. Education, healthcare and entertainment are key, obvious areas of 4G applications

Touch Screens

There are three basic systems that are used to recognize a person's touch:

1. Resistive
2. Capacitive
3. Surface acoustic wave

The Resistive System

1. It consists of a normal glass panel that is covered with a conductive and a resistive metallic layer. These two layers are held apart and a scratch-resistant layer is placed on top of the whole setup. An electrical current runs through the two layers while the monitor is operational. When a user touches the screen, the two layers make contact in that

exact spot. The change in the electrical field is noted and the coordinates of the point of contact are calculated by the computer.

The Capacitive System

1. Here a capacitor layer is placed on the glass panel of the monitor. When a user touches the monitor with his or her finger, some of the charge is transferred to the user, so the charge on the capacitive layer decreases. This decrease is measured in circuits located at each corner of the monitor. Thus from the relative differences in charge at each corner coordinates are known.
2. One advantage that the capacitive system has over the resistive system is that it transmits almost 90% of the light from the monitor, whereas the resistive system only transmits about 75%. This gives the capacitive system a much clearer picture than the resistive system.

The Surface Acoustic Wave System

1. Here two transducers (one receiving and one sending) are placed along the x and y axes of the monitor's glass plate. Also placed on the glass are reflectors -- they reflect an electrical signal sent from one transducer to the other. The receiving transducer is able to tell if the wave has been disturbed by a touch event at any instant, and can locate it accordingly.
2. The wave setup has no metallic layers on the screen, allowing for 100% light throughput and perfect image clarity. This makes the surface acoustic wave system best for displaying detailed graphics.
3. A resistive system registers a touch as long as the two layers make contact, which means that it doesn't matter if you touch it with your finger or a rubber ball. A capacitive system, on the other hand, must have a conductive input, usually your finger, in order to register a touch. The surface acoustic wave system works much like the resistive system, allowing a touch with almost any object -- except hard and small objects like a pen tip.

The Infra Red System

HOW DOES A TOUCHSCREEN PHONE WORK?



TECHNOLOGY

There are three types of technologies widely used in touch screen phones today: resistive, capacitive, and infrared.

	RESISTIVE	CAPACITIVE	INFRARED (HEAT-SENSITIVE AND OPTICAL)
PHONES	 Samsung Messager Touch, Samsung Instinct, HTC Touch Diamond, LG Dare	 Huawei Ascend, Sanyo Zio, Apple's iPhone, HTC Hero, DROID Eris, Palm Pre, Blackberry Storm	 Samsung U600 (heat), Neonode N2 (optical)
HOW IT WORKS	 Small dots separate multiple layers of material that are transmitting currents. When the top flexible layer is pushed into the lower layer, the electrical current	 The current is broadcast from the corners of the screen. When a finger touches the screen, it	 Heat-sensitive must be touched with a warm object to register point of impact. Optical uses sensors to shoot a grid of invisible beams just above the screen. Point of

TV Displays

TELEVISION DISPLAY TYPES

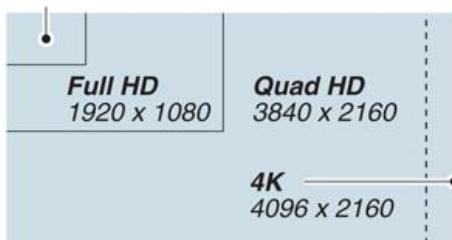
(Note: Diagrams are not to scale)

OLED - Organic Light Emitting Diode

Organically glowing materials used in OLED panels don't require separate backlights, making them far slimmer than other displays

Pixel resolutions compared

Standard definition 720 x 480

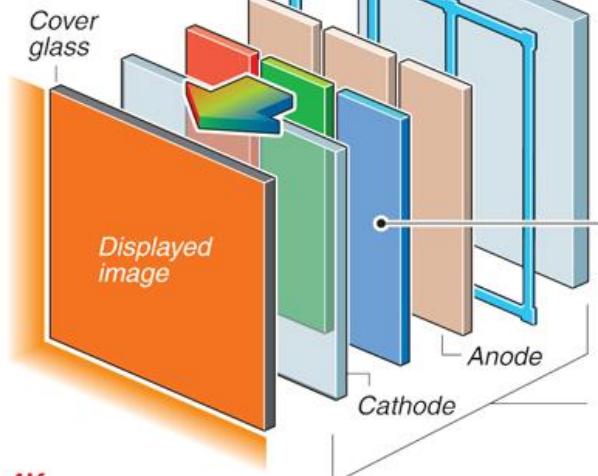
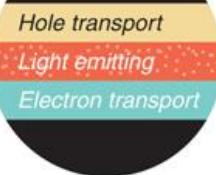


Active Matrix
Type used in larger displays such as TV

Thin film transistor (TFT) matrix

Glass or plastic substrate

Organic layers



Electricity passing through layers excites the molecules, producing light

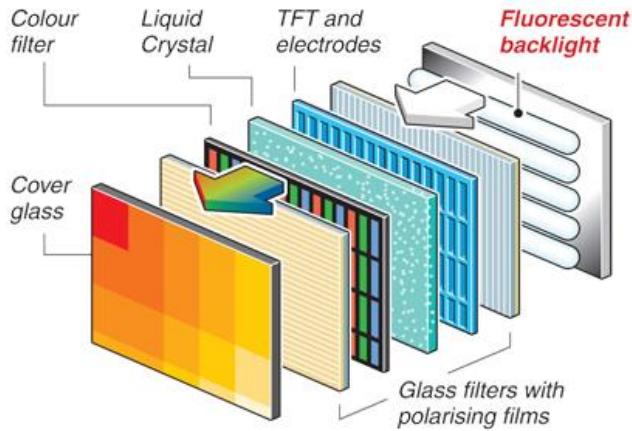
Sandwiched layers are 200 times thinner than a strand of human hair

4K

- A development in screen resolution that extends the life of conventional LCD technology by offering screens four times the resolution of current full high-definition (HD) models

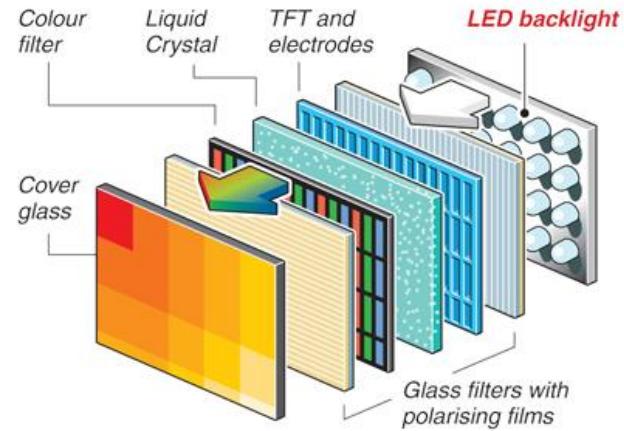
LCD - Liquid Crystal Display

Today's dominant flat display technology produces images by blocking or allowing light to pass from the light source behind the LCD display



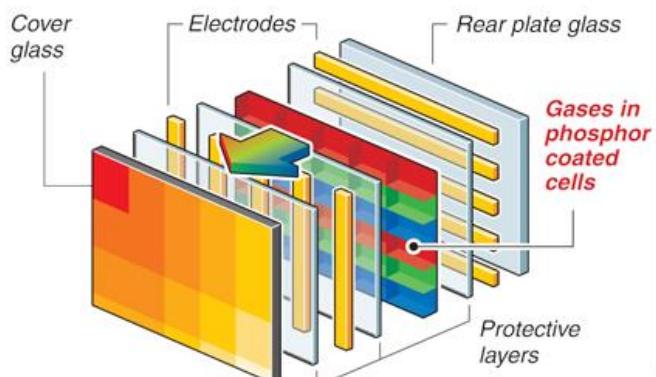
LED - Light Emitting Diode

LEDs are LCD TVs that replace the cold cathode fluorescent lamps (CCFL) used in conventional LCD displays



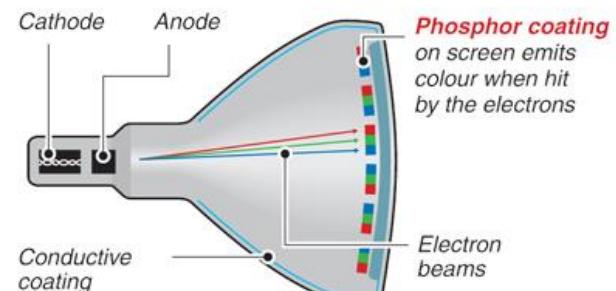
Plasma Display

Plasma is similar to OLED in that it emits its own light to produce RGB colours. Cells containing xenon and neon gases emit light when charged



Cathode Ray Tube (CRT)

Dominated the TV market before flat panel displays arrived in the mid-2000s. The technology still accounted for one in 10 TVs sold last year due to solid demand in emerging markets



Near Field Communication (NFC)

1. It is a variant of RFID and is an ultra short range wireless (<4 cm) as against Bluetooth which can cover ~10 meters.
2. NFC enabled smart-phones can replace credit cards and is expected to grow to \$150 bio in 2015.
3. This is because it has very reliable encryption which can store sensitive information.

Gigabit Passive Optical Network (GPN)

1. This is a technology used to upgrade the broadband situation in India. It can carry voice, data as well as video.
2. It uses optical fibre. The advantage it has is that it doesn't need any repeaters over a distance of 60 km thereby saving on power, equipment and security costs.

Magnetic Bacteria

1. They are iron eating bacteria and have the capability to produce small magnets just like those in hard disks. So they can be used to produce faster and smaller hard disks.

Energy

B100 Biodiesel

1. It is pure form of biodiesel and is prepared from marine micro-algae. It has zero sulphur and can fuel normal diesel engines. It was developed as a part of NMITLI (New Millennium India Technology Leadership Initiative).

Bio Battery

1. It generates electricity from shredded paper. Paper contains cellulose which is decomposed into glucose by certain enzymes. Glucose molecules are then broken by another set of enzymes into hydrogen ions and electrons. The hydrogen ions then get oxidized to release energy. But it is low power.

Bio Light

1. Uses luminescent bacteria and methane. But is too dim to replace conventional lighting.

Crude Grades

1. WTI: It is produced in US and is light and sweet (low-sulfur). It is good for producing products like low-sulfur gasoline and low-sulfur diesel.
2. Brent: It is a mix of crude from different oil fields in North Sea. It is not as light or sweet as WTI but still high grade. OPEC basket is heavier and sourer than Brent.
3. Other grades are Dubai and Oman oil. Lighter and sweeter oils have higher fractions of gasoline and hence more in demand.

API Gravity

1. It is a measure of how heavy or light a liquid is compared to water. If its API gravity is greater than 10°, it is lighter and floats on water; if less than 10°, it is heavier and sinks.
2. Light crude is one having API gravity > 31.1°. Medium is between 22.3° to 31.1° and heavy is below 23.3° but more than 10°.

Sweetness

1. If crude has < 0.5% sulphur, it is sweet otherwise sour.

Environment

Antarctic Methane Hydrate

1. It is the accumulation of methane in Antarctic sedimentary basins. The micro-organisms there converted the ice sheet's large deposits of organic carbon into CH₄. This methane lies trapped under the ice. But it could be released into the atmosphere as rising global temperatures melt the ice sheet, fueling even more global warming. Methane stays in the atmosphere for up to 15 years.
2. The gas is normally trapped as methane hydrate in sediments under a seabed. Methane hydrate is a form of ice containing a large amount of methane which is usually stable. As temperatures rise, the hydrate breaks down and methane is released from the sea bed, mostly dissolving into the seawater. Scientists have already identified thousands of sites in the Arctic where methane is bubbling into the atmosphere but the potential for methane formation under the Antarctic Ice Sheet has been less well studied.

Magnetic Soap

1. It is used in oil spills. It has got iron salts dissolved in it. When mixed with water, iron ions are created which are magnetic.
2. The soap breaks the spill as oil droplets get attached to it. Then a magnet can be brought at the top to lift the soap along with oil.

Bio marker

1. It is a substance used as an indicator of a particular biological condition like disease etc or presence of certain chemicals.

Bio-fertilizers

1. It contains living microorganisms which colonize the rhizosphere or the interior of the plant and promotes growth by increasing the supply of primary nutrients through the natural processes of nitrogen fixation and phosphorus and controlling diseases. Rhizobium (legumes), Azotobacter (cereals, cotton, vegetables), blue-green algae (paddy) are the ones used.
2. They don't contain any harmful chemicals, preserve soil, restore nutrient cycle, build organic matter and are used in organic farming.

3. Phosphate bio fertilizers are in demand because phosphate ion is insoluble and hence only 20% of applied phosphate in chemical fertilizers is actually utilized. On the other hand bio-fertilizers are able to solubilize phosphate efficiently.

Rhizosphere

1. It is the narrow region of soil that is directly influenced by root secretions and where the soil microorganisms carry out their activities fixing nutrients. This zone helps in nutrient recycling and disease control.

Nano Technology

CARBON NANOTUBES - COPPER

- Carbon nanotubes (CNTs) are allotropes of carbon with a cylindrical nanostructure. Nanotubes have been constructed with length-to-diameter ratio of up to 132,000,000:1, significantly larger than for any other material. These cylindrical carbon molecules have unusual properties, which are valuable for nanotechnology, electronics, optics and other fields of materials science and technology.
- When carbon nanotubes are embedded in copper, the resulting new material's ampacity gets boosted to massive 10,000 per cent, with an electrical conductivity comparable to copper's.
- Ampacity is the maximum amount of current a conductor can carry before losing its electrical properties; large ampacity is vital to good performance. However, of late, researchers worldwide have focused more on boosting conductivity than ampacity.
- A material with higher ampacity and which is simultaneously conductive is required to withstand, handle and transport the increasing current densities of modern electronics.
- The new material, dubbed CNT-Cu (for carbon nanotubes-copper), consists of 45 per cent CNTs by volume and is less dense than a pure copper conductor by 42 per cent. To produce it, the researchers electrodeposited copper into the pores of macroscopic CNT solids such as buckypaper.
- An advantage of the material is that it reduces the amount of copper required and provides 100 times higher performance. So we expect that the cost-by-performance of this material will be acceptable to industries.
- Copper conductors are assailed by a mechanism called electromigration that suppresses its ampacity.
- As electrons move inside the conductor, they are often scattered by atoms in their path. As the current density increases, scattering also increases until, at a threshold called the conductor's rating, the material can no longer conduct the electrons, resulting in electromigration.

Nano Cement / Nano Sand

1. Indian scientists have developed nano-sand particles that will help construct stronger buildings in a shorter time by reducing the time needed for curing. They used nanotechnology to modify the structure of sand to obtain nano-sand, or silica particles, for use in cement concrete.
2. They synthesized spherical particles of nano-silica using a substance called tetra-ethoxy-silane as starting material and ammonia as the base catalyst. When these nano-particles are added in cement paste, they give compressive strength and calcium leaching resistance to cement.

Top down approach vs bottom up approach

1. In top down approach, nano materials are constructed from macro objects. This is expensive and time consuming. In bottom up approach, nano objects are constructed from atoms and molecules. This is cheaper and faster.

Quasi-Crystals

1. The particles are arranged orderly like crystals but don't show a repeating pattern. The arrangement never repeats.

Carbon Nano Tubes

1. They are allotropes of carbon which have cylindrical shape. Their length to diameter ratio is 132 mm:1. They belong to the fullerene structural family of carbon and their ends may be capped by hemispheres.
2. They have extraordinary thermal and electrical conductivities along the axis of the tube, high melting points and mechanical strength for which they are used in electronics, optics, structural materials, data storage, replace CRT televisions with low energy televisions, aircraft manufacturing, automobiles (engines, windshields, body).

Cancer Treatment

1. Nano robots are introduced in the body of the cancer patient, can transport molecules, communicate the information to the physician. They have chemotactic sensors which can recognize certain antigens. Using these they are able to identify cancerous cells and deliver the anti-cancer dose specifically to those cells only.
2. New nano material has been discovered which can directly deliver the material inside the cancer cell's nucleus. They are called drug loaded gold nano stars as they are in shape of a star and are made of gold. The star attaches to the cell protein and delivers the drug directly to the nucleus. Because of its large surface area it is able to carry higher concentrations of drug.

Orally Delivered Nano Particles

1. Now scientists have successfully synthesized orally administered nano particles to deliver bio materials like DNA and RNA to cure certain diseases. These nano particles show no side-effect to surrounding tissues and are eliminated from the body after performing their function.

Nano Fibers

1. Water repellent, stain repellent, wrinkle free clothes. Bullet proof jackets. Fluorescent clothes.

Indium Selenide

1. A nano material used to increase efficiency of solar cells.

Nano Shells

1. They are gold nano shells and used for cancer treatment. Cancerous shells are bombed by infrared irradiated gold nano shells which kill the cancerous cells. They are targeted to bind with cancerous cells only using some antibodies.

Precision Farming

1. They use nano sensors to monitor local soil, plant conditions which they relay real time to the GPS integrated system making it possible to give a localized response. Thus farm efficiency can be maximized.

Nano Composite Coating

1. It helps in improving shelf life of the food by applying a nano coating of antimicrobial agents directly on the food covering. Silicate and silver nano particles are often used for such purposes.

Lanthanum nano particles

1. They can absorb phosphorus so can be cheaply introduced into the ponds to remove all phosphorus and kill the algae. They can save the money spent on dealgaelification.

Iron oxide nano particles

1. They are used in water filtration as they can bind with and remove arsenic from water.

Smart Windows

1. They have nano coatings of vanadium and tungsten. They reflect heat allowing only the visible light to pass through and hence help in keeping the home cool without the need of air conditioning.

Nano Accumulation

1. Nano particles have long lives and have large surface area to volume ratio. As a result they can accumulate inside our bodies and cover the surface of the tissues leading to health complications.

Nano Crystalline Cellulose

1. It attacks the free radicals and prevents aging. It combines with C-60 (buckminster fullerene) which creates a vacuum to absorb the free radicals.

Graphene and Gallium Nitride

1. Gallium nitride is used in LEDs (used in traffic lights) as a semi conductor. But it releases a lot of heat. Graphene can absorb such heat efficiently.

Nano Wires

1. They are made of copper and nickel and can conduct electricity even under the conditions where normal wires break down. Thus they can be used in products like smart packaging, interactive clothing, touch screens etc.
2. Currently touch screens are using Indium which is a rare earth metal and China has banned its export. Also it is brittle which means iPads can't be rolling iPads. The copper nanowire films can be deposited from a liquid in a fast, inexpensive coating process which are much more flexible and hundred times cheaper than Indium.

Nano and Environment

Potential Environmental Benefits

1. In most commercially available “nano-consumer products”, environmental protection is not the primary goal. Neither textiles with nano silver to combat perspiration odor, nor especially stable golf clubs with CNTs, help protect the environment. Manufacturers often promise such advantages, typically without providing the relevant evidence. Examples include self-cleaning surface coatings or textiles with spot protection, which are advertised as reducing the cleaning effort and therefore saving energy, water and cleaning agents.
2. Determining the actual effects of a product on the environment – both positive and negative – requires examining the entire life cycle from production of the raw material to disposal at the end of the life cycle. As a rule, the descriptions of environmental benefits fail to consider the amount of resources and energy consumed in producing the products.

Life cycle assessment

1. A Life Cycle Assessment is the appropriate approach to analyze the sustainable benefits. It encompasses all the environmentally relevant factors when extracting resources from the environment as well as the emissions. For nano products LCA follows the International Organization for Standardization ISO framework.
2. Impact nanomaterials on health, however, remain largely unknown. This means that health effects of nanomaterials still cannot be incorporated into an LCA at the present time. An additional difficulty in compiling an LCA for “nano-products” is that information on a product’s properties and ingredients is often lacking. Manufacturers often point to the proprietary nature of such data. So most LCAs fail to be comprehensive.
3. The available LCAs indicate that the environmental impacts of a “nano-product” lie mostly in the production phase. Thus, producing an antibacterial T-shirt with nano silver creates considerably more environmental damage than a conventional T-shirt. This is because the production of nano silver emits larger amounts of environmentally damaging greenhouse gases. Similarly the LCA of two solar processes to purify water showed a distinctly higher environmental impact of the photocatalytic process with nano-TiO₂ as opposed to the conventional approach. This was due to the high

consumption of resources in producing the nanoscale titanium dioxide. But nano coated plastic bottles show a clear significant advantage over non nano coated bottles.

4. To date, no resounding successes of nanotechnology in solving our environmental and climate-related problems have been documented: not every “nano-product” is by definition environmentally friendly or sustainable. Currently, one kilogram CNTs contains about 0.1 to 1 terajoules (TJ) of energy. One TJ corresponds to the energy content of about 167 barrels of crude. This makes CNTs one of the most energy-intensive materials known to mankind. Nanotechnology has contributed little to making vehicles and airplanes lighter and thus more fuel efficient.

Bio Science

XNA

- Synthetic biologists have developed six alternative polymers called XNAs that can also store genetic information, replicate and evolve like the genetic systems consisting of DNA and RNA.
- The “X” in XNA stands for “xeno” a Latin prefix that means exotic or foreign.
- Scientists have used this term to indicate the synthetic nature of these molecules – that one of the ingredients typically found in the building blocks that make up RNA and DNA has been replaced by something different from what occurs naturally.

Benefits of XNA

- It is believed that XNAs might, in the future, help in the creation of synthetic genetic systems based on alternative chemical platforms, and hence entirely synthetic alternative novel forms of life that will not require DNA or RNA for functioning.
- It is also assumed that XNAs and their enzymes might shed light on the origin of life and provide an answer to why life as we know it is based on the dominance of only two molecules – DNA and RNA.
- **Medicine**, too, could benefit from XNAs because of their non-biodegradable nature.

Regenerative Medicine

- Regenerative medicine is an emerging interdisciplinary field of research and clinical applications focused on the repair, replacement or regeneration of cells, tissues, or organs.
- By using a combination of several technologies, it aims at restoring impaired function resulting from any cause, including congenital defects, disease, and trauma.
- These approaches may include, but are not limited to, the use of stem cells, soluble molecules, genetic engineering, tissue engineering, and advanced cell therapy.
- The main advantage of regenerative medicine over current therapies is that it is a one-time cure to a particular disease.
- It saves the patient from recurring treatments and its associated costs.

IN VITRO MEAT

- At €2,50,000, the burger produced recently using meat cultured in a lab is probably the world's most expensive sandwich. But it marks a major milestone in the long pursuit by a few scientists to grow meat *in vitro*.
- The small piece of meat containing 20,000 strips of muscle tissue, each one mm thick by 2.5 cm long, is a proof of concept that culturing meat in a petri dish is indeed scientifically possible.

75

www.visionias.in

©Vision IAS

- The starting material for the lab-made meat is a kind of adult stem cell harvested from the muscles of cattle. Unlike embryonic stem cells that need to be coaxed to become cells of a certain kind, adult stem cells are preprogrammed to produce specialised cells — muscle cells in this case.
- But the downside is that adult stem cells cannot replicate endlessly like their embryonic counterparts. Having proved the science, commercial production of meat would become a reality only if scientists solve a few major problems.
- The most challenging is finding a truly cheap, efficient, animal-free media in which the stem cells can be grown. The foetal calf serum media currently used come from slaughtered animals. Aside from the source of the nutrient broth, the fact that it also contains antibiotics and anti-fungal agents almost rules out this serum as a likely candidate when mass production becomes a reality. Animal-free media are commercially available, but are equally expensive.
- It may take a few decades for the technology to reach the stage where meat grown in customised bioreactors becomes available in supermarkets at a competitive price. But there is a clear need for such meat.
- Besides saving more than 42 million cattle from being butchered every year in the U.S. alone, the huge environmental gain that would accrue cannot be dismissed lightly.
- According to a 2006 Food and Agriculture Organization report, livestock raised specifically for meat releases 18 per cent of greenhouse gas emissions; about 30 per cent of land is used for grazing and growing animal feed.
- The quantum of antibiotics used in livestock is one of the main reasons for the rise in drug-resistant bacteria. It would also minimise many viral strains from jumping from animals to humans.
- There is also need to make the product quite comparable in taste, texture and nutrient content to find more

Elephant Mosquito

- **Toxorhynchites**, also called "elephant mosquito", is a cosmopolitan genus of mosquitoes.
- The genus includes the largest known species of mosquito, and it is among the few kinds of mosquito that do not consume blood.
- The adults subsist on carbohydrate-rich materials, such as honeydew, or saps and juices from damaged plants, refuse, fruit, and nectar.

Why is it in news?

- Research shows that the larvae of the elephant mosquito destroy the larvae of mosquitoes such as *Aedes aegypti*, which spreads the debilitating dengue.

Integrated Pest Management (IPM)

- It is a broad-based approach that integrates a range of practices for economic control of pests.
- IPM aims to suppress pest populations below the economic injury level (EIL).
- The Food and Agriculture Organisation of the UN defines IPM as the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment.

Why is it in news?

- N. Vijaya Kumar, entomologist at Perunthalaivar Kamarajar Krishi Vigyan Kendra, has received international awards and two National awards for his work on integrated pest management.
- Integrated Pest Management (IPM), he was working on, deals with the use of insects and organisms and substances to fight pests on crops.

Chennai Declaration on Antimicrobial Resistance

- For the first time, medical societies in India came together and organised a symposium, A Roadmap to Tackle the Challenges of Antimicrobial Resistance, in Chennai to discuss the problem of antimicrobial resistance and possible solutions.
- International experts were invited to explain how high-income countries were trying to tackle antimicrobial resistance.
- The Chennai Declaration calls for urgent initiatives to formulate an effective national policy to combat the rising antimicrobial resistance, including a ban on over-the-counter sale of antibiotics, and to make changes in the medical education curriculum to include training in antibiotic usage and infection control.

Platelets in Fighting Infection

- The clotting of blood, crucial to wound healing, is carried out by cell fragments called platelets.
- This is the most established function of platelets, but studies in recent years have begun to hint that platelets may have other important roles in our immune system - like fighting infection with the help of Kupffer cells.
- Kupffer cells are located in the liver and protect us from infection by capturing and eventually destroying bacteria that pass by.

Potash Mobilizing Bacterial (KMB) Biofertilizer

- Potash is one of the major nutrients required by all crops. The entire requirement of potassic fertiliser in India is met by imports and distributed to farmers at subsidised price eroding both the foreign exchange reserve and revenue.
- Recently a bacterium mobilizing soil potassium (KMB) has been identified from the banana rhizosphere soil.
- By using Potash Mobilizing Bacterial (KMB) biofertilizer farmers can mobilize the potassium present in their own field soil and save up to 50 per cent of their potassium fertilizer requirement.

Artemisinin-Based Control Treatments (ACTs)

- Efforts to combat the spread of malaria are now mainly dependent on artemisinin-based control treatments (ACTs), as the malaria parasite became resistant to older drugs that treated the disease.
- But there is concern that if these ACTs also develop resistance, there are no other drugs available for widespread use.

Another Way of Testing

- Scientists have developed a new way of testing whether a lethal form of malaria is resistant to primaquine and artemisinin drugs.

WHO's Programme to Tackle Drug-Resistant Malaria

- The World Health Organisation recently announced a \$ 400 million programme to combat a resistant strain of malaria that has emerged in South-east Asia in recent years.
- The programme, which has already received around one-third of the required funding, will seek to prevent the spread of a falciparum parasite that has become resistant to artemisinin-based combination therapy (ACT), the global standard treatment for the disease.

Dua's Layer

- Dua's layer, according to a 2013 paper by Harminder Singh Dua's group at the University of Nottingham is a layer of the cornea that had not been detected previously.
- It is the fourth layer from the front.
- Despite its thinness, the layer is very strong and impervious to air.

Lifestyle Diseases

Alzheimer

APP Gene

1. The gene is responsible for a protein which sticks together in the brain and blocks neurons from communicating with each other causing Alzheimer. Some rare mutation in the gene results in a 40% reduction in the formation of these harmful 'plaques'.
2. It is estimated that it affects 1 in 14 people over the age of 65. It can be inherited in some cases. The condition is caused by parts of the brain wasting away, particularly in the cerebral cortex. As it wastes away, clumps of protein, known as 'plaques' and 'tangles', start to form in the brain. The plaques and tangles start to destroy even more brain cells. Early symptoms include minor memory problems and saying the right words.

Free Radicals

1. They are atoms, molecules or ions with an unpaired electron or with open shell configuration. They are reactive (get oxidized) and cause cell damage in the body. They lead to aging, cancer, age related diseases etc.
2. Antioxidants are used to contain free radicals. Vitamin C and E are anti-oxidants. Guava has the highest concentration of anti-oxidants.

Bioaerosols

1. Bioaerosols are suspensions of air borne particles containing living organisms or released by living organisms. They cause lung diseases, allergies and even cancer.
2. In normal course due to evaporation of water bacteria suspended in air are usually inert. But in humid conditions, they are capable of activity along with spores, yeast etc.

Saturated vs Unsaturated Fats

1. Saturated fats have no double bonds (hence more H) while unsaturated fats have double bonds (hence less H). Saturated fats give more energy per gram and are harmful as they increase cholesterol while unsaturated fats decrease cholesterol.

Animal proteins vs plant proteins

1. Animal proteins are called 1st class proteins because they contain all essential amino acids while plant proteins are 2nd class proteins as they don't contain all essential amino acids.

Poly Unsaturated Fatty Acids (PUFA)

1. They are unsaturated fatty acids with 2 or more double bonds. They are essential fatty acids as they can't be synthesized inside the body and hence need to be supplied from the diet. They lower blood cholesterol and form structural components of cell membranes. They are thus essential for proper growth and good cardiac condition. Their deficiency leads to scaly skin and stunted growth.
2. But pufas also generate free radicals inside the body and hence excess intake of pufas needs to be accompanied by higher intake of anti-oxidants (vitamins C, E, selenium).
3. Omega 3 fatty acids: They are long chain pufas containing a double bond on the 3rd C atom.

Deficiency Diseases

Vitamin A (Retinol)

1. It is present as such only in animal food. Plants contain pro-vitamin A which can be synthesized and stored into vitamin A in our body in liver.
2. Its deficiency causes low testosterone levels, night blindness and xerophthalmia which is the dryness of eye ball. Its excess cause hypervitaminosis which leads to dryness of skin, loss of hair, loss of body weight and enlargement of liver.
3. Sources include milk, carrot, green vegetables, meat, golden rice.

Vitamin B-1 (Thiamine)

1. It is a water soluble vitamin. It is used in alcoholic fermentation. In our body it is used in carbohydrate metabolism and nerve impulse transmission. Deficiency causes wet beriberi (weight loss, nervous disorder, irregular heart beats, edema), dry beri beri (weak limbs, impaired senses).
2. Cerebral beri beri: Alcohol interferes with the absorption of thiamine in the body so in chronic alcoholics this thiamine deficiency disease is present. It leads to loss of memory and to and fro motion of eye.
3. It is only synthesized in bacteria, fungi and plants. It is found in yeast, pork, milk, cereals, soybean, green vegetables.

Vitamin B-2 (Riboflavin)

1. It is found in milk, green vegetables, yeast, meat, egg.
2. It is used in metabolism of fats and proteins. Its deficiency causes arboflavinosis (which leads to sore throat and decreased RBC count) and cheilosis (fissures at the corners of the mouth, tongue inflammation). It usually occurs along with protein deficiency or deficiency of other vitamins.

Vitamin B-5 (Niacin)

1. It is found in green vegetables, groundnuts, cereals, meat, fish, poultry. Maize interferes with the absorption of niacin in the body hence it is more prevalent in maize belts.
2. It works to metabolize proteins, fats and to synthesize certain enzymes. Its deficiency is called pellagra which creates skin lesions, inflammation, memory loss.

Vitamin B-6

1. Its deficiency leads to convulsions and seizures.

Vitamin B-9 (Folic acid)

1. It is found only in animal food.
2. It aids in the formation and repair of DNA, cell division (hence important for pregnant women and children) and to produce healthy RBCs to prevent anaemia. Its deficiency leads to pernicious anaemia (RBCs become oval in shape instead of double concave), pregnancy complications and nervous disorders.
3. It is synthesized by the bacteria present in the colon of large intestine.

Vitamin B-12 (Cobalamin)

1. It is a water-soluble vitamin and maintains normal functioning of nervous system and helps in the formation of blood. Its deficiency naturally leads to nervous disorders and anaemia. It is also involved in the cell metabolism.
2. Sources are fortified breakfast cereals, fish, liver, poultry, eggs and milk. Ultimately, it must be obtained from bacteria which inhabit a section of the gut.

Vitamin C (Ascorbic acid)

1. It is found in citrus fruits.
2. Collagen protein: It is the most abundant protein in mammals constituting ~1/3rd of total body protein. It is a major component of connective tissues. Vitamin C is required for its synthesis.
3. Its deficiency causes scurvy. It is also an anti-oxidant.

Vitamin D (Calciferol)

1. It is found in sunlight, milk, fish, egg.
2. Its deficiency causes rickets i.e. increased loss of Ca through urine and hence nothing left for bones.

Vitamin E (Tocopherol)

1. It is found in green vegetables, milk, butter, vegetable oil.
2. It is an anti-sterility vitamin and also an anti-oxidant. Its deficiency leads to sterility, fragile RBCs, nervous disorders.

Vitamin K

1. It is synthesized within the body by the symbiotic bacteria (e-coli) present in the colon of large intestine.
2. It is needed for blood coagulation.

Sodium

1. It aids in contraction of muscles, transmission of nerve impulses and maintenance of electrolyte balance in the body. It is found in salt, milk, eggs, fish. It is the most commonly occurring extracellular cation.

Potassium

1. It is the most commonly occurring intracellular cation. It does the same thing as Na.

Calcium

1. It is needed for bones and teeth, coagulation of blood, muscle contraction. It is found in milk, eggs, green vegetables, cereals, fish.

Phosphorus

1. It is associated with bone hardening, body fluids. It is found in green vegetables, milk, cereals.

Kwashiorkor

1. This is due to only protein deficiency. It strikes in children between 1 - 3 years.

Marasmus

1. This is due to both carbohydrate and protein deficiency but carbohydrate deficiency is severe. It strikes in children < 1 year.

Dropsy

1. It is caused by adulteration of mustard oil with Argemone oil.

Communicable Diseases

Malaria

Causes

1. It is caused by Plasmodium. 90% malaria cases are caused by *plasmodium falciparum*. The parasite multiplies within the RBCs and then destroys them. They affect spleen and liver.
2. Studies have found that people with sickle cell anaemia are unlikely to get malaria since the parasite can't latch on to the sickle shaped haemoglobin.

Vaccine

1. Development of a vaccine so far has not been effective because plasmodium changes its shape and structure easily to attack RBCs.
2. Now a RBC receptor has been identified which is essential for plasmodium to invade the RBC. By targeting this single receptor, it will be possible to develop a vaccine.

Drugs

1. Synriam is the indigenous drug developed by Ranbaxy. It attacks *plasmodium falciparum*.

Virus Life Cycle

1. Once *plasmodium falciparum* is inside the body, it needs help before it can move on to its next victim. This is where the female anopheles mosquito comes in: she ingests the parasite when she takes a blood meal from an infected person. After passing through various stages of its life cycle within her body over a period of about ten days, it is ready to be passed on to the next human being she bites.
2. There are three fronts on which the disease can be fought. One is to eliminate the mosquitos, or to stop them biting (for example through the use of mosquito nets permeated with insecticide); the second is to treat everyone who has been infected, to prevent the parasite from being passed on; and the third is to vaccinate those who have not yet been infected.

Immune System

Dendritic Cells

1. They are a part of immune system in mammals. They act as messengers between innate and adaptive immunity via the process of antigen presentation. Dendritic cells are present in tissues in contact with the external environment such as the skin.

2. In dendritic cell therapy, the dendritic cells from the blood are harvested, grown and reintroduced in a large number so as to elicit a larger immunity response.

Innate Immunity

1. It is the first line of defense defending the host from infections in a non-specific manner. It recognizes and responds to pathogens in a generic, memoryless way.
2. It includes inflammation, recruiting immune cells to the sites of infection, identification and removal of foreign substances, activating adaptive immune system and acting as a barrier to infectious agents.

Antigen Presentation

1. It is a process by which dendritic cells capture antigens and then enable their recognition by T-cells (adaptive immunity cells).

Antigen

1. It is an antibody generator substance. Each antibody binds to a specific antigen by way of an interaction similar to the fit between a lock and a key.

Antibody

1. It is a large Y-shaped protein produced by B-cells that is used by the immune system to identify and neutralize foreign objects.
2. They are also called immunoglobulin (Ig). Ig M is the first antibody. Ig G is the most abundant one and replaces M and remains permanently in blood. Ig E indicates presence of allergy and Ig A is present in mother milk, saliva and tears.

Adaptive Immunity

1. It has the ability to recognize and remember specific pathogens and to mount stronger attacks each time the pathogen is encountered. It is adaptive immunity because the body's immune system prepares itself for future challenges.

B Cells

1. They are lymphocytes which produce antibodies.

T Cells

1. They are lymphocytes which intercept the antigens containing antibodies. They are of 3 types - (a) suppressor t cells i.e. protect our body from our own lymphocytes, (b) killer t cells i.e. directly kill invading pathogens, and (c) helper t cells i.e. induce more production of b cells and killer t cells.

Water Purification

1. Storage: Storing river water for a week leads to bacteria count dropping by 90%.
2. Chlorination: It kills bacteria, most viruses, amoeba, e-coli but has no effect on spores and some viruses (polio, hepatitis, jaundice). It forms ClO anion in basic water and HClO (hypochlorous acid) in acidic water.
3. Ozonation: It eliminates odor, taste, color and all Cl from water. It inactivates viruses quickly.

4. UV treatment: It kills many bacteria and viruses. Solar water disinfection treats small quantities of water cheaply using natural sunlight. Contaminated water is poured into transparent plastic bottles and exposed to full sunlight for six hours. The sunlight treats the contaminated water through two synergistic mechanisms: UV-A irradiation and increased water temperature.
5. RO treatment: It is a membrane filtration method that removes many types of large molecules and ions from water by applying pressure to the solution when it is on one side of a selective membrane. The result is that the solute is retained on the pressurized side of the membrane and the pure solvent is allowed to pass to the other side. To be "selective," this membrane should not allow large molecules or ions through the pores, but should allow smaller components of solvent to pass freely.

Osmotic pressure

1. It is the pressure needed to prevent the inward flow of water across a semipermeable membrane. It is also defined as the minimum pressure needed to nullify osmosis.

Tuberculosis

1. It is caused by a bacteria called Mycobacterium tuberculosis. It spreads by inhaling droplets spread via an infected person's cough. The bacteria can affect any part of the body but commonly affects lung. Symptoms are chronic cough with bloody sputum (blood in the cough and not vomiting blood).
2. It can be prevented by BCG vaccine. It has been declared a notifiable disease and has to be notified to the CMO.

BCG Vaccine

1. It is a vaccine against tuberculosis that is prepared from a strain of the attenuated (weakened) live bovine tuberculosis virus.

DPT Vaccine

1. Worked against diphtheria, pertussis and tetanus.

Pentavalent Vaccine

1. Pentavalent vaccine will protect children from diphtheria, pertussis, hepatitis B and haemophilus influenza Hib disease.
2. It is administered to children at 6, 10 and 14 weeks of age and will replace the existing DPT and Hepatitis B vaccine primary dose of which is given at the same age. It reduces the number of vaccines from 9 to 3.

Hepatitis

Hepatitis - A

1. What it does: The infection generally produces a self-limited disease. However, some patients might experience a relapse of symptoms during the 6 months after acute illness. Acute liver failure from Hepatitis A is rare. The blood carries the virus to its target, the liver, where it multiplies.
2. How to combat: Antibody produced in response to HAV infection persists for life and confers protection against reinfection. Substances toxic to liver should be avoided. The vaccine

begins to protect 4 weeks after receiving the first dose. The 6- to 12-month booster is required for long-term protection.

Hepatitis - B

1. How it spreads: It spreads via exchange of bodily fluids (sexual contact, blood transfusion, needles, tattoo, child birth)
2. What it does: Hepatitis B is irritation and inflammation of the liver due to infection with the hepatitis B virus. The virus (a DNA virus) multiplies inside the liver cells and interferes in its functioning. It may cause no symptoms and may lead to chronic infection and liver damage. It may also cause other liver diseases and cirrhosis (scarring of liver).
3. How to combat: Vaccine, medicine (can only stop the virus from multiplying and can't kill existing virus). In most people the infection is cleared automatically and treatment is needed only in chronic cases.

Hepatitis - C

1. How it spreads: It spreads by blood to blood contact (needles, transfusions, mother to child, sexual contact).
2. What it does: It is a RNA virus. Chronic infection may lead to cirrhosis, liver failure, cancer and other diseases.
3. How to combat: No vaccine exists. Medicines can check the individual diseases.

Hepatitis - D

1. How it spreads: It spreads in the same manner as Hepatitis B.
2. What it does: It is a RNA virus and can attack only with or after Hepatitis B infects.
3. How to combat: It can be prevented by preventing Hepatitis B.

Hepatitis - E

1. How it spreads: It spreads via fecal-oral transmission i.e. contaminated food, water, contact with infected stools.
2. What it does: It is a RNA virus and causes liver diseases.
3. How to combat: High quality water. Vaccine also developed.

Jaundice

1. What it does: Everyday, a small number of red blood cells die and are replaced by new ones. The liver removes the old blood cells, forming bilirubin. The liver helps break down bilirubin so that it can be removed by the body in the stool. When too much bilirubin builds up in the body (either due to excess RBC death, problems in secretion out of body, liver malfunction), jaundice may result.

Types

1. Pre-hepatic jaundice: Anything which causes excessive destruction of RBCs like malaria.
2. Hepatic jaundice: Anything which affects liver ability to secrete bilirubin (an orange-yellow pigment formed in the liver by the breakdown of hemoglobin and excreted in bile).
3. Post-hepatic jaundice: Anything which interrupts the excretion of bile like a stone.

Rotavirus

1. It is the most common cause of severe diarrhoea among infants and young children.
2. Nearly every child in the world has been infected with rotavirus at least once by the age of five. Immunity develops with each infection, so subsequent infections are less severe; adults are rarely affected.
3. The virus is transmitted by the faecal-oral route. It infects and damages intestinal cells and causes gastroenteritis.
4. Rotavirus is easily manageable, but still lakhs of children die annually in India. Recently an indigenously developed cheap vaccine called Rotavac was developed. It would be 10 times cheaper than existing vaccines and would cost only Rs. 50 per dose.

H7N9 & International Data Sharing

1. It broke out in China and has been labeled by the WHO as one of the most lethal influenza viruses so far. Definite information about the host and mode of spread is not known. Some links with poultry are suspected. Human to human transmission is not confirmed but infected have been found in clusters.
2. The good thing is willingness of China to readily share live virus samples with WHO and upload the genetic information of the virus to the Global Initiative on Sharing All Influenza Data (GISAID) database. This is a huge leap forward compared with its near secrecy during the 2002 SARS outbreak.
3. But the darker side of data sharing has already reared its ugly head. Western pharmaceutical companies use the data to make vaccines but recognizing IPRs of the host countries and then sell these vaccines to them at high prices. It happened with Thailand following the H5N1 outbreak in 2007.

H1N1 / Bird Flu

1. WHO declared it to be over in August 2010 and said it would continue for some more years as common influenza. Since then India has witnessed 3 major outbreaks of H1N1 but none of them carry the dangerous mutation of the virus. The outbreaks contain virus belonging to Clade 6 & 7.

Controversial Papers on Bird Flu which were banned due to the threat of making bio-weapons out of H1N1

1. Currently bird flu can spread only by direct contact with infected birds and not from humans to humans via air, water etc. This is because of a protein found in the virus called HA protein (haem-agglutinin). This protein is like a hook by which the virus attaches itself to the host cell. The protein helps the virus binds itself with the sialic acids found in the receptors

of the host cell. Sialic acids of birds are different from sialic acids of mammals and HA protein can recognize sialic acids of birds easily and not mammals. So it has difficulty binding with human cells.

2. The researchers took the HA gene, made millions of mutations, spliced them back. Finally they were able to develop mutant viruses which could bind with mammalian cells and in fact one of them became a mammalian specialist (i.e. could now bind only with mammalian cells and not birds). When they took the genetic material of these viruses and bound it with the genetic material of human influenza viruses they found the resultant mutant could pass through air from mammals to mammals.

Influenza A

1. Humans can be infected with influenza types A, B, and C viruses. Subtypes of influenza A that are currently circulating among people worldwide include H1N1, and H3N2 viruses.
2. Wild birds are the natural host for all known subtypes of influenza A viruses. Typically, wild birds do not become sick when they are infected with avian influenza A viruses. However, domestic poultry, such as turkeys and chickens, can become very sick and die from avian influenza, and some avian influenza A viruses also can cause serious disease and death in wild birds.
3. Low pathogenic vs high pathogenic: A virus is further classified as low pathogenic (LPAI) or highly pathogenic (HPAI). Most avian influenza A viruses are LPAI viruses that are usually associated with mild disease in poultry. In contrast, HPAI viruses can cause severe illness and high mortality in poultry. H5N1 is a HPAI. LPAI viruses have the potential to evolve into HPAI viruses and this has been documented in some poultry outbreaks.
4. Human diseases: HPAI can also affect humans severely (H7N7, H5N1). LPAs can cause mild symptoms like conjunctivitis and influenza type illness in humans. In general, direct human infection with avian influenza viruses occurs very infrequently, and has been associated with direct contact.
5. Antigenic drift: It refers to small, gradual changes that occur through point mutations in the two genes that contain the genetic material to produce the main surface proteins, hemagglutinin, and neuraminidase. These point mutations occur unpredictably and result in minor changes to these surface proteins. Antigenic drift produces new virus strains that may not be recognized by antibodies to earlier influenza strains. This is one of the main reasons why people can become infected with influenza viruses more than one time.
6. Antigenic shift: It refers to an abrupt, major change to produce a novel influenza A virus subtype in humans that was not currently circulating among people. Antigenic shift can occur either through direct animal (poultry)-to-human transmission or through mixing of human influenza A and animal influenza A virus.

Influenza B

1. Influenza B viruses are usually found only in humans. Influenza B viruses can cause morbidity and mortality among humans, but in general are associated with less severe

epidemics than influenza A viruses. Although influenza type B viruses can cause human epidemics, they have not caused pandemics.

Influenza Type C

1. Influenza type C viruses cause mild illness in humans and do not cause epidemics or pandemics.

Biotechnology

Bionics

1. Bionics means the replacement or enhancement of organs by mechanical versions. Bionic implants differ from mere prostheses by mimicking the original function very closely, or even surpassing it.
2. While the technologies that make bionic implants possible are still in a very early stage, a few bionic items already exist such as artificial ears, heart, retina, limbs. Use of nanotechnology can produce artificial RBCs.

Mitochondria Replacement Technique

1. It is used for preventing women from transmitting mitochondrial disorders to their children.
2. One concern about it is the idea of '3 parents'. A woman other than the mother providing genetic material to a baby has not gone down well with everyone.
3. Another is the fear of 'designer babies'. But mitochondria's genetic material does not in any way contribute to the working of the nuclear DNA, so such concerns are unfounded.

In Vitro Fertilisation

Issues

1. Mix-ups: In a few cases, embryo mix-ups have occurred, leading to legal action and complex paternity suits. Technological solutions for this are tagging individual specimen containers with unique RFID.
2. Pre-implantation genetic screening and designer babies: Although this can potentially save thousands of lives each year, but it would be akin to interfere in the natural evolution process. Coupled with the greed of industry to make quick profits, its main application is likely to be designer babies.
3. Pregnancy post menopause: Leading to serious health risks and issues such as orphaning of the child.

4. Same-sex couples, single and unmarried parents.
5. 3-parent babies.
6. Discarding unwanted embryos.
7. Risk of multiple births.

Process

1. It is a process by which an egg is fertilised outside the body. It is a major treatment for infertility when other methods have failed.

Gene Patenting

1. A gene patent is applied for by a company which isolates and identifies the fragment of DNA which makes up the specified gene. The gene can then be synthesised by the use of messenger RNA. This isolated synthetic gene is known as complementary DNA (cDNA), as opposed to genetic DNA (gDNA), which is the naturally occurring version.
2. Patent applications are always for both cDNA and gDNA. If only cDNA was patent-worthy, researchers could work around by using gDNA to isolate and develop cDNA, via a different set of processes. If both patents are granted, the holder has the exclusive right to research that gene.
3. Bio-patents hold for 20 years. Myriad Genetics charges \$4,000 for the BRCA tests. An entire human genome sequencing for over 23,000 genes can now be done for about \$1,000.

Biotech in Industry

Fermentation Technology

1. Biotechnology specially fermentation technology can help boost India's manufacturing sector. Fermentation-based manufacturing supports production of antibiotics, vaccines, bio pharmaceuticals, enzymes, alcohol, foods and bio-fuels.

Bio Informatics

1. Its one application is in diagnostics based on bio-markers.
2. Biometrics is another application of bio informatics. The cost of sequencing entire human genomes is shrinking exponentially and it won't be too long before it overtakes present-day conventional biometrics to make DNA fingerprinting the most reliable identification technology of the future.

The Agricultural Biosecurity Bill 2013

1. Objectives

1. It would also equip the country to meet obligations under several trade and sanitary agreements in food and agricultural products.
2. It aims to establish a national biosecurity system covering plant, animal and marine issues to combat threats of bioterrorism from pests and weeds.

2. Authority

1. It establishes the Agricultural Biosecurity Authority of India.
2. The Authority shall be headed by a Director General, appointed by the central government, and comprise experts in plant and animal pests and diseases, and representatives of various ministries and organisations.
3. Thus the authority is not independent at all. Experience also tells that the experts don't get much of a say and the bureaucrats dictate all the functioning in such a setup.

3. Functions

1. The Authority shall be bound by directions on policy as specified by the central government.
2. Regulating the import and export of plants, animals and related products, specially pests.

4. Quarantine functions

1. No person can carry such a pest and is bound to notify immediately when he becomes aware of the existence of such pests.
2. The Authority may notify any pest to be a quarantine pest. It can also notify an area to be a controlled area if it suspects or determines that the area is infested or infected with a quarantine pest.
3. When an area is notified to be controlled, the Authority shall communicate the quarantine measures that the state government shall implement. If the state government fails to take measures in a controlled area, then the Authority can take necessary steps for the eradication or containment of the quarantine pest.
4. Provides for taking samples, search and seizure, treatment, quarantine and disposal to prevent spread of infection.

5. Biosecurity emergencies

1. The Authority may recommend that the central government declare a biosecurity emergency in an area in case of an outbreak.
2. During the biosecurity emergency, the centre may give directions to the Authority for managing the outbreak.

6. Grievance redressal mechanism

1. Persons aggrieved by any order of the implementing officer, may appeal to the central government within a period of 30 days of the order.

GM Crops

Parliamentary Committee on Agriculture Report

1. It asked the government to stop the field trials of all GM crops and a ban on Bt Brinjal till further studies. It demanded a probe on how the permission was given to commercialize Br Brinjal while all the stipulated tests were not carried out. It indicated a collusion (from inception to a moratorium) between the regulator, minister and the companies. It asserted that there is no 'trickle down' gain from such crops. One of the concerns raised strongly by those opposing GM crops in India is that many important crops like rice, brinjal, and mustard, among others, originated here, and introducing genetically modified versions of these crops could be a major threat to the vast number of domestic and wild varieties of these crops. In fact, globally, there is a clear view that GM crops must not be introduced in centres of origin and diversity
2. It criticized the composition and the role of the regulatory Genetic Engineering Approval Committee and the Review Committee on Genetic Manipulation. The DBT, whose mandate is to promote GM crops and fund various transgenics research, has a nominee as the co-chair of the GEAC, who gives the final approval for environmental and commercial release of GM crops.
3. It asks for labeling of GM crops. Will the committee also support consolidation of small holdings into large farms, corporatisation of food handling and the supply chain and organised retail?
4. GM crops can also cause harm by uncheck pollination spread. Next GM crops have simply not been around long enough for us to have any confident information about their safety. No country in the world, even the ones where most GM foods are found have the mechanisms in place that can check for the safety.
5. Our current regulatory system is a shame and the Bt Brinjal experience has taught us that there is a clear tilt towards pro industry. The BRAI proposal is much worse than the current GEAC led regulatory system as there is in your face conflict of interest as it is championed by the MoS&T and it is missing critical aspects like independent biosafety testing, deterrent liability and public participation.
6. Open Field Trials could result in environmental release of GMOs and this could cause irreversible damage to our biodiversity.

Bt Cotton

1. Maharashtra cancelled the license of Mahyco to sell the Bt Cotton seed. Bt Cotton has contaminated the other varieties and now other seeds are no longer available. GM technology cannot be a monopoly of one company. Imagine the national security issues. It was clear that at least for the rain-fed cotton farmers of our country, the introduction of Bt

cotton offered no socio-economic benefits. On the contrary, it being a capital intensive practice, the investment of farmers increased manifold thus exposing them to greater risks due to massive indebtedness.

2. Bt Cotton simply eliminates the threat of ball worms and does nothing else. But studies indicate that the ball worm has developed resistance and is back. Bt stands for *Bacillus Thuringiensis* - a soil dwelling bacteria - with pesticidal properties.

Socio Economic Impact of Bt Cotton

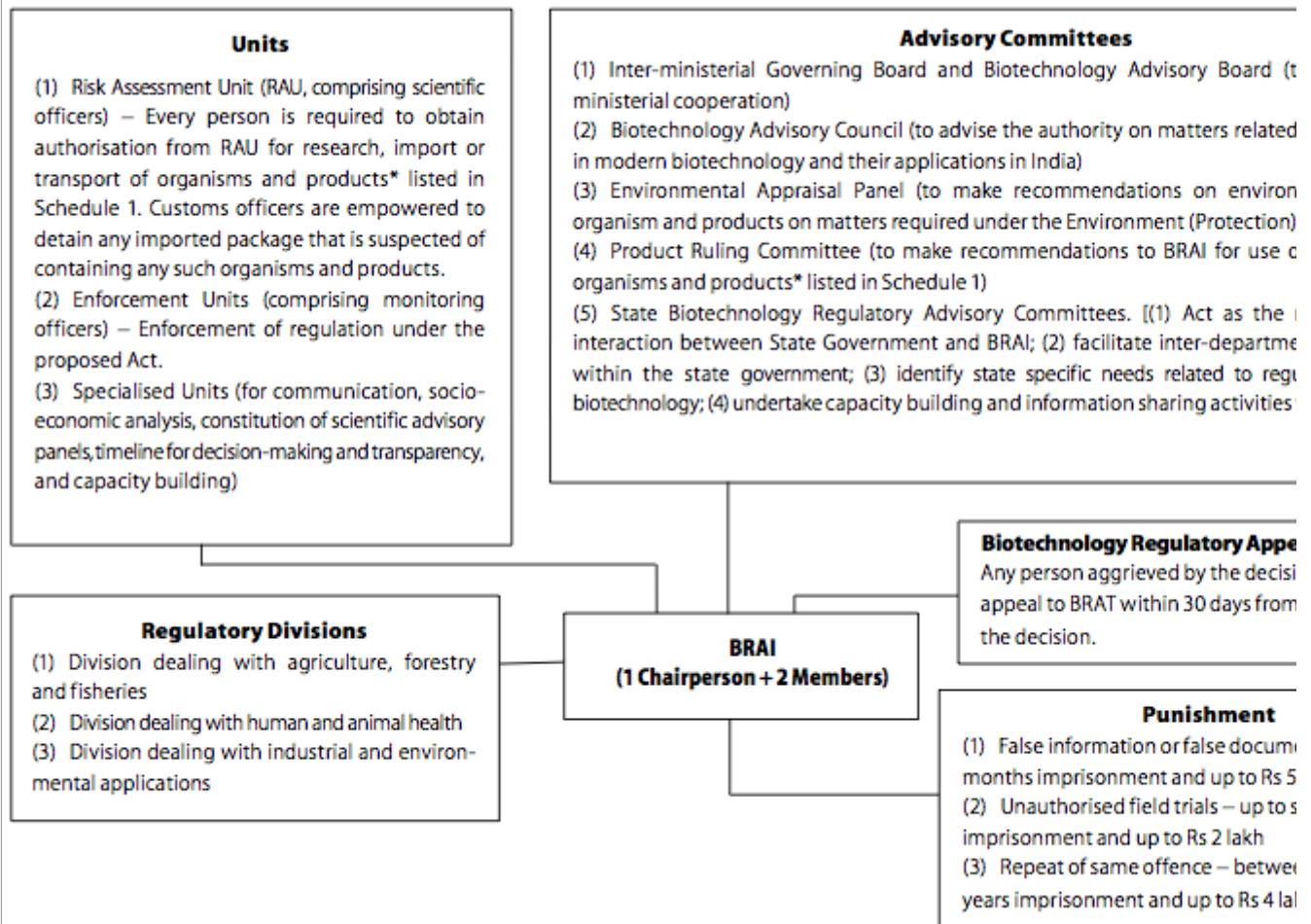
1. Cotton Advisory Board data show that cotton yields increased by about 60% between 2002 and 2004 when the area under Bt cotton was a meagre 5.6% and the area under non-Bt cotton was 94.4%. The yields did not increase significantly more than the pre-Bt era even until 2011 when the Bt cotton area touched 96%. This yield stagnation in India is primarily because of the vast majority of inappropriate hybrids. Bt protects the crop against bollworms and does nothing else. But in India, Bt cotton is available only as Bt hybrids available in over 1,000 hybrids, while in the rest of the world Bt cotton is available only as a few straight varieties. India should also have had Bt technology in straight varieties.
2. Most of the Bt hybrids are of 180-to 200-day duration and are not suited for rain-fed conditions which are the main areas where cotton is grown in India. Hybrids also tend to be input intensive, so they are not suitable for at least half the area in the country, which is under marginal soils in rain-fed regions. For rain-fed regions early-maturing straight varieties with low input requirements are the best option.
3. The main advantage with straight varieties is that farmers can reuse farm-saved seeds and can take the liberty of early dry sowing, even before the onset of the monsoon, without having to worry about the risks of poor germination and re-sowing.
4. The problem is thus not so much with Bt technology but with late maturing hybrids. Farmers in rain-fed regions are compelled to choose from a long list of Bt hybrids, most of which are late maturing.

GM Crops and India's Rice Exports

1. The threat to our food grain exports has often been cited as one of the reasons for not allowing GM crop trials. Is this a genuine concern?
2. Rice tops in the list of exported food grains. Much of our non-basmati rice exports end up in countries such as Bangladesh and Nigeria which don't care about GM.
3. Europe accounts for just 3% of the total basmati exported from India. More than 70% goes to Gulf countries which again are not GM sensitive.

Biotechnology Regulatory Authority

Figure 1: Structure of Proposed BRAI



1. The Bill establishes the Biotechnology Regulatory Authority of India (Authority).
2. Regulatory divisions of the Authority have been created for the implementation of safety assessment procedures and processes. The divisions are: (i) agriculture, forest and fisheries, (ii) human health and veterinary products, and (iii) industrial and environmental applications.
3. It will take into consideration both bio safety and SEC issues while granting clearance.
4. A Risk Assessment Unit will appraise applications for proposed research, transport or import of an organism or product, before final approval is granted. The Product Rulings Committee will make recommendations to the Authority for the manufacture or use of organisms or products. The Environmental Appraisal Panel will make recommendations on environmental safety of organisms and products.
5. An Inter-Ministerial Governance Board has been established to promote inter-ministerial or departmental co-operation for the effective discharge of the functions of the Authority.
6. A Biotechnology Advisory Council will render strategic advice to the Authority regarding developments in modern biotechnology and their implications in India.
7. **State level body:** A State Biotechnology Regulatory Advisory Committee will act as a nodal

agency between the state government and the Authority with regard to the regulation of modern biotechnology.

8. **Appellate Tribunal:** A Biotechnology Regulatory Appellate Tribunal will hear appeals against the decisions, orders or directions of the Authority.

Functions of the Authority

1. Regulating the research, transport, import, containment, environmental release, manufacture and use of organisms and products of modern biotechnology.
2. The Authority has the power to call for information, conduct an inquiry and issue directions for the safety.
3. Field trials for GM crops cannot be conducted unless the Authority permits them. The Bill will not apply to the clinical trials of drugs.

Disclosure of Information

1. The Authority will not disclose confidential commercial information made available in an application to the Authority.
2. However, the Authority may disclose it in public interest or if this disclosure will not harm any person.

Issues

1. BRAI is proposed to be under Ministry of S&T which is a clear case of conflict of interest. It should be under MoEF.
2. BRAI will only certify the safety and efficacy of the LMO products. Their commercial use is subject to the various rules and laws prevailing. Thus even after BRAI approval a state government can decide not to allow Bt crops in its state. What kind of single window is this?
3. SEC assessment will be done by the respective departments and the concerned line ministries. Thus it will rely on multiple departments and govt. and this will only lead to delays.
4. Entire institution to be dominated by generalist bureaucrats with little interaction with civil society.
5. No mention of mandatory labeling of GM crops. In EU any product having more than .9% GM material is to be labeled.

Gene Therapy

1. It involves altering DNA by encoding it and then planting it back. If it is planted in somatic cells, it is called somatic gene therapy and the alterations are not inherited. If it is planted in germ cells, it is called germ gene therapy and traits are inherited. Preventive gene therapy means altering the DNA before a disease manifests itself.

Somatic Cells

1. A somatic cell is any cell in the body which is not a gamete, germ cell. Gametes are cells that fuse during sexual reproduction, for organisms that reproduce sexually; Germ cells are cells that give rise to gametes.

Induced Pluripotent Stem Cells (iPSC)

- iPSCs are body (somatic) cells which have been reprogrammed to function like embryonic stem cells, thereby sidestepping the controversial use of killing the embryos while harvesting the stem cells.
- This is done by introducing four regulatory factors (pieces of DNA) into the cells.

Somatic Cell Nuclear Transfer

1. It involves removing the nucleus from a somatic cell, usually a skin cell. This nucleus contains all of the genetic information needed to produce the organism it was removed from. This nucleus is then injected into an ovum of the same species which has had its own nucleus removed.

Aspartame (calorie free sugar)

1. It is a dipeptide produced from amino acids including phenylalanine and aspartic acid. It is 200x sweeter than sugar and hence is needed in very small quantities.

Carcinogen in Pepsi

1. The caramel coloring used in Pepsi contains carcinogen Both Coke and Pepsi agreed recently to reduce this chemical in their drinks.
2. It can cause cancer. It is 4-methylimidazole, or 4-Mel, which can form during the cooking process.

Innovation

Global Innovation Index (GII)

1. It is calculated as average of two sub-indices. The Innovation Input Sub-Index weighs key factors that contribute to a country's economy such as its institutions, human capital and research output, infrastructure, market sophistication, and business sophistication. The Innovation Output Sub-Index captures actual evidence of innovation results based on knowledge and technology outputs and creative outputs.

India's Performance

1. In the first edition of the GII in 2008, India ranked 23 among 107 countries. After a dramatic slide of 18 positions in 2009, it has been falling less slowly, but steadily.
2. India fares relatively better on criteria such as GCF (rank 9), investment in new business (rank 20), industrial cluster development (rank 29), per capita GDP growth (rank 14), computer and information services exports (rank 1), creative goods exports (rank 11).

3. However it ranks low in political stability (rank 123), ease of starting business (rank 128), school life expectancy (rank 109), pupil-teacher ratio (rank 108) and knowledge absorption (rank 122).

Food Banking Network

1. In the US, food banks often do not give out food directly to the needy; instead they distribute it to a wide variety of agencies which in turn supply it to people in need. In India, there are institutional feeding programs which include school feeding programs, shelter homes, old age homes which will get the food from the food bank.
2. It works because it is (a) universally supported – People everywhere recognize and respect the conviction that no one should go hungry. (b) Practical and efficient - Food banking appeals to the heart and the head; it feeds people while reducing waste. (c) Scalable – Food banks can start at the community level and expand and network to feed a state, a nation and the world. (d) Adaptable – Food banks can operate in different ways to suit different cultures and economies. (e) Non-competitive – Food banking does not interfere with commercial channels of food distribution.
3. The largest sources of food are for-profit growers, manufacturers, distributors and retailers who in the normal course of business have excess food that they cannot sell.

National Nano Science and Technology Mission, 2007

1. To produce nano materials in India.
2. Capacity building in research.
3. Train human resources.
4. Promoting foreign collaboration.

IPRs

Apple vs Samsung

1. Patents are supposed to be given for an innovation which is 'novel', 'useful' and 'non obvious'. Design patents follow a simpler process and are given a patent for 14 years.
2. It can be debated whether Apple's 'zoom with double tap', 'slide to unlock', 'bouncing back on scroll to end effect' etc. can qualify under novel and non obvious.
3. Excessive patenting has harm in the way that companies now do patent trolling (speculative lawsuits by patent holders), defensive patenting (acquiring patents mainly to pre empt the risk of litigation) and innovation gridlock (too many patents awarded to too many companies so that a new product can't be designed comprising them).

Novartis - Glivec Judgement of SC

1. Indian laws say that "the mere discovery of a new form of a known substance which does not result in the enhancement of the known efficacy of that substance" is not patentable.

2. The Supreme Court interpreted the word “efficacy” to mean therapeutic efficacy which must be judged strictly and narrowly. The court rejected Novartis’ claims of better bio-availability and better physical characteristics such as better storability.
3. The principal economic rationale for granting patents is that it will stimulate investment for research for innovation. Where innovation is absent or trivial or limited, a country is justified in denying a patent because the negative effect is stronger than the positive effect.
4. Novartis says that the Supreme Court decision will destroy the incentive to do R&D and to invest in the country. But what kind of R&D is this which engages only in evergreening?
5. It also says that it will be cautious before introducing new drugs in the country. If Novartis does not introduce new drugs in the country that would be a good ground for issuing a compulsory license.

Nuclear Physics

Nuclear Reactors

Nuclear Fuels

Plutonium

1. It is manmade in reactors. It is the best nuclear fuel because it releases more energy, is safer and has highest breeding ratio i.e. conversion of fissionable material into fissile material. Pu occurs in two different isotopes namely Pu-239 and Pu-240.
2. Pu-239 undergoes nuclear fission steadily and it does not crumble too early and therefore it builds up a powerful blast and its energy release is also more predictable. If the Pu core contains the concentration of more than 90% of Pu-239 then it is called weapon-grade plutonium.
3. Pu-240 undergoes nuclear reaction rapidly and it crumbles too early. So, it is not suitable in manufacturing nuclear weapons. If a Pu core contains more than 40% Pu-240 isotopes then it is called reactor-grade plutonium.

Uranium

1. U-238 is fissionable and a poor nuclear fuel. It undergoes nuclear fission only when bombarded by a fast moving neutron.
2. U-235 is fissile and a good nuclear fuel. It undergoes nuclear fission only when bombarded by a slow moving neutron. It produces Krypton and Barium upon fission.
3. Natural Uranium has only 0.7% U-235. Its burn-up is 7000 MW days per tonne.
4. Slightly Enriched Uranium is 1.1% U-235. Its burn-up is 3x that of natural Uranium. India will use this now in its PHWRs (2nd Generation reactors).
5. Low enriched uranium: U-235 is < 4%. Highly enriched uranium: U-235 >80%. It is used in nuclear weapons.
6. U-233 is man-made by converting Th into U. It undergoes nuclear fission when bombarded by fast moving neutrons.

Types of Nuclear Reactors

1. Slow Reactor: It contains some light material like water, heavy water or graphite to slow down the neutrons. It uses U-235 as fuel where reaction can only happen with slow neutrons. The probability of reaction by a neutron is high, so low enriched U can also be used.
2. Fast Reactor: No such light material is there and the neutrons retain their energy and reaction remains fast. It uses U-238 or U-233 as a fuel.
3. Breeder Reactor: The walls of the reactor contain U-238 which absorbs the fast neutrons escaping from the reactor to produce fissile Pu-239. Thus a breeder reactor produces more fuel than it consumes.

Hot Run

1. The reactor temperature is taken to the level which the actual reaction will generate without inserting the nuclear fuel. At such temperature, the coolant and other assemblies are tested.

Traveling Wave Reactors

1. Bill Gates funded Terra Power reactors which will run on nuclear waste i.e. depleted uranium. They can run for decades on depleted fuel and hence produce very little waste and are safer.

India's Nuclear Program

Background

1. The 1st generation nuclear reactors have a capacity of 250 mw each. They are PHWR (2nd Generation internationally) that make use of U-238 as the fuel and the heavy water as the coolant. They generate power and at the same time convert part of U-238 into Pu.
2. The 2nd generation nuclear reactors are fast breeder reactors of 500 MW each. They use plutonium derived from 1st generation reactors and convert thorium into U-233. The first of such reactors will be established at Tarapore (international 3rd Generation).
3. The 3rd generation nuclear reactors (international 4th Generation) will be of 1000 mw each. They will use U-233. They will be called light water reactors (LWR) as they use light water for coolant. They will generate power and convert thorium into more uranium-233.
4. Large Uranium mines have been discovered in Tumallapalle in AP.

Fast Breeder Reactor Program

Safety in Fast Breeder Reactors

1. The Core Disassembly Accident: In Slow Reactors, if the fuel collapses due to a meltdown, there is less surface area for neutrons to interact with the moderator and hence reaction slows down. In Fast Reactors, a collapse of fuel means more fissile material packed in smaller volume and the reaction rate increases. If it happens quickly, the pressure in the fuel rises fast enough to cause an explosion which may breech the protective container. This is called the CDA.
2. Coolant Void Coefficient: If due to an accident, the coolant gets heated up and expands then in fast reactors the neutrons will interact less with the coolant and hence will have

more energy and hence faster reaction. This phenomenon was present in Chernobyl accident and is called Positive Coolant Void Coefficient i.e. the reaction rate increases with increase in the coolant temperature.

India's Fast Breeder Reactors

1. A key ratio of safety is the power generating capacity to energy release which the protective container is designed to withstand. In the Palkappam FBR, power capacity is 1200MW and energy withstanding capacity is 100MJ. Thus the ratio is 0.08 compared to the ratio of 0.5 which Germany considers unsafe.
2. Indian FBRs are designed based on assumption that only 50% of the fuel may melt down and only 1% of thermal energy may get converted into work! International standards are 100% and 10% respectively.

Thorium Reactor Program

1. Thorium in itself is not a nuclear fuel but needs to be impregnated with neutrons to make U233 which is fissile.
2. U233 is a superior nuclear fuel due to lower critical mass and lower spontaneous fission rate than U235. But along with U233, U232 is also produced which produces gamma radiations naturally thus making it extremely costly and hazardous to handle.
3. India's plan to convert Thorium into U233 involves Fast Breeder Reactors which are themselves very unsafe. Due to above limitations many countries have already abandoned Thorium. But we stick to it.

Closed Fuel Cycle

1. India has adopted closed fuel cycle, which involves reprocessing and recycling of the spent fuel. During reprocessing, only about 2-3% of the spent fuel becomes waste and the rest is recycled.
2. This waste, called high level waste (HLW), is converted into glass through a process, called vitrification. T
3. The vitrified waste is stored in a Solid Storage Facility for 30-40 years prior to its disposal in a deep geological repository. The need for a deep geological repository arises only after three to four decades.

Nuclear Safety

Safety in Kundankulam

1. The structure has *double sealed container* and is designed to be safe under earthquakes.
2. The plant is located at an elevation of 6m to avoid a tsunami.
3. To prevent Hydrogen explosions from damaging the plant, the reactor has *Hydrogen Recombiners* to absorb any leaked Hydrogen.
4. It has *Passive Heat Removal System (PHRS)* which cools the reactor without human intervention in case of a power failure and coolant dysfunction.

5. It has a Core Catcher which is a Gallium Oxide base to capture stray neutrons in case of a meltdown.
6. The waste generated will occupy minimal space.

General Safety Measures

1. A committee has reviewed all reactors for potential threat from earthquakes and tsunamis.
2. Coordination programmes with National Disaster Management Authority have been drawn up to meet an eventuality of a nuclear disaster.
3. The Nuclear Safety Regulatory Authority Bill 2011 has been introduced in the Parliament.
4. IAEA will be conducting safety review of Indian reactors.

Fatehabad NPP EIA Process

1. EIA is prepared by consultants who are retained to work on behalf of their client — the nuclear organization proposing the project.
2. The EIA report prepared by Mecon was leaked one day ahead of the farcical public hearing. As per the Environment Impact Assessment Notification, 2006 the EIA report is a public document, which must be made available to people as a pre-condition for public hearing.
3. India has drawn up a plan to reach a nuclear power capacity of 63,000 MW in 2032 under the influence of nuclear technology companies. Claims of the Department of Atomic Energy are not credible. As per DAE's plans, India should have had a nuclear power capacity of 8,000 MW by 1980, but its actual installed capacity was 540 MW. It set a target of 43,500 MW for 2000. But the installed capacity in that year was only 2,720 MW.
4. The regulatory agency Atomic Energy Regulatory Authority is itself regulated by the nuclear power promoters, the Atomic Energy Commission.

Particle Physics

Standard Model

Three Generations of Matter (Fermions)			
Quarks	Leptons	Leptons	Gauge Bosons
I mass → 2.4 MeV/c ² charge → 2/3 spin → 1/2 name → u d	II mass → 1.27 GeV/c ² charge → 2/3 spin → 1/2 name → c s	III mass → 171.2 GeV/c ² charge → 2/3 spin → 1/2 name → t b	0 0 1 photon g Z ⁰ W [±]
up down	strange	bottom	gluon
e electron neutrino	μ muon neutrino	τ tau neutrino	Z boson
electron	muon	tau	W boson

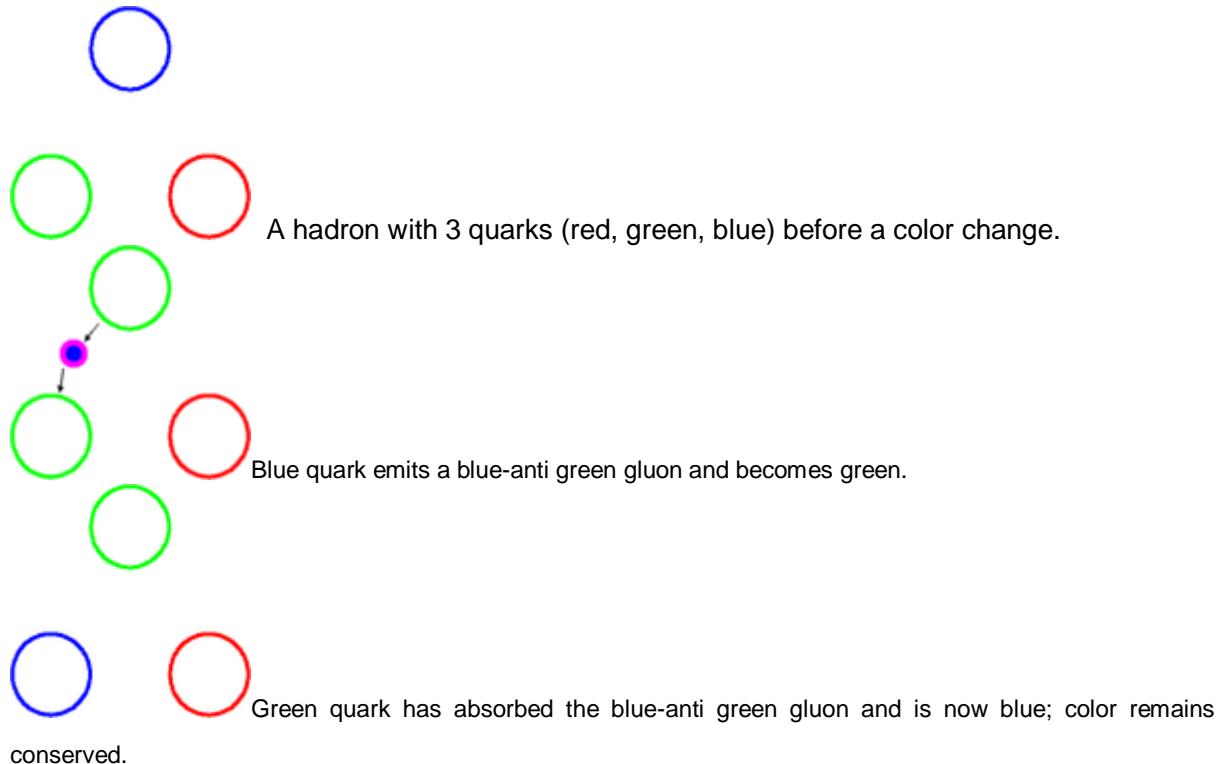
1. This model gives a set of 12 fermions (6 quarks, 6 leptons) and 5 bosons which are the fundamental particles and their interactions give rise to all other matter and forces.

- Its drawbacks are - (a) There is no particle for dark matter. (b) It doesn't explain gravity as there is no gravity particle.

Fermions

- There are 12 fermion particles each of spin 1/2 and following Pauli's exclusion principle (i.e. no 2 particles can have same quantum state). Each of them has an anti-particle as well.
- Pauli's exclusion principle gives a structure of fermions rigidity and it is believed to constitute matter.
- There are six quarks (up, down, charm, strange, top, bottom), and six leptons (electron, electron neutrino, muon, muon neutrino, tau, tau neutrino).

Quarks



- The defining property of the quarks is that they carry color charge, and hence, interact via the strong interaction.
- The color confinement results in quarks being perpetually bound to one another forming hadrons.
- Quarks also carry electric charge and weak isospin. Hence they interact with other fermions both electromagnetically and via the weak interaction.

Hadrons

- They are color neutral composite particles formed when quarks combine and exchange color.

Mesons

- They are hadrons formed when a quark combines with an antiquark. They are very unstable.

Baryons

1. They are hadrons formed when 3 quarks combine. Protons and neutrons are examples of smallest baryons.

Leptons

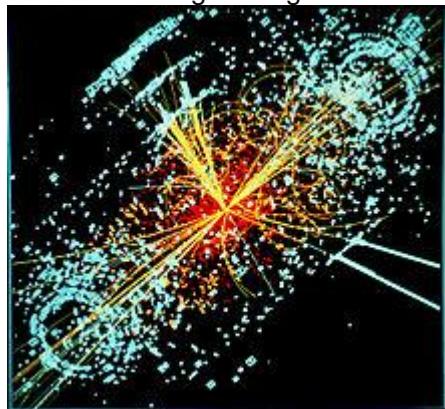
1. The remaining six fermions do not carry color charge and are called leptons.
2. The three neutrinos do not carry electric charge either, so their motion is directly influenced only by the weak nuclear force, which makes them notoriously difficult to detect.
3. However, by virtue of carrying an electric charge, the electron, muon, and tau all interact electromagnetically

Bosons

1. They are the force carrying or force mediating particle. Their exchange leads to force fields like magnetic fields, strong and weak fields. Photons are carriers of electro-magnetic fields, w and z bosons are of weak fields and gluons of strong fields.
2. Their integer spin is 1 so they don't follow Pauli's exclusion principle. They obey Bose-Einstein statistics: when one swaps two bosons, the wave function of the system is unchanged. Hence any structure of bosons has no rigidity and has the same wave function as any other structure. This makes them force carriers.

Higgs Boson

1. The reason why protons are used despite being composite rather than electrons is that to reach very high energies, the particles have to be kept in circular orbits. However, an accelerating charged particle in a ring emits what is known as synchrotron radiation which tends to slow it down. Energy has to be pumped in constantly. A light particle such as the electron loses energy at a much more rapid rate and it is not cost effective to use electrons at such high energies.



1. Electroweak symmetry is the combining of electromagnetic and weak forces at high energy levels (100 GeV or 10^{15} K temperature). At such temperatures W & Z bosons (carriers of weak field) and photons (carriers of electromagnetic field) behave in a similar manner.
2. Higgs mechanism is spontaneous breaking of this electroweak symmetry. In the absence of spontaneous breaking the W and Z bosons would have to have zero mass like photons. But they do have mass. It also predicts the existence of Higgs boson.

3. The Higgs field is the energy of vacuum or a field with a non-zero value that fills all of space. In the first instant of time, the universe was a symmetry of an undifferentiated energy. Then symmetries began to break and when the particles (like W & Z bosons) interact with the Higgs field at lower energies after breaking of symmetries, they acquire potential energy and hence mass.
4. The Higgs boson is an excitation of the Higgs field above its ground state. Its mass range has been narrowed down to 115-130 GeV/c². Its discovery would further validate the Standard Model as essentially correct, as it is the only elementary particle predicted by the Standard Model that has not yet been observed. The Standard Model completely fixes the properties of the Higgs boson, except for its mass. It is expected to have no spin and no electric or color charge, and it interacts with other particles only through weak interaction.

Atlas

Experiment

1. This is one of the 7 experiments being conducted @ LHC to prove that Higgs boson exists.

Neutrinos

Detection

1. Neutrino detectors are often built underground to isolate the detector from cosmic rays and other background radiation.
2. Cherenkov detection: It is based on neutral current interaction and detects the Cherenkov radiations (optical shock wave produced by a charged particle moving faster than light in that medium. Antares is the largest telescope of such type.
3. Radiochemical detection: It is based on charged current interaction. A neutrino converts Cl-37 atom into an Ar-37 atom. The Ar so produced is periodically removed by using He which is then cooled to separate Ar. Similarly Ga-71 is converted into Ge-71.

Physics

1. There are three types of neutrinos - electron, muon and tau neutrinos, which are named after the type of particle that arises after neutrino collisions. Neutrino can interact via 2 modes - neutral current and charged current.
2. Neutral current interaction: The neutrino leaves the detector after having transferred some of its energy and momentum to a target particle. If the target particle is charged and sufficiently light (e.g. an electron), it may be accelerated to a speed > speed of light in that medium (though < speed of light in vacuum) and consequently emit Cherenkov radiation, which can be observed directly. However, no information on neutrino type is left behind.
3. Charged current interaction: The neutrino transforms into a heavier particle depending upon its type (electron, muon or tau). For a neutrino to convert into these heavier particles, sufficient energy is needed which is generally found in solar neutrinos. Detectors are placed which can distinguish among these leptons (electron, muon, tau) and also reveal the type of the incident neutrino. Because the interaction involves the exchange of a charged boson, the target particle also changes character (e.g., neutron → proton). This property is used to detect the neutrinos.

Particle Accelerators

1. Electrostatic accelerators use static electric fields to accelerate particles. A small-scale example of this class is the cathode ray tube in an ordinary old television set. The achievable kinetic energy for particles in these devices is limited by electrical breakdown.
2. Oscillating field accelerators, on the other hand, use radio frequency electromagnetic fields and circumvent the breakdown problem. This class is the basis for all modern accelerator concepts and large-scale facilities.

Large Hadron Collider

1. The LHC lies in a tunnel 27 km in circumference beneath the Franco-Swiss border near Geneva. Its synchrotron (varies the magnetic field with time) is designed to collide opposing particle beams of either protons at up to 7 TeV.
2. Atlas & CMS: They are general purpose detectors and will be used to look for Higgs boson and extra dimensions.
3. Alice: It will study the quark-gluon plasma which existed shortly after the big bang.
4. LHCb: Equal amounts of matter and antimatter were created in big bang. But antimatter disappeared. This will study antimatter.

Space

Space Phenomenon

Zephyr rover

- NASA is considering sending a sail-powered robotic rover to Venus that could use the planet's high wind speeds and hot temperatures for exploration.
- The wind-sailing rover would not only be able to move around Venus, but would also have electronics inside able to withstand the temperatures of 450 degrees celsius.
- The idea has been funded by NASA's innovative advanced concepts programme.

VirgoHI21

- Astronomers have discovered an invisible galaxy that could be the first of many that will help unravel one of the universe's greatest mysteries.
- The object appears to be made mostly of "Dark Matter," material of an unknown nature that can't be seen.
- The invisible galaxy is thought to lack stars because its density is not high enough to trigger star birth.

Gaia Spacecraft

- Gaia is a space observatory of the European Space Agency (ESA).
- The probe will become the Earth's first early warning system against asteroid impacts – even those that lie centuries ahead.
- The powerful Gaia space telescope designed to create a 3D map of stars in the Milky Way.
- It will detect killer asteroids on a potentially fatal collision course with earth.
- One of the key tasks of the telescope, featuring the most high-powered video camera ever built, is to stare at the space between the Earth and the Sun to plot the tracks of the thousands of asteroids lurking there

GSAT-7

- Recently launched GSAT-7 or INSAT-4F is a multi-band communication satellite developed by ISRO.
- It is the sixth among the stack of seven INSAT-4 series communication satellites which was designed, developed and fabricated by India.
- GSAT-7 is an advanced communication satellite built by ISRO to provide wide range of service spectrum from low bit rate voice to high bit rate data communication.
- GSAT-7 Communication payload is designed to provide communication capabilities to users over a wide oceanic region including the Indian land-mass.
- It is first military satellite and was put into the geosynchronous orbit, about 36,000 km above Earth.

Doris

- The Doris system uses a ground network of beacons, which send signals to a receiver on Saral.
- These data are used to keep permanent track of the satellite's precise position on its orbit.
- With the Diode software, the very precise real-time location and velocity of the satellite are directly computed on-board.

LRA

The LRA is an array of mirrors that provide a target for laser tracking measurements from the ground. By analyzing the round-trip time of the laser beam, we can locate very precisely where the satellite is on its orbit. The LRA is used to calibrate the other location systems on the satellite with a very high degree of precision.

ARGOS

- ARGOS Data Collection System is built by the French National Space Agency CNES.
- ARGOS contributes to the development and operational implementation of the global ARGOS Data Collection System.
- It will collect a variety of data from ocean buoys to transmit the same to the ARGOS Ground Segment for subsequent processing and distribution.

Solid State C-band Transponder (SCBT)

- Solid State C-band Transponder (SCBT) is from ISRO and intended for ground RADAR calibration.
- It is a continuation of such support provided by C-Band Transponders flown in the earlier IRS-P3 and IRS-P5 missions.

Cartosat-3

- Cartosat-3 is the fifth satellite of the Cartosat series of satellites from ISRO, the current generation of Indian remote sensing satellites.
- Cartosat-3 is a much more capable satellite, having a resolution of 25 cm (10").
- It uses 1.2 m optics with 60% of weight removal compared to Cartosat-2.
- Other features include the use of adaptive optics, acous to optical devices, in-orbit focusing using MEMs and large area-light weight mirrors.
- Cartosat-3 is planned to be launched on board PSLV during 2014.

GSAT-7

- GSAT-7, India's first full-fledged military communications satellite, was launched from the Kourou spaceport of French Guiana in South America.
- The multiple-band spacecraft will be used exclusively by the Navy to shore up secure, real-time communications among its warships, submarines, aircraft and land systems.
- GSAT-7/ INSAT-4F is said to significantly improve the country's maritime security and intelligence gathering in a wide swathe on the eastern and western flanks of the Indian Ocean region.
- Around 2014-15, ISRO is expected to launch the second naval satellite, GSAT-7A.
- The 2,650-kg GSAT-7 is the last of ISRO's seven fourth-generation satellites. Part funded by the Navy, it is built to meet the Navy's a long-term modernisation plan that includes use of satellites and information technology.

Clipper

- NASA is planning a new exploration project called "Clipper".
- The mission follows the success of Cassini, a probe that closely explored Titan, a moon of Saturn.
- NASA will send a spacecraft to Jupiter's orbit and conduct a number of fly-bys to study Europa in its entirety.
- Clipper could be launched by 2021 and would take a further three-six years to reach Europa.

National Large Solar Telescope (NLST)

- The National Large Solar Telescope (NLST) is a Gregorian multi-purpose open telescope proposed to be built in Merak village in Ladakh in India and aims to study the sun's microscopic structure.
- The Indian Institute of Astrophysics is the nodal agency with various other scientific bodies like the Indian Space Research Organisation (ISRO), Aryabhata Research Institute of Observational Sciences, Tata Institute of Fundamental Research (TIFR) and Inter-University Centre for Astronomy and Astrophysics (IUCAA) also participating.
- NLST is proposed to be Gregorian multi-purpose open telescope with the provision of carrying out night time stellar observations using a spectrograph.
- It hopes to resolve features on the Sun of the size of about 0.1 arcsec.

-
-
- Currently, the world's largest solar telescope is the McMath-Pierce Solar Telescope, with a diameter of 1.6 metres in Kitt Peak National Observatory at Arizona in the U.S.
 - NLST will be the largest solar telescope in the world till 2020 at least till the next generation of 4-m class telescopes come into operation.

Gregorian Telescope

- The Gregorian telescope consists of two concave mirrors.
- The primary mirror (a concave paraboloid) collects the light and brings it to a focus before the secondary mirror (a concave ellipsoid) where it is reflected back through a hole in the centre of the primary, and thence out the bottom end of the instrument where it can be viewed with the aid of the eyepiece.

Cherenkov Telescope Array (CTA)

- The Cherenkov Telescope Array or CTA is a project to build a new generation ground-based gamma-ray instrument in the energy range extending from some tens of GeV to above 100 TeV.
- Scientists and engineers from 27 countries, including India, are pitching for this next-generation gamma-ray telescope that could transform the future of high-energy astrophysics.
- The project involves a large array of telescopes to complement existing observatories, the most potent of which orbit the Earth.
- It is proposed as an open observatory and will consist of two arrays of IACTs*, a first array at the northern hemisphere with emphasis on the study of extragalactic objects at the lowest possible energies, and a second array at the southern hemisphere, which is to cover the full energy range and concentrate on galactic sources.
- By building it on land, scientists feel the CTA could be much more sophisticated than orbiting observatories, which have logistical constraints.

Cherenkov Telescope Array (CTA)

- Scientists and engineers from 27 countries, including India, are pitching for a next-generation gamma-ray telescope that could transform the future of high-energy astrophysics.
- Cherenkov Telescope Array (CTA), the project involves a large array of telescopes to complement existing observatories, the most potent of which orbit the Earth.
- By building it on land, scientists feel the CTA could be much more sophisticated than orbiting observatories, which have logistical constraints.
- The CTA which will consist of two networked arrays in the northern and southern hemispheres.
- One proposed northern hemisphere location is in Ladakh, Jammu and Kashmir.
- While existing telescopes, like MAGIC (Canary Islands) and VERITAS (Arizona), and the orbiting Fermi-LAT and Swift, are efficient up to the 100-GeV energy mark, the CTA will be able to reach up to 100,000 GeV with the same efficiency.
- Gamma rays originate from sources like dark matter annihilation, dying stars and super massive black holes, whose physics is little understood. Such sources accelerate protons and electrons to huge energies and these interact with ambient matter, radiation and magnetic fields to generate gamma rays, which then travel through space.
- When gamma-rays hit atoms in Earth's upper atmosphere, a shower of particles is produced that cascades downward.
- Individual telescopes pick these up, but a network of telescopes, such as CTA, spread over a large area would collect greater amounts, tracking them back better to their sources.

Advanced Technology Solar Telescope (ATST)

- The Hawaii based telescope is intended to provide a revolutionary new window on the solar magnetic atmosphere and will be the primary scientific tool for understanding the impacts of variations in the solar output on the Earth's climate.
- The ATST is set to begin operations in 18 months.
[In News: Dome of world's largest solar telescope completed | Business Standard]

Asteroid 2012 DA14

- DA14 is the largest known object of its size which passed Earth this close without making any impact.
- It shot past in a south-north direction above Earth.

High Density Multi Species Cropping System (HDMSCS)

- High density multi species cropping system (HDMSCS), is one of the mixed cropping systems, where a number of compatible crops are grown in an area to meet the diverse needs of the farmers such as food, fuel, timber, fodder and cash.
- The advantage of the system is the generation of recyclable biomass which is the backbone of organic farming to generate useful organic manure.

Satellite Hall of Fame

- The SSPI Hall of Fame recognizes the invaluable contributions of the visionaries who have transformed life on planet Earth for the better through satellite technology.
- Members of the Hall of Fame are recognized pioneers in communications, satellite-related aerospace, scientific research, or the development and delivery of applications for business, institutions and government via satellite.
- Induction into the Hall of Fame will be based on a record of significant achievement in organizations that develop, operate and/or use satellite technology to achieve their mission.
- The Awards selection committee particularly favors achievements with lasting value such as:
 - The successful introduction of new or improved technologies or services
 - The creation of new businesses, business models or markets
 - Contributions to long-term organizational growth
 - The solution of new types of problems using satellite technology

Why is it news?

- U.R. Rao, who led the country's space programme between 1984 and 1994, has become the first Indian to be inducted into the prestigious Satellite Hall of Fame.

PREDICCS

- Web-based tool.
- For predicting and forecasting the radiation environment in near-Earth, lunar and Martian space.
- It will provide critical information as preparations are made for potential future manned missions to the Moon and Mars.

In News:

Now, a website to update you about space radiation hazards (The Hindu Business Line)

- Scientists have developed the first on-line system for predicting and forecasting the radiation environment in near-Earth, lunar and Martian space.
- The tool was made possible through NASA's Living With A Star (LWS) Targeted Research and Technology programme.

Asteroid Capture Capsule

- NASA scientists are planning to capture a asteroid, relocate it and turn it into a space station for astronauts to refuel at on their way to Mars.
- An old Atlas V rocket will be used to attach an asteroid capture capsule.
- It will then be launched towards the asteroid between the Earth and the Moon.

Why is it in news?

- A pulsar **PSR B0943+10**, has been observed switching between two different modes of radiation – X-ray and radio – within a second.
- The X-ray emissions were tracked using the European Space Agency's **XMM-Newton orbiting space telescope**, and the radio signals were studied using the **Low Frequency Array (LOFAR)** near Exloo, the Netherlands, and **GMRT**.
- While **LOFAR** can detect only at a fixed frequency, **GMRT** can sweep a range of frequencies.

What is so strange about it?

- Pulsars usually emit radiation at radio or X-ray frequencies exclusively, although ones emitting purely gamma radiation have also been found.
- PSR **B0943+10** has been known since the 1980s to emit radiation in the radio frequency.
- But now it has been observed switching between **two modes of radiation**.

W49B

- NASA has claimed to have discovered the **youngest black hole**, named **W49B**, in **Earth's galaxy** or the Milky Way.
- The black hole, located within a supernova remnant, was formed by a rare supernova explosion of a massive star.

Bion-M1

- Russia launches satellite for space biology research.
- To examine the consequences of spaceflight on animals to set up for human interplanetary flights.
- Bion-M1 is the world's only returnable satellite committed to biological research.
- The satellite is proposed at biological research in space and for interplanetary flights in future.

VOYAGER 1

- Scientists have confirmed that the 35-year old probe, launched to study the Jovian system, has crossed into a region of space that shows all the signs of it being the interstellar medium.
- Last year around August 25, 2012, more than 19 billion kilometres from the Sun, the Voyager 1 space probe became the first human-made object to cross out of the Solar System and into interstellar space.
- Voyager 1, a testament to durable engineering, was launched by NASA in 1977 alongside its identical sister probe Voyager 2 to study the outer Solar System and the interstellar medium – whatever occupies the gigantic chasms between stars in the universe.
- Voyager 1 flew by Jupiter in 1979 and Saturn in 1980, concluding its primary mission. It was the first probe to provide detailed images of the two planets and their moons. In 1990, 9.6 billion km from Earth, it turned around and photographed the entire Solar System.
- Ever since, it has been drifting toward its edge at some 17 km/s, surrounded by a hot 'sea' of charged particles called plasma. To detect the crossover, which isn't at an exact boundary, scientists were looking for some telltale signs: the plasma's density would increase, its temperature decrease, and the direction of the surrounding magnetic field would change.
- And while nobody is sure of what to expect from Voyager 1, that the probe is now bathed in particles arising from stars other than just the Sun is opportunity enough. Its particles and fields science experiment will function till 2020, until when the small nuclear battery on-board will be able to power them.
- After that, the Golden Record, a gold-plated disc containing photos of and sounds from Earth, added to the payload just in case other life-forms encounter the probe, will preserve Voyager 1's ambassadorship.

Nasa spots Pluto's largest moon Charon

Nasa's New Horizons spacecraft has taken its first photograph of Pluto's icy moon Charon from 880 million miles away.

Launched on 19 January 2006 and estimated to reach the dwarf planet Pluto in 2015, the robotic spacecraft snapped six photographs of Charon using its highest-resolution telescopic camera. New Horizons will be the first spacecraft to explore Pluto, its five moons, and the weird Kuiper Belt of which they are residents.

When New Horizons reaches Pluto on 14 July 2015, it will pass as close to the surface as 12500 kilometers above it.

C/2012 S1 (ISON)

- A rare supercomet, C/2012 S1 (ISON), rushing towards the Sun from the outer solar system
- at its peak it may outshine the Moon in November, 2013.
- This is ISON's first trip to the inner solar system.
- Its observations will also throw light on material in the outer solar system 4.6 billion years ago, when ISON formed.

HFLS3

- A giant galaxy.
- The galaxy is 12.8 Billion light years away from Earth and is producing stars when our universe was in its infancy.
- HFLS3 is so distant that the light we see from it has taken 13 billion years to get to Earth.
- HFLS3 has one of the highest star formation rates astronomers have discovered.

Magnetars vs Pulsars

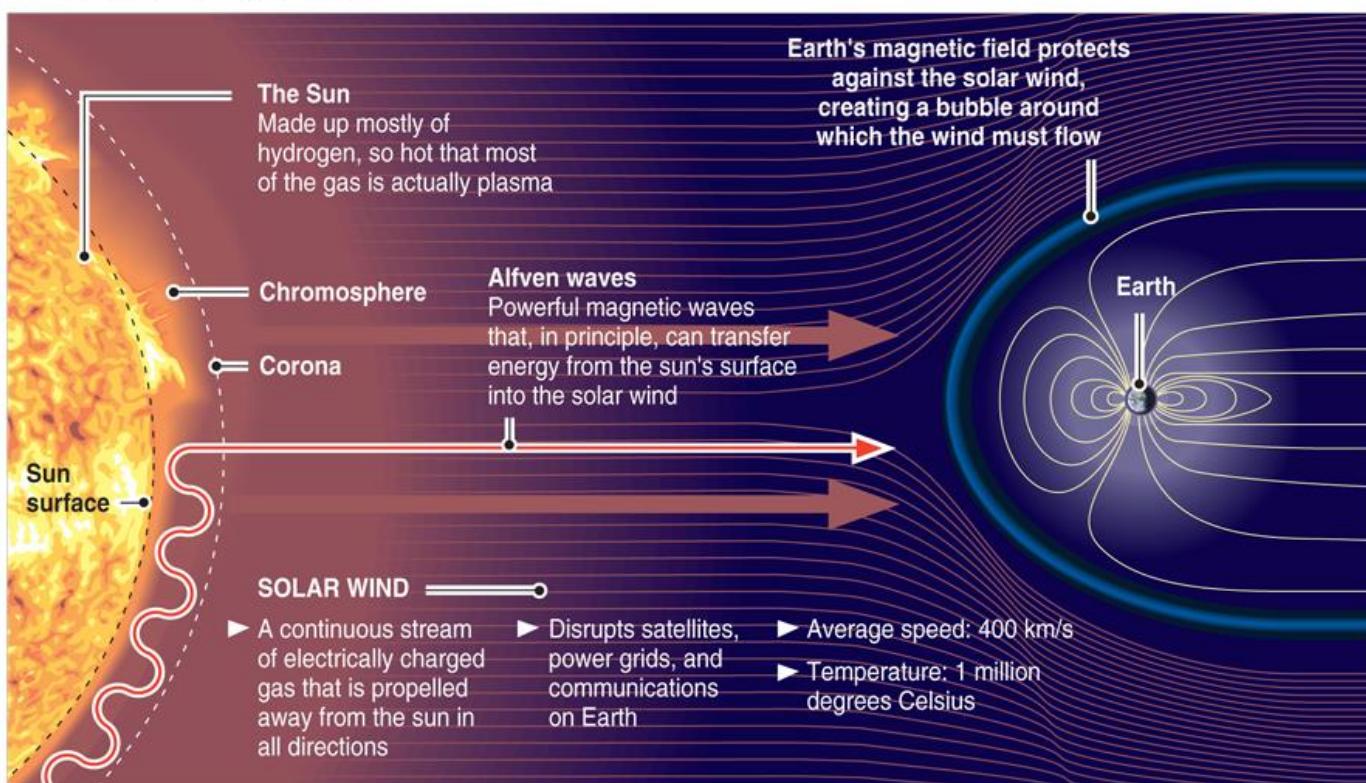
1. Magnetars are neutron stars (the dead core of massive stars after the supernova) which radiate X-rays and have the most intense magnetic fields known in the universe.
2. Pulsars are spinning neutron stars with much lower magnetic fields than magnetars that appear to pulse radio waves as they rotate rapidly.
3. Recently a hybrid has been discovered. Its internal field is many times stronger than its external magnetic field, leading to its entry into the new class of 'low-field magnetars'.

Solar Tornadoes

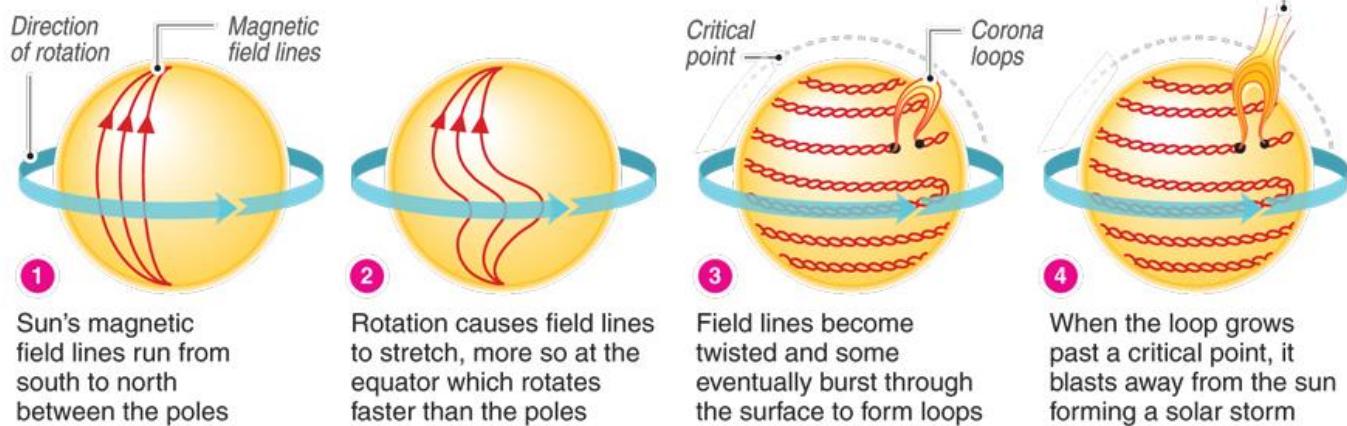
1. A solar tornado is a solar windstorm of charged particles. The solar wind blows at 600,000 to 2,000,000 miles per hour. Solar tornadoes carry the energy from the energy reservoir below the Sun's surface, called the convection zone, to the outer atmosphere in the form of magnetic waves.
2. One of the major problems in modern astrophysics is why the atmosphere of Sun is considerably hotter than its surface? It is understood that the energy originates from below the Sun's surface and carried to atmosphere directly by the solar tornadoes that generate magnetic waves to heat the magnetized solar plasma.

Solar Flares / Alfvén Waves

SOLAR FLARES



HOW A SOLAR FLARE IS FORMED



Source: NASA

Drawings are not to scale

Graphic: K. Pong/G. Cabrera/RNGS

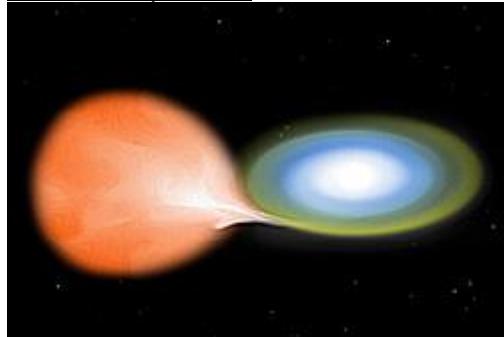


Galaxy Clusters, Dark Matter Arc & Gravitational Lens

1. Galaxy clusters are collections of hundreds to thousands of galaxies bound together by gravity. They are the most massive structures in our universe. Astronomers frequently study galaxy clusters to look faraway as they act as gravitational lenses and magnify galaxies behind them that would otherwise be too dim to see with telescopes.
2. Dark matter, whose composition is still a mystery, doesn't emit or absorb light, so astronomers can't see it directly with telescopes. They deduce that it exists based on how its gravity affects visible matter. To see the dark matter of the filament that connects the

clusters Abell 222 and 223 scientists took advantage of gravitational lensing. The extent of gravitational lensing revealed the presence of dark matter.

Nova vs Supernova

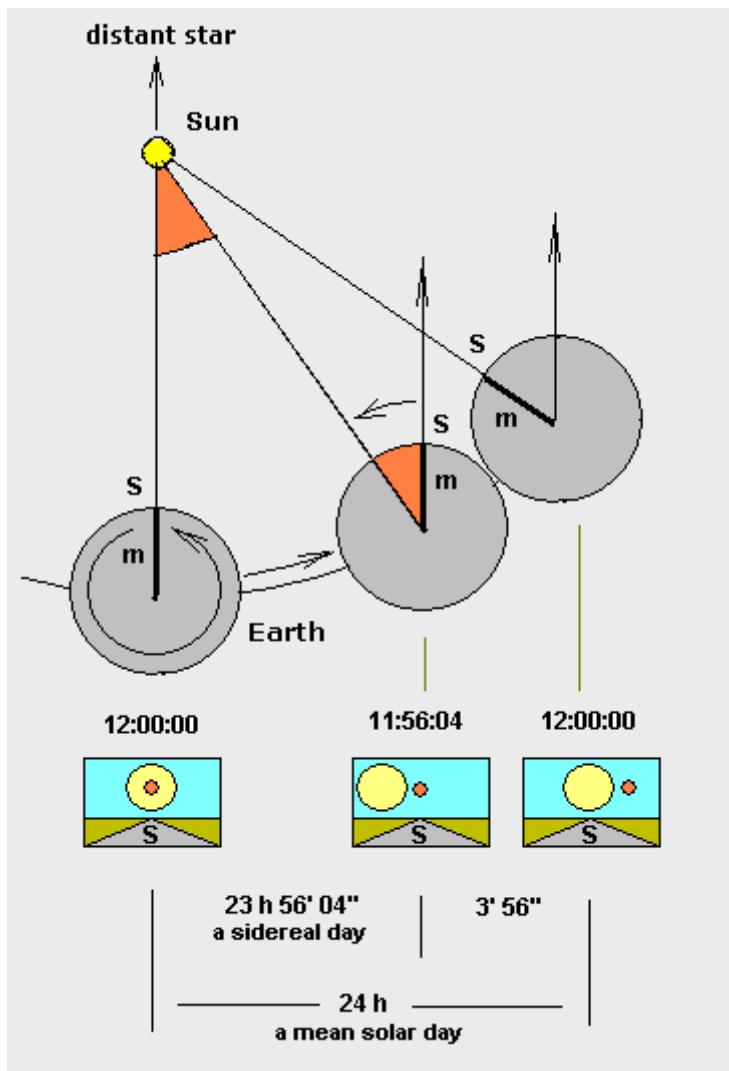


1. A nova occurs as a star (white dwarf) starts to pull hydrogen matter from its companion star. As hydrogen accretes, pressure and density pushes up temperature which ignites it and fusion happens. An explosion occurs and surface matter of the white dwarf is thrown away.
2. A supernova is a nova on a much bigger mass scale when stars reach a critical limit. Almost entire mass of the star is thrown away in a supernova as against the 5% of surface matter in a nova. The luminosity is also much more.
3. ARP-220 is the collision of 2 galaxies in Serpens constellation. Astronomers have recorded 7 supernovae here proving star making factories are also supernova factories.

Orbits

1. Polar orbits: The satellite passes directly over or close to poles. Each successive orbit is not over the same point.
2. Sun synchronous orbits: The satellite passes over a point exactly (or close to) at the same local time. It is used in applications such as measuring temperature changes over a period.
3. Geo synchronous orbits: The satellite orbits around the earth in 1 sidereal day and returns to the same point over earth after exactly 23 hours, 56 minutes, 4 seconds.
4. Semi-geo synchronous orbits: It makes 2 rotations of earth in 1 sidereal day.
5. Geo stationary orbits: This is a special case of geo synchronous orbit where the satellite is in a circular orbit over equator and remains directly over a point. It is 35,786 km away.
6. Low earth orbits: They are generally from 160 - 2000 km. Satellites over 500 km face little drag. A constellation of LEO satellites can perform the role of a communications satellite. Less energy and low power amplifiers are needed in them. Mostly elliptical, average orbital period is 90 minutes.
7. Medium earth orbits: From 2,000 km to 35,786 km. Mostly circular and average orbital period is between 2 hours and 24 hours. Used in GPS and other navigation systems.

Sidereal Day



- It is the time taken by earth to rotate so that a distant star is exactly in the same position once again. It is different from the solar day because while making one rotation the earth also revolves around the sun. It is 23 hours, 56 minutes, 4 seconds.

Satellite Resolutions

- MRS mode: Medium resolution mode is with 25 m resolution.
- CRS mode: Coarse resolution mode is with 50 m resolution.
- FRS mode: Fine resolution mode is from 3 - 12 m resolution.
- Spotlight mode: It is with 1 m resolution.

Super massive black holes

- They are found in galaxy centers. The material around them becomes incredibly hot and emits all kinds of radiations which are so bright that they outshine everything else in the galaxy. The larger the black hole the larger the central bulge is and the hotter the material is.
- Herschel telescope: It has a camera which studies millimeter length wavelengths which are the only band where the hot material around a black hole doesn't outshine everything else. So by looking at distant galaxies in their star formation phase through these waves we can

see what is going on. The telescope has found that once the black hole gets big enough the star formation rate in the galaxy drops.

Space Missions

Watchdog Satellites

1. They are satellites used to guard other satellites against anti-satellite weapons.

China

Nuclear Powered Moon Rover Mission

1. China's first moon rover will run on a nuclear-powered battery. The rover will land on moon next year on board Change-3. The battery will be able to power it for more than 30 years. The nuclear power system will make China the third country to have this technology.
2. The rover will use nuclear energy during 'night'. A lunar night is for 14 days.

India

SI No	Mission	Objective
SATELLITE MISSIONS		
1	SARAL	Satellite with Argos and Altimeter for Oceanography studies.
2	CARTOSAT-2C	High resolution Cartography satellite for mapping applications for special users.
3	CARTOSAT-2D	
4	RESOURCESAT-2A	Satellite for Natural Resource Survey applications.
5	OCEANSAT-3	Satellite for Ocean and Coastal studies.
6	CARTOSAT-3	Advanced very high resolution cartography satellite.
7	GISAT	Geo Imaging Satellite for monitoring and Disaster Management applications.
23	IRNSS-1	Indian Regional Navigational Satellite System (IRNSS) for
24	IRNSS-2	

25	IRNSS-3	satellite based positioning services – The constellation consists of Seven IRNSS satellites.	
26	IRNSS-4		
27	IRNSS-5		
28	IRNSS-6		
29	IRNSS-7		
30	ASTROSAT	Multi-wavelength Space Astronomy Observatory for scientific investigations.	
SI No	Mission	Objective	
31	MARS ORBITER	Technological mission to reach Martian orbit and studying the surface and atmospheric features of Mars.	
32	CHANDRAYAAN-2	Scientific investigations of Lunar surface with in-situ measurements.	
33	ADITYA	Scientific Satellite for study of Sun and Solar Corona phenomena.	
LAUNCH VEHICLE MISSIONS			
36	PSLV – C22	For launching of IRNSS-1 satellite.	
39	PSLV – C25	For launching of MARS orbiter.	

51	GSLV – D5	Development flight with indigenous cryogenic stage for launching GSAT-14 satellite.
53	GSLV – F8	For launching of Chandrayaan-2

B. Scientific Objectives:

- Exploration of Mars surface features, morphology, mineralogy and Martian atmosphere by indigenous scientific instruments.

Payloads:

Payloads

- Lyman-Alpha Photometer (LAP) - a photometer that measures the relative abundance of deuterium and hydrogen from Lyman-alpha emissions in the upper atmosphere. Measuring the deuterium/hydrogen ratio will allow to estimate the process of water loss to outer space.
- Methane Sensor For Mars (MSM) - will measure methane in the atmosphere of Mars, if any, and map its sources.
- Mars Exospheric Neutral Composition Analyzer (MENCA) - is a quadrupole mass analyzer capable of analyzing the neutral composition of particles in the exosphere.
- Thermal Infrared Imaging Spectrometer (TIS) - will measure the temperature and emissivity of the Martian surface, this can allow mapping surface composition and mineralogy of Mars.
- Mars Colour Camera (MCC) - will provide images in the visual spectrum, providing context information for the other science instruments.

IRNSS

1. Developed by India, the IRNSS-1A, the first of the 7 satellites constituting the Indian Regional Navigation Satellite System, has a mission life of 10 years. It is designed to provide accurate position information service to users in the country as well as the region extending up to 1,500 km from its boundary, which is its primary service area.
2. PSLV-C22 carried IRNSS-1A satellite. The data from the satellite would help the country in a range of fields including disaster management, vehicle tracking, fleet management and marine navigation.

GPS Technology

1. A GPS receiver calculates its position by precisely timing the signals sent by GPS satellites.
2. Each satellite continually transmits messages that include
 1. The time the message was transmitted.
 2. Satellite's position at time of message transmission.
3. The receiver uses the messages it receives to determine the transit time of each message and computes the distance to each satellite using the speed of light.
4. 4 satellites must be visible to obtain an accurate result including time. If one variable is already known, a receiver can determine its position using only three satellites. For example, a ship or aircraft may have known elevation.

10K Watt Satellite Programme

1. India recently launched GSAT-8 which was a 6,000 Watt satellite and is developing a 8,000 Watt GSAT-11 to be launched in 2 years. In five years time, it will launch a 10,000 Watt

communication satellite which can accommodate 60-70 transponders. GSAT-8 has 24 transponders. The 10,000 watt satellite will also have the next generation high frequency Ka-band transponders.

Satellite with ARgos and ALtika (SARAL)

Applications

1. Marine meteorology and sea state forecasting.
2. Seasonal forecasting.
3. Climate monitoring.
4. Ocean, earth system and climate research.
5. Continental ice studies.
6. Its data will help in protection of marine ecosystems and biodiversity.

Instruments

1. Ka band Altimeter, ALTIKA: Altimeters determine sea level by bouncing a radar signal off its surface and measuring the return-trip time. ALTIKA operates at a high frequency in K_a band making it more accurate. It can measure ocean surface topography with an accuracy of 8 mm, against 2.5 cm on average using current-generation altimeters. The disadvantage, however, is that high-frequency waves are extremely sensitive to rain.
2. ARGOS Data Collection System: It will collect a variety of data from ocean buoys to transmit it to the ARGOS ground segment for subsequent processing and distribution.

India's more powerful Geostationary Satellite Launch Vehicle (GSLV) has been less successful, having failed four of its seven flights between 2001 and 2010. The GSLV uses the PSLV's first two stages and has a cryogenic engine, initially built by Russia and now built by India, in its third stage. It can carry four-tonne payloads to LEO or two-tonne communication satellites to a higher geostationary earth orbit (GEO). Its successor, the GSLV Mark 3, will be able to lift four-tonne communication satellites, capable of carrying a larger number of transponders and facilitating a greater volume of communications, to a GEO. Thus, India's main technological challenge in the coming years is to perfect the GSLV and GSLV Mark 3.

- second stage. This variant can launch 1900 kg into geostationary transfer orbit.
- GSLV Mk I (c): This variant has a 15 tonne third stage. GSLV-F06 (flight 6) is the only attempted launch of the Mark I(c) version to date.
- GSLV Mk II : This variant uses an Indian cryogenic engine and is capable of launching 2500 kg into geostationary transfer orbit. Previous GSLV vehicles (GSLV Mk.I) have used Russian cryogenic engines.
- GSLV Mk III: This rocket is the technological successor to the GSLV, however is not derived from its predecessor.

GSLV MK III

- The GSLV-III or Geosynchronous Satellite Launch Vehicle mark III a current launch vehicle development project by the Indian Space Research Organization.
- It is now scheduled for its first suborbital test launch of the GSLV booster stage in 2014.
- It is intended to launch heavy satellites into geostationary orbit, and will allow India to become less dependent on foreign rockets for heavy lifting.

PSLV

1. The PSLV can place roughly 1.6-tonne satellites in a pole-to-pole orbit of 650 km. It also sent up Chandrayaan-1 and will also send Mars orbiter mission.
2. It is sought after vehicle for two main reasons:
 1. One, it has a niche in that class of payloads.
 2. Two, the number of successful launches.

AstroSat

1. It is an astronomy satellite India will put in polar circular orbit in 2013 to study the universe at optical, ultraviolet and X-ray wavelengths simultaneously.

GSAT-12

1. It was launched by PSLV-XL into a sub-geosynchronous transfer orbit with an apogee of 21,000 km instead of 36,000 km and pedigree of 284 km. It will replace INSAT-3B.

Chandrayan-2

1. It will have an orbiter, a Russian built lander and a rover.
2. The orbiter will be equipped with cameras and remote sensing equipment and will circle the moon.
3. The lander will deliver the rover to moon's surface along with its own suite of equipment.
4. The rover will look for water near South Pole of the moon.

RiSat-1

1. India's 1st radar imaging satellite. Can see through cloud cover, sun, cyclones as well and hence useful in estimating area under cultivation for paddy kharif crops, cyclones, floods etc. Radar satellites can pick up melting glaciers and submarines.
2. It will be put in the polar orbit @ 480 km by PSLV-XL. A radar satellite apart from being technologically challenging is also heavy and so PSLVs couldn't carry them earlier.
3. India launched earlier RISAT-2 but it was an Israeli satellite for reconnaissance.

US

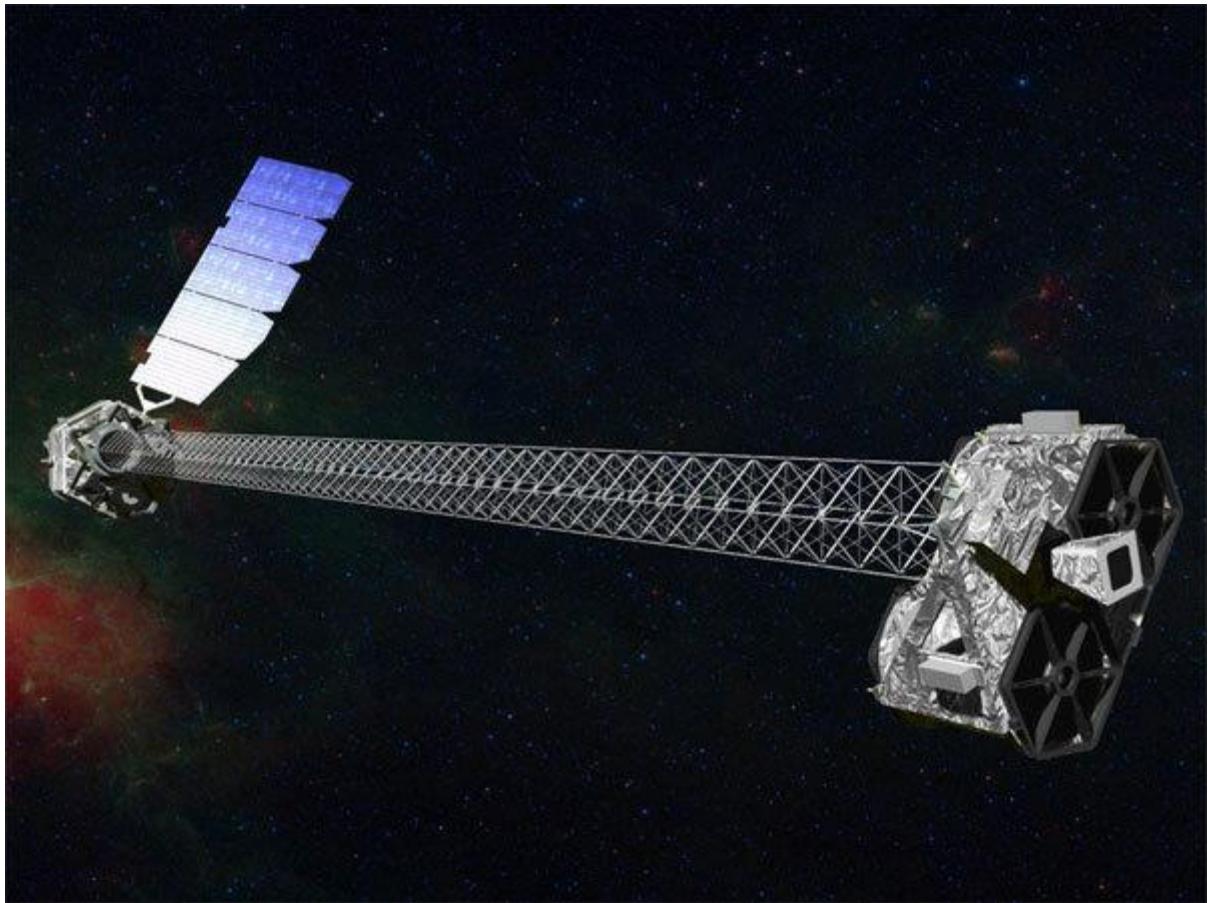
Classification of Satellites

1. Mini satellite: Wet mass (100 kg, 500 kg).
2. Micro satellite: Wet mass (10 kg, 100 kg).
3. Nano satellite: Wet mass (1 kg, 10 kg). They are sometimes developed in swarms and need a mother satellite.
4. Pico satellite: Wet mass (0.1 kg, 1 kg). They are sometimes developed in swarms and need a mother satellite.
5. Molecular satellite: Wet mass < 10 g.

SpaceX

1. This is the first commercial service which took supplies to international space station. Its capsule (Dragon) docked with the ISS. After the retirement of space shuttle programme, US was using Russian ships. But they didn't have reentry functions and simply burnt up while falling back into the atmosphere. Dragon capsule (of SpaceX) has reentry function and can bring back cargo from the ISS to earth.
2. The rocket (Falcon 9) uses liquid O₂ and kerosene and has multiple (9) Merlin engines. Even if one of the engine fails, the rocket will be able to deliver.
3. Satellite service provider Intelsat has signed the first commercial contract for Falcon Heavy rocket. SpaceX will be launching at least one Intelsat satellite into geosynchronous transfer orbit.
4. SpaceX already seems to have built a viable business here, having announced more than \$1 billion of contracts in the last few years. Commercial operations will reduce the cost of space flights. To date, space travel has been expensive and, as a government-managed operation, has had little incentive to streamline. Companies like Virgin Galactic, XCOR and Space Adventures are booking passengers on suborbital joy rides to space, promised for dates within the next few years, and hundreds of people are signing up. SpaceX can provide rides to NASA astronauts at \$20 million a seat, a third of the Russian price.

NuSTAR



1. Issues with X ray telescopes: X rays are notoriously difficult to reflect / refract. This is because they are so high energy that when they fall on the mirror they get absorbed instead of reflecting. So the angle of incidence on the mirror has to be very small (grazing incidence). But this means large surface areas of mirrors as well as low efficiency.
2. Wolter-1 mirrors: The Wolter-I mirror reflects X-rays twice, once off of an upper mirror section shaped as a parabola and a second time off a lower mirror section shaped as a hyperbola. The surfaces of the mirrors are nearly parallel to the incoming X-ray, allowing the X-ray to become reflected instead of absorbed. The shallow angles, however, result in a very small collection area per surface.
3. Multilayers: Multilayers are thin coatings of two alternating materials deposited one on top of the other. A typical multilayer has 200 pairs of coatings. To achieve enhanced reflectivity, a high density contrast between the two materials is needed, and common high density materials are Tungsten (W) and Platinum (Pt), while common materials for the low density layers are Silicon (Si), Carbon (C), and Siliconcarbide (SiC). The multilayer stack leads to constructive interference leading to enhanced reflectivity.
4. Comparison with previous X ray telescopes: Past missions such as Chandra used high density materials such as platinum, iridium and gold as mirror coatings to achieve high reflectivity for low energy X-rays. However, the efficiency of those mirrors to reflect higher energy photons falls off rapidly. So they would instead have patterned screens to block some of the light and would use the resulting pattern of cast shadows to reconstruct the

original images. The resulting images were thus fuzzy at best. But NuSTAR mirrors will be coated with structures called "depth-graded multilayers" which can reflect light up to 79 keV.

5. Instruments: NuSTAR will fly two Wolter-I optic units, each pointing at the same patch of sky. The co-aligned units increase collecting area, thus providing more sensitive images in a given amount of time. The mirrors and detectors are connected by a 10-meter-long bridge that will unfold once the telescope is in orbit around Earth.
6. Comparison with other telescopes: Other space telescopes like the Hubble, Swift and Chandra don't work at such high-energy wavelengths. NuSTAR will be able to detect X-rays with energies as high as 79 keV. Previous highest was 15 keV.

Jupiter Mission - Juno

1. It's a solar powered spacecraft and will reach Jupiter in 2016 where it will orbit the poles.
2. It will spend 2 years going around the sun and then will get a gravitational boost as it flies by the earth.
3. It will try to find out if Jupiter's core has heavier metals or it is just gas. It will also study the magnetic fields and the Great Red Spot which is a storm on Jupiter.

Moon Mission - GRAIL

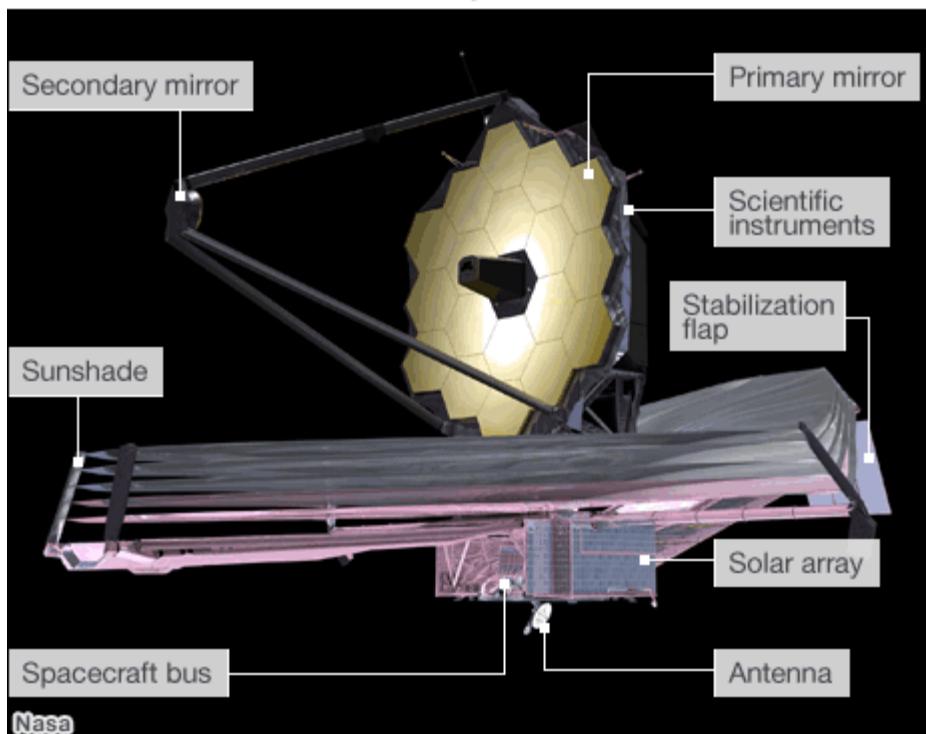
1. The Gravity Recovery and Interior Laboratory (GRAIL) will explore the content of moon's interior by flying over it and mapping variations in gravitational field.
2. There will be 2 satellites (Ebb and Flow) which will fly over moon with a certain gap between them. As the gravitational field intensity changes, the distance between them will also change. This instrument is called lunar gravity ranging system.

GRACE

1. It will accurately map variations in the Earth's gravity field. It has two identical spacecrafts flying about 220 kilometers apart. It will map the Earth's gravity fields by making accurate measurements of the distance between the two satellites, using GPS and a microwave ranging system.
2. The results from this mission will yield crucial information about the distribution and flow of mass within the Earth and its surroundings. It will tell us about the changes due to surface and deep currents in the ocean; runoff and ground water storage on land masses; exchanges between ice sheets or glaciers and the oceans; and variations of mass within the Earth.

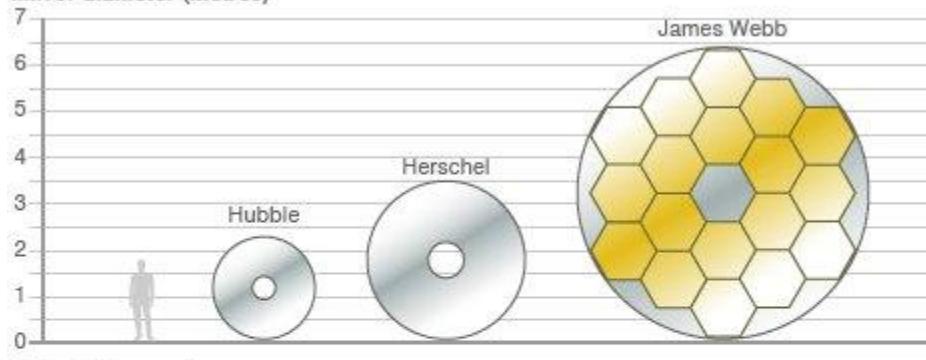
James Webb telescope

James Webb Telescope Design

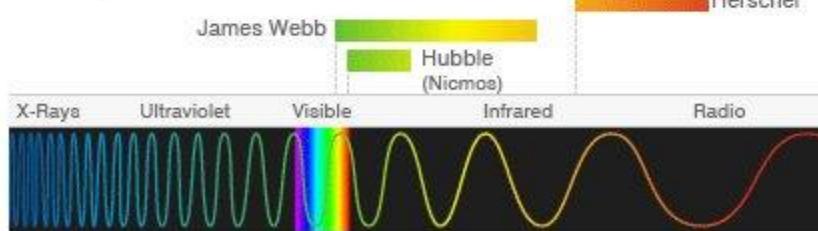


Nasa

SPACE TELESCOPE COMPARISON Mirror diameter (metres)



Detectable spectrum



SOURCE: ESA

1. It is the successor of Hubble to be launched in 2018. Its primary mirror is 2x that of Hubble. It has a shield to protect its vision from sun light. It has infrared detectors and can look back 13 billion years ago in time. It will study first generation of stars. It will be in an orbit 1.5 million km away from earth. Its own equipment need to be super cool so as to avoid infrared contamination of the images.

SKA (Square Kilometer Array) Telescope

1. It is a radio telescope and will be located in South Africa, Australia and New Zealand. It is a \$2 billion project to be completed by 2024. It will have thousands of receivers to give a total

receiver surface area of a square kilometer. It will be used to study the origins of the universe, dark matter and will be able to detect very weak signals.

2. Issues with mining: Under the Astronomy Advantage Act 2007, SAF has prohibited hydraulic fracturing (fracking) in the area where drillers blast large amounts of sand and water laced with chemicals deep underground to free natural gas and oil from shale deposits. There are had substantial shale gas reserves and SAF is one of the richest shale gas country. It can also cut down trees, re-route air flights, silence radio signals and prohibit anything that harms astronomy in the region.
3. India has designed the movement control software of SKA and is currently an associate member of the project to be upgraded to full membership before the launch of the project.

Planetary Resources

Concept

1. Planet forming processes sorted and stratified earth's minerals. So most of the platinum sunk into the core. But asteroids are fragments of planets and moons and hence may be rich in rare metals.

Plan

1. By 2013 to launch a constellation of telescopes to track near earth asteroids with orbits passing close to earth at high frequencies.
2. Within a decade to launch probes to the identified asteroids to study them closely.
3. Then mining can take place in 2 ways - (a) To deploy intelligent robots on the asteroids which will keep on mining them and drop off the load whenever the asteroid passes close to the earth. (b) To try to push them in an orbit around the earth.

Missile Physics

Multiple Independent Targeted Re-entry Vehicles (MIRV)

1. This refers to a missile capable of delivering multiple warheads to different target locations. Basically @ different points in the same trajectory, the main vehicle has to launch the individual capsules @ the desired velocity. Such a system is there in India's PSLV launches and would be present in Agni-V.

Missile Classification

1. Short range ballistic missile: < 1000 km.
2. Medium range ballistic missile: 1000-3000 km.
3. Intermediate range ballistic missile: 3000-5500 km.
4. Intercontinental ballistic missile: > 5500 km.

Solid fuels

1. Solid rockets can provide high thrust for relatively short periods of time.
2. Solid rocket propellant can remain loaded in the rocket for long durations and then be reliably launched at a moment's notice.
3. Solid fuels have high energy density enabling smaller but more powerful missiles.

Computers

Dhruva-3, the latest in series of indigenous High Performance Computing Systems designed and set up by DRDO for solving mission critical Defence Research and Development applications was inaugurated today by Shri Avinash Chander, DG DRDO and Scientific Adviser to the Defence Minister at Advanced Numerical Research and Analysis Group (ANURAG) in Hyderabad. Addressing the function, he said Dhruva-3 is a high end facility and very useful for the design of aircraft, particularly Advanced Medium Combat Aircraft (AMCA) and other such aircraft where we require analysis of aerodynamics at high speed and under different conditions. "It is one of the fastest computing facility in the country and will also play a very good role in cyber security and information processing

DHRUVA-3 will be used for designing aero-frame structures, stress analysis of materials and simulation of complex systems.

Robocoin

- The world's first Bitcoin ATM machine which can transact digital currency – Bitcoins -for any official currency has been unveiled in Vancouver, Canada.
- The ATM named Robocoin allows users to buy or sell the digital currency known as bitcoins.
- The ATM in Vancouver is operated by Las Vegas-based Robocoin and Vancouver-based Bitcoiniacs.



The **Deep Web** (also called the **Deepnet**, the **Invisible Web**, the **Undernet** or the **Hidden Web**) is World Wide Web content that is not part of the Surface Web, which is indexed by standard search engines. It should not be confused with the dark Internet, the computers that can no longer be reached via Internet, or with a Darknet distributed filesharing network, which could be classified as a smaller part of the Deep Web.

Mike Bergman, founder of BrightPlanet and credited with coining the phrase,^[1] said that searching on the Internet today can be compared to dragging a net across the surface of the ocean: a great deal may be caught in the net, but there is a wealth of information that is deep and therefore missed.^[2] Most of the Web's information is buried far down on dynamically generated sites, and standard search engines do not find it. Traditional search engines cannot

"see" or retrieve content in the deep Web—those pages do not exist until they are created dynamically as the result of a specific search.

Deep Web resources may be classified into one or more of the following categories:

- Dynamic content: [dynamic pages](#) which are returned in response to a submitted query or accessed only through a form, especially if open-domain input elements (such as text fields) are used; such fields are hard to navigate without domain knowledge.
- Unlinked content: pages which are not linked to by other pages, which may prevent [Web crawling](#) programs from accessing the content. This content is referred to as pages without backlinks (or inlinks).
- Private Web: sites that require registration and login (password-protected resources).
- Contextual Web: pages with content varying for different access contexts (e.g., ranges of client IP addresses or previous navigation sequence).
- Limited access content: sites that limit access to their pages in a technical way (e.g., using the [Robots Exclusion Standard](#), [CAPTCHAs](#), or no-cache Pragma [HTTP headers](#) which prohibit search engines from browsing them and creating [cached](#) copies.^[8])
- Scripted content: pages that are only accessible through links produced by [JavaScript](#) as well as content dynamically downloaded from Web servers via [Flash](#) or [Ajax](#) solutions.
- Non-HTML/text content: textual content encoded in multimedia (image or video) files or specific [file formats](#) not handled by search engines.

Lev Grossman has been diving into the deep Web. He co-reported a cover story about it for Time magazine, and he is with us now. Welcome.

LEV GROSSMAN: Thank you.

HOBSON: So beyond Silk Road, what else is part of the deep Web?

GROSSMAN: Well, the deep Web is a very broad and large thing, and you have sites like Silk Road, which are criminal; the Silk Road deals with drugs and things like that. But then more broadly you have a whole spectrum of criminal activity that exists on the deep Web and thrives there because of the anonymity that it provides.

There's quite a bit of child pornography. You'll see trafficking in weapons, in fake IDs, hacking software, stolen credit cards, really, you know, anything contraband that you could sell over the Net gets sold there.

Well, the real irony of this story, is this thing was built by the U.S. government, in particular, the U.S. Naval Research Laboratory. They worked out the theory in the '90s

and then launched it in 2003. And they had very good reasons for doing it. The deep Web is a vital tool for intelligence agents, law enforcement. Political dissidents in foreign countries with oppressive governments are trained in it by the State Department.

hey did such an incredibly good job that as far as is known, theoretically there is no way to find someone on the deep Web.

One of the documents that was leaked by Edward Snowden this summer was an NSA study of Tor, and basically they concluded we have no idea how to crack this thing, and we can get people if they screw up, sometimes if we're lucky, but otherwise this thing is ironclad.

He found it on the deep Web using not only Tor, the deep Web technology, but also bitcoin, which is a new kind of currency, which is based on very strong cryptography, which like the deep Web, it's very hard to track, it's very hard to trace. If you - it's not like using a credit card. When you use bitcoin to buy something or sell something, it leaves very little trace anywhere, and it's very hard to track down who owns what bitcoins.

Silk Road, the world's most successful online drug bazaar, until the feds caught him. His real name, according to a 39-page federal complaint against him, is Ross Ulbricht, 29. He supposedly took the pseudonym from a character in the movie and book, *The Princess Bride*. In the Silk Road, DPR, as his followers called him, created a business model for anyone wanting to sell illicit items online using free encryption software called Tor and the virtually anonymous crypto-currency Bitcoin

The Senate Homeland Security Committee, officials tell TIME, plans on holding hearings on Bitcoin within the month. The committee sent letters to nine federal agencies in July asking for their thoughts on Bitcoins and other virtual currencies in the hopes of developing a holistic approach to the so-called cryptocurrency that neither stifles the currency's potential nor enables criminals to abuse it.

According to Bergman, there is a lot of information hidden in the form of websites that standard search engines do not find because those pages do not exist until they are created dynamically through a specific search. It makes use of an anonymity network called 'Tor' which encrypts the data and then distributes the small packets of data across multiple relays set-ups by users across the world. These websites with the help of Tor are launched on onion network i.e. they make use of onion URL.

Tor (previously **TOR**, an acronym for **The Onion Router**)^{[5][not in citation given]} is free software for enabling online anonymity. Tor directs Internet traffic through a free, worldwide, volunteer network consisting of more than four thousand relays^[6] to conceal a user's location or usage from anyone conducting network surveillance or traffic analysis. Using Tor makes it more difficult to trace Internet activity, including "visits to Web sites, online posts, instant messages, and other communication forms", back to the user^[7] and is intended to protect the personal privacy of users, as well as their freedom and ability to conduct confidential business by keeping their internet activities from being monitored.

The original data, including its destination, are encrypted and re-encrypted multiple times, and are sent through a virtual circuit comprising successive, randomly selected Tor relays. Each relay decrypts a "layer" of encryption to reveal only the next relay in the circuit, in order to pass the remaining encrypted data on to it. The final relay decrypts the last layer of encryption and sends the original data, without revealing or even knowing its sender, to the destination. This method reduces the chance of the original data being understood in transit and, more notably, conceals the routing of it

Super Computers

China

Tianhe-2

- Tianhe-2, a supercomputer developed by China's National University of Defence Technology, achieved processing speeds of 33.86 petaflops (1000 trillion calculations) per second on a benchmarking test.
- It earned the supercomputer the number one spot in the Top 500 survey of supercomputers.
- Its main rival, the U.S.-designed Titan, had achieved a performance of 17.59 petaflops per second.
- Generally, such supercomputers are meant for use in defence and scientific areas and are not commercially available. China is likely to use it for both offence and defensive purposes.

India

Saga-220

1. ISRO made SAGA-220 (Supercomputer for Aerospace with GPU Architecture). It has 220 teraflops peak speed.
2. It will be used to solve complex supercomputing problems.

Internet

Big Data

Concept

1. It is a collection of data sets so large and complex that it becomes difficult to process using traditional data processing applications. Big data is difficult to work with using most relational database management systems and desktop statistics and visualization packages, requiring instead "massively parallel software running on tens, hundreds, or even thousands of servers.
2. The trend to larger data sets is due to the additional information derivable from analysis of a single large set of related data, as compared to separate smaller sets with the same total amount of data. It can be used in many things including crime prevention.

Limitations

1. Big data only establishes correlations and linkages which is obviously not enough for many important tasks like policymaking, healthcare industry. Establishing causality is where still traditional techniques have to be applied. Economics and finance teach us about the limitations of big data since such correlation techniques have already been employed there with only very limited success (time series analysis in finance and cross country analysis in economics).

IPv4 vs IPv6

1. IPv4 uses a 32 bit address system whereas IPv6 uses 128 bit integer system. They are assigned by Internet Assigned Numbers Authority.

Other Advantages of IPv6 over IPv4

1. Security: Internet Protocol Security is mandatory in the network layer and is a part of the IPv6. It supports end-to-end security, authentication and non-repudiation.
 2. IP host mobility: This feature enables a mobile node to arbitrarily change its location on an IP network while still remaining reachable and maintaining existing connections.
-
1. But such heavy use would create an insurmountable bottleneck for trillions of queries placed every day. So caching is used in DNS servers to overcome this problem, and as a result, root name servers actually are involved with very little of the total traffic.

Reverse lookup

1. A reverse lookup is a query of the DNS for domain names when the IP address is known. Multiple domain names may be associated with an IP address. The DNS stores IP addresses in the form of domain names as specially formatted names in pointer (PTR) records within the infrastructure top-level domain arpa. When performing a reverse lookup, the DNS client converts the address into these formats, and then queries the name for a PTR record following the delegation chain as for any DNS query.