

IMPORTANT COLOUR BOX INFORMATION

CHAPTER 2: HUMAN REPRODUCTION

CRYPTORCHISM:

- The failure of one or both testes to descend down into the scrotal sacs is known as cryptorchism (crypto – hidden + orchis – testicle).
- It occurs in 1 – 3 percent of new born males.
- A surgical correction at a young age can rectify the defect, else these individuals may become sterile and are unable to produce viable sperms.

POLY CYSTIC OVARY SYNDROME (PCOS)

- PCOS is a complex endocrine system disorder that affects women in their reproductive years. Polycystic means ‘many cysts’.
- It refers to many partially formed follicles on the ovaries, which contain an egg each.
- But they do not grow to maturity or produce eggs that can be fertilized.
- Women with PCOS may experience irregular menstrual cycles, increased androgen levels, excessive facial or body hair growth (**hirsutism**), acne, obesity, reduced fertility and increased risk of diabetes.
- Treatment for PCOS includes a healthy lifestyle, weight loss and targeted hormone therapy.

Twins are two offsprings produced in the same pregnancy.

- **Monozygotic** (Identical) twins are produced when a single fertilized egg splits into two during the first cleavage.
- They are of the same sex, look alike and share the same genes.
- **Dizygotic** (Fraternal) twins are produced when two separate eggs are fertilized by two separate sperms.
- The twins may be of the same sex or different sex and are non-identical.
- **Siamese** (United) twins are the conjoined twins who are joined during birth.

Colostrum

- Colostrum, a nutrient rich fluid produced by the human female immediately after giving birth, is loaded with immune, growth and tissue repair factors.
- It acts as a natural antimicrobial agent to actively stimulate the maturation of the infant’s immune system.
- No artificial feed can substitute the first milk, with all its natural benefits and therefore should be definitely fed to the baby after birth.

CAESAREAN

- When normal vaginal delivery is not possible due to factors like position of the baby and nature of the placenta, the baby is delivered through a surgical incision in the woman’s abdomen and uterus.
- It is also termed as abdominal delivery or Caesarean Section or ‘C’ Section.

1. Males are said to be **sterile** when they fail to produce viable sperms.
2. **Azoospermia** refers to the failure of spermatogenesis.
3. Enlargement of prostate gland is called **prostatitis** and can lead to difficulty in urination.
4. Castration or surgical removal of testis is known as **orchidectomy**.
5. **Spermarche** is the first ejaculation of the semen.

CHAPTER 3: REPRODUCTIVE HEALTH

- Health care programmes such as massive child immunization, supply of nutritional food to the pregnant women, Janani Suraksha Yojana, Janani Shishu Suraksha Karyakaram, RMNCH+A approach (an integrated approach for reproductive, maternal, new born,

child and adolescent health), Pradhan Mantri Surakshit Matritva Abhiyan, etc., are taken up at the national level by the Government of India.

Mayer-Rokitansky syndrome

- All women are born with ovaries, but some do not have functional uterus. This condition is called **Mayer-Rokitansky syndrome**.

There are several types of ultrasound imaging techniques.

- As the most common type, the 2-D ultrasound provides a flat picture of one aspect of the baby.
- The 3-D image allows the health care provider to see the width, height and depth of the images, which can be helpful during the diagnosis.
- The latest technology is 4-D ultrasound, which allows the health care provider to visualize the unborn baby moving in real time with a three-dimensional image.
- Vitamin E is known as anti-sterility vitamin as it helps in the normal functioning of reproductive structures.
- Sex hormones were discovered by Adolf Butenandt.
- 11th July is observed as World Population Day.
- 1st December is observed as World AIDS Day.
- NACO (National AIDS Control Organisation) was established in 1992.
- Syphilis and gonorrhoea are commonly called as international diseases.

CHAPTER 4: PRINCIPLES OF INHERITANCE AND VARIATION

- X-Chromosome was discovered by Henking (1891)
- Y-Chromosome was discovered by Stevens (1902)
- The number of Barr bodies follows N-1 rule (N minus one rule), where N is the total number of X chromosomes present.

CHAPTER 5: MOLECULAR GENETICS

One gene-one enzyme hypothesis

- The experiments of **George Beadle and Edward Tatum** in the early 1940's on *Neurospora crassa* (the red bread mould) led them to propose one gene one enzyme hypothesis, which states that one gene controls the production of one enzyme.

One gene-one polypeptide hypothesis

- It was observed that an enzyme may be composed of more than one polypeptide chain and a gene can code for only one polypeptide chain.
- Thus one gene-one polypeptide hypothesis states that one gene controls the production of only one polypeptide chain of an enzyme molecule.

Wobble Hypothesis

- It is a hypothesis proposed by Crick (1966) which states that tRNA anticodon has the ability to wobble at its 5' end by pairing with even non-complementary base of mRNA codon.
- According to this hypothesis, in codon-anticodon pairing the third base may not be complementary.
- The third base of the codon is called wobble base and this position is called wobble position. The actual base pairing occurs at first two positions only.
- The importance of Wobbling hypothesis is that it reduces the number of tRNAs required for polypeptide synthesis and it overcomes the effect of code degeneracy.

- In the above example though the codon and the anti codon do not match perfectly, yet the required amino acid is brought perfectly. This enables the economy of tRNA, GUU, GUC, GUA and GUG code for the amino acid - Valine.
- Many antibiotics do not allow pathogenic bacteria to flourish in animal host because they inhibit one or the other stage of bacterial protein synthesis.
- The antibiotic tetracycline inhibits binding between aminoacyl tRNA and mRNA.
- Neomycin inhibits the interaction between tRNA and mRNA.
- Erythromycin inhibits the translocation of mRNA along the ribosome.
- Streptomycin inhibits the initiation of translation and causes misreading.
- Chloramphenicol inhibits peptidyl transferase and formation of peptide bonds.

CHAPTER 6: EVOLUTION

- **Coacervates** (large colloidal particles that precipitate out in aqueous medium) are the first pre-cells which gradually transformed into living cells.
- Hugo de Vries believed that speciation are due to Mutation and called saltation (single step large Mutation).

CHAPTER 7: HUMAN HEALTH AND DISEASES

Bacterial resistance

- If an antibiotic is used too often to fight a specific bacterial infection, the bacteria may become resistant to the specific antibiotic.
- Hence the specific antibiotic can no longer be used to treat the bacterial infection.
- Some bacteria have developed resistance to many antibiotics.
- Therefore, infections caused by these bacteria are difficult to be cured.

Risk of bacterial resistance can be reduced by observing the following steps

- Avoid using antibiotics to treat minor infections that can be taken care by our immune system.
- Do not use an antibiotic to treat viral infections such as common cold or flu.
- Always follow the prescription. Skipping doses or failing to complete the prescription may allow antibiotic resistance to develop.
- Common cold is caused by more than 150 different strains of Rhino viruses.
- More over their RNA genome keeps changing due to mutation.
- Hence it is very difficult to prepare a common vaccine for the disease.
- **Nipah virus** is a zoonotic virus (transmitted from animals to humans) and also transmitted through contaminated food.
- In infected people, it causes a range of illness from asymptomatic infection to acute respiratory illness and fatal encephalitis.
- **Bursa of Fabricius** is a primary lymphoid organ of birds.
- It is attached to the dorsal side of the cloaca.
- B lymphocytes mature in the bursa and bring about humoral immunity.
- **Peyer's patches** are oval-shaped areas of thickened tissue that are embedded in the mucus-secreting lining of the small intestine of humans and other vertebrate animals.

- Peyer's patches contain a variety of immune cells, including macrophages, dendritic cells, T cells, and B cells.
- The **tonsils** (palatine tonsils) are a pair of soft tissue masses located at the back of the throat (pharynx).
- The tonsils are part of the lymphatic system, which help to fight infections.
- They stop invading germs including bacteria and viruses.
- **Spleen** is a secondary lymphoid organ located in the upper part of the abdominal cavity close to the diaphragm.
- Spleen contains B and T cells.
- It brings humoral and cell mediated immunity.
- The mucosa-associated lymphoid tissue (**MALT**) is a diffuse system of small concentrations of lymphoid tissue in the alimentary, respiratory and urino-genital tracts.
- **MALT** is populated by lymphocytes such as T and B cells, as well as plasma cells and macrophages, each of which is well situated to encounter antigens passing through the mucosal epithelium.
- It also possesses IgA antibodies.
- Gut-associated lymphoid tissue (**GALT**) is a component of the mucosa associated lymphoid tissue (**MALT**) which works in the immune system to protect the body from invasion in the gut.
- Bronchus Associated Lymphoid Tissues (**BALT**) also a component of MALT is made of lymphoid tissue (tonsils, lymph nodes, lymph follicles) is found in the respiratory mucosae from the nasal cavities to the lungs.
- **Dendritic cells** are called so because its covered with long, thin membrane extensions that resemble dendrites of nerve cells.
- These cells present the antigen to T-helper cells.
- Four types of dendritic cells are known. They are langerhans, interstitial cells, myeloid and lymphoid cells

Scope of Immunology

- The younger graduates in this field can find number of employment opportunities in Government as well as private hospitals.
- The scope of the immunology is immunotherapy, microbial immunology, clinical immunology, cellular immunology, allergy and immunology, translational immunology, transplantation immunology, neuro-inflammatory disorders, tumour immunology, vaccine immunology, inflammatory disorders, ocular immunology and inflammation.
- **Alcoholism** is the inability to control drinking due to physical and emotional dependence on alcohol.
- Treatment involves counselling by a healthcare professional.
- Detoxification programme in a hospital or medical facility is an option for those who need additional assistance.
- Medications are available to reduce the desire to drink and smoke.

Alcoholic Anonymous

- Alcoholic anonymous was started in 1935 by a businessman and a doctor who had been a “hopeless drunk” for many years.
 - After the men helped each other to stop drinking and to stay sober, they then founded the alcoholic anonymous to help other alcoholics.
 - Since that time alcoholic anonymous has spread throughout the world.
1. Freezing does not kill bacteria; it only arrests their growth.
 2. Antibiotics not only kill harmful bacteria, but also kill beneficial bacteria of our body.
 3. UTI- Urinary Tract Infection is one of the most common bacterial infections affecting 150 million people each year worldwide.
 4. World malaria day is on 25th April.
 5. Iceland and the Faroe islands are the only countries in the world, where there are “No mosquitoes” (Mosquito free countries).
 6. VCRC- Vector Control Research Center is situated in Puduchery. WHO is collaborating with the Centre for Research and Training in Lymphatic Filariasis and Integrated Methods of Vector Control.
 7. Sterile insect technique (SIT) The screw-worm fly was the first pest successfully eliminated from an area through the sterile insect technique, by the use of an integrated area-wide approach.
 8. *Zika virus* could become a surgical weapon against brain cancer.

CHAPTER 8: MICROBES IN HUMAN WELFARE

Alcohol content in various beverages

- Beer - 3 - 5 percent.
 - Wine - 9 - 14 percent
 - Wine coolers - 4 - 6 percent.
 - Whiskey, Gin, Scotch and Vodka - 35 - 50 percent.
- **Antibiosis** is the property of antibiotics to kill microorganisms.
 - **Broad-spectrum antibiotics** act against a wide range of disease-causing bacteria.
 - **Narrow-spectrum antibiotics** are active against a selected group of bacterial types.
 - **Biodiesel** is a fuel made from vegetable oils, fats or greases.
 - Biodiesel fuel can be used in diesel engines without altering the engine.
 - Pure biodiesel is non-toxic, biodegradable and produces lower level of air pollutants than petroleum-based diesel fuel.
 - The Government of India approved the National Policy on Biofuels in December 2009 and identified *Jatropha curcas* as the most suitable oilseed for biodiesel production.
 - *Pongamia* species is also a suitable choice for production of biodiesel.

CHAPTER 9: APPLICATIONS OF BIOTECHNOLOGY

- **Best and Banting** in 1921, isolated insulin from the pancreatic islets of a dog and demonstrated its effectiveness against diabetes.
- **Edible vaccines** are prepared by molecular pharming using the science of genetic engineering.
- Selected genes are introduced into plants and the transgenic plants are induced to manufacture the encoded protein.

- Edible vaccines are mucosal targeted vaccines which cause stimulation of both systemic and mucosal immune response.
- At present edible vaccines for measles, cholera, foot and mouth disease and hepatitis are tested on animals and under developmental phase.
- **The recombinant vaccine for hepatitis B (HbsAg)** was the first synthetic vaccine launched in 1997 which was marketed by trade names Recombivax and Engerix-B.
- India is the fourth country in the world after USA, France and Belgium to develop an indigenous hepatitis B vaccine.
- **The first clinical gene therapy** was given in 1990 by French Anderson to a four year old girl with adenosine deaminase (ADA) deficiency.
- ADA deficiency or SCID (Severe combined immunodeficiency) is an autosomal recessive metabolic disorder.
- It is caused by the deletion or dysfunction of the gene coding for ADA enzyme.
- In these patients the nonfunctioning T-Lymphocytes cannot elicit immune responses against invading pathogens.
- The right approach for SCID treatment would be to give the patient a functioning ADA which breaks down toxic biological products.
- In some children ADA deficiency could be cured by bone marrow transplantation, where defective immune cells could be replaced with healthy immune cells from a donor.
- In some patients it can be treated by enzyme replacement therapy, in which functional ADA is injected into the patient.
- During gene therapy the lymphocytes from the blood of the patient are removed and grown in a nutrient culture medium.
- A healthy and functional human gene, ADA cDNA encoding this enzyme is introduced into the lymphocytes using a retrovirus.
- The genetically engineered lymphocytes are subsequently returned to the patient.
- Since these cells are not immortal, the patient requires periodic infusion of such genetically engineered lymphocytes.
- The disease could be cured permanently if the gene for ADA isolated from bone marrow cells are introduced into the cells of the early embryonic stages.
- **Totipotency (Toti-total)** is the ability of a single cell to divide and produce all of the differentiated cells in an organism.
- **Pluripotency (Pluri-several)** refers to a stem cell that has the potential to differentiate into any of the three germ layers-ectoderm, endoderm and mesoderm.
- **Multipotency (multi-Many)** refers to the stem cells that can differentiate into various types of cells that are related. For example blood stem cells can differentiate into lymphocytes, monocytes, neutrophils etc.,
- **Oligopotency (Oligo-Few)** refers to stem cells that can differentiate into few cell types. For example lymphoid or myeloid stem cells can differentiate into B and T cells but not RBC.
- **Unipotency (Uni- Single)** refers to the ability of the stem cells to differentiate into only one cell type.
- **A gene 'knock out'** is a genetically engineered organism that carries one or more genes in its chromosomes that have been made inoperative.

CHAPTER 10: ORGANISMS AND POPULATIONS

Van't Hoff's rule

- Van't Hoff proposed that, with the increase of every 10°C, the rate of metabolic activity doubles or the reaction rate is halved with the decrease of 10°C.
- This rule is referred as the Van't Hoff's rule.
- The effect of temperature on the rate of reaction is expressed in terms of temperature coefficient or Q₁₀ value.
- The Q₁₀ values are estimated taking the ratio between the rate of reaction at X°C and rate of reaction at (X-10°C).
- In the living system the Q₁₀ value is about 2.0. If the Q₁₀ value is 2.0, it means 10°C increase and the rate of metabolism doubles.
- **Phototaxis:** The movement of organism in response to light, either towards the source of light as in Moths (positive phototaxis) or away from light (Euglena, Volvox, earthworm (negative phototaxis).
- **Phototropism:** The growth or orientation of an organism in response to light, either towards the source of light (positive phototropism) as seen in Sunflower, or a way from light (negative phototropism) as in case of the root of plants.
- **Photokinesis:** A change in the speed of locomotion (or frequency of turning) in a motile organism or cell which is made in response to a change in light intensity is called Photokinesis. It involves undirected random movement in response to light.
- **Ethology** is the scientific study of animal behaviour, under natural conditions.
- **Biotic potential or Reproductive capacity (r):** It is the maximum reproductive capacity of an organism under optimum environmental conditions.
- **Carrying capacity (K):** The maximum number of organism that a region can support without environmental degradation is called carrying capacity.
- **Environmental resistance:** Is the sum total of the environmental limiting factors, both biotic and abiotic, which together act to prevent the biotic potential of an organism from being realized.

CHAPTER 11: BIODIVERSITY AND ITS CONSERVATION

- **Mean Sea Level (MSL)** is an average level of the surface of one or more of Earth's oceans (or seas) from which heights such as elevations may be measured.

Where are the Sparrows?

- Common Sparrows are going extinct because of mindless urbanization.
- They are losing not just their natural habitats but also the essential human touch they need and thrive upon.
- The population of sparrows is dwindling due to the use of packed food, insecticides in farming and changing lifestyles, and match box-styled architecture resulting in an inadequate availability of food and shelter for the birds.
- Unlike pigeons that can make nests on ledges, sparrows need cavities to build their nests.

One more species goes extinct...

- George the tree snail (*Achatinella apexfulva*) died on January 1, 2019, at the age of 14.
- He was the last snail of his species and is emblematic of the loss of native Hawaiian molluscs.

Project Tiger:

- The Government of India launched the 'Project Tiger' in 1973 to protect our national animal. From 9 tiger reserves since its inception, the Project Tiger coverage has increased to 50 at present.
- Project Tiger is an ongoing Centrally Sponsored Scheme of the Ministry of Environment and Forests, providing central assistance to the states for tiger conservation in designated tiger reserves.
- Project Tiger was launched in the Jim Corbett National Park, Uttarakhand in 1973.
- The project ensures a viable population of Bengal tigers in their natural habitats, protecting them from extinction and preserving areas of biological importance as a natural heritage.
- The National Tiger Conservation Authority (NTCA) is a statutory body of the Ministry, created under the Wildlife (Protection) Act, 1972.
- India holds over half the world's tiger population. According to the latest tiger census report released on 20th January 2015 by NTCA, the current tiger population is estimated at 2,212.

THE MADRAS CROCODILE BANK TRUST

- The Madras Crocodile Bank Trust and Centre for Herpetology was the brain child of the legendary Romulus Whitaker and a handful of like-minded conservation visionaries, who began work on the facility in 1976.
- It aimed to save India's dwindling crocodilian population.
- The mission is to promote the conservation of reptiles and amphibians and their habitats through education, scientific research and capture breeding.
- The crocodile bank remains a world leader in the field of frontline conservation and the preservation of natural landscapes.
- The Crocodile Bank currently consists of a large reptile park near Chennai and several field projects located throughout the subcontinent reaching as far as the Nicobar Islands.
- About half a million people visit the bank every year, making it one of the most popular tourist attractions along the East Coast Road.

Arignar Anna Zoological Park, Vandalur

- Arignar Anna Zoological Park is spread over an area of 602 hectares. of Reserve Forest at Vandalur, Chennai.
- It is one of the largest zoo in South East Asia in terms of area.
- The Zoological Park exhibits different classes of animals – it has around 2500 wild animals of nearly 180 species which includes Mammals, Birds and Reptiles.
- 34 years since its establishment, the Zoological Park has emerged as a successful ex-situ conservation centre and a captive breeding centre for many endangered species like Royal Bengal Tiger, Lion Tailed Macaque, Nilgiri Langur, Gray Wolf, etc.,
- The Zoo has many attractive features like Butterfly Park, Childrens Park, Walk Through Aviary, Lion & Deer Safari, Forest Museum, Interpretation centre, etc., which attracts more than 21 lakh visitors every year.

CHAPTER 12: ENVIRONMENTAL ISSUES

- The Taj Mahal, a UNESCO world heritage site, is facing deterioration and damage by industrial gases due to several industrial units around Agra.
- The white marble has decolorized to yellow.

- On January 28, 2017, two cargo ships collided off the Ennore coast in Chennai causing oil to spill into the sea.
- Due to wave action and the southern current, the spill spread over to 34 km down south affecting the coast.
- Beach sand also got spoiled by the oil sludge. It took more than a thousand volunteers to clean the oil sludge.

Assessment by CPCB

- The number of polluted stretches in India's rivers has increased to 351 from 302 (in 2006), and the number of critically polluted stretches – where water quality indicators are the poorest – has gone up to 45 from 35 (Source: The Hindu, 17 September, 2018).

- **Mosquito Repellents**

DEET (n-n-diethylmetatoluamide) and allethrin used in mosquito coils may cause itching, burning, tingling sensation or numbness.

- **Colony collapse syndrome** in Honey bees due to pesticides/herbicides can lead to destruction of hives and lower agricultural productivity. **!!Remember bees are Nature's best pollinators!!**

- **G. Nammalvar** was a supporter and expert of **organic farming**.

- He was an agricultural scientist, environmental activist celebrated for his work on spreading **Ecological farming & Organic farming**.
- He was against the use of chemical fertilisers and pesticides. He trained hundreds of farmers in natural farming.
- Nammalvar was the author of several **Tamil** and **English** books on natural farming, pesticides & fertilisers and was featured in magazines & television programs.
- He founded the Nammalvar Ecological Foundation for Farm Research and Global Food Security Trust or simply **Vaanagam** at Karur, Tamilnadu.
- He developed social forest at Ammankurai and the Kolunji Ecological Farm in Pudukottai.
- He and his friends made a 10-acre barren land into fertile cultivable land in the dry Pudukottai district.
- He planted 52 varieties of trees in the same waste land extending in 20 acres.
- His organization 'Kudumbam' preserves and regenerates hundreds of native flora and fauna, in order to ensure a sustainable livelihood.

- **Dr. Sultan Ahmed Ismail** is an Indian soil biologist and ecologist from Tamil Nadu.

- His work has centered on techniques for recycling biodegradable waste into fertiliser using varieties of earthworms, and on soil bioremediation.
- Dr. Ismail received a D.Sc. in Zoology from the University of Madras for his research on the role of earthworms in soil ecology and waste management.
- He works on vermicomposting as a sustainable ecological practice.
- He has been instrumental in introducing as well as spreading awareness on environmental issues, solid waste management, vermicomposting, organic farming, vermitech and waste management to several educational institutions, industries and organic farmers in India and abroad.
- **Remedies: '4R'**- Refuse, Reduce, Reuse and Recycle mantra is the best available remedy for plastic waste pollution.
- Tamil Nadu State government successfully implemented the ban on single use plastics from 1st January 2019.