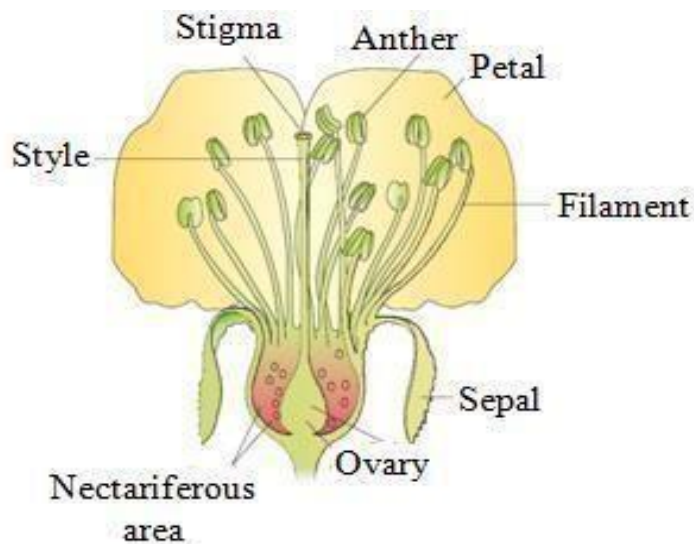
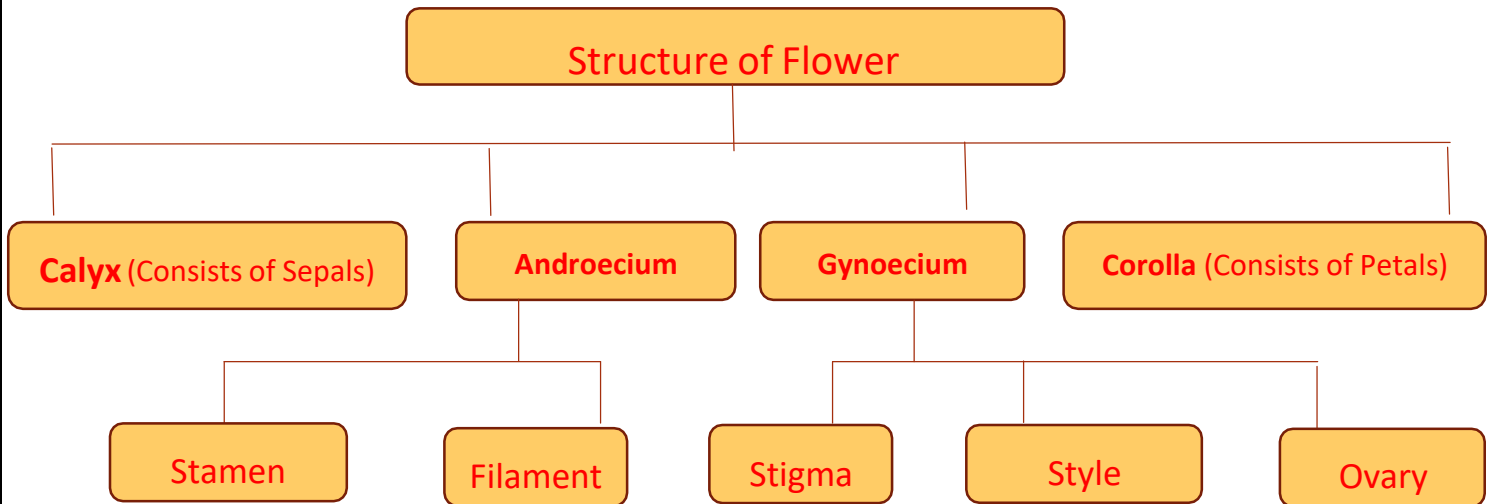


CHAPTER 1

SEXUAL REPRODUCTION IN FLOWERING PLANTS



Pre fertilization events:

This stage is characterised by the production of male and female gametes and transfer of gametes for fertilization process. During this stage androecium (stamen) and gynoecium (pistil) are fully developed for the production of gametes.

Structure of Stamen:

Typical **stamen** consists of two parts, long and slender stalk called **filament** and terminal bilobed structure called **anther**.

Anther: A typical angiosperm anther is a bilobed and dithecous structure. Each anther contains four microsporangia located at the corners, two in each lobe. Microsporangia become pollen sacs and are packed with pollen grains.

Structure of microsporangium:

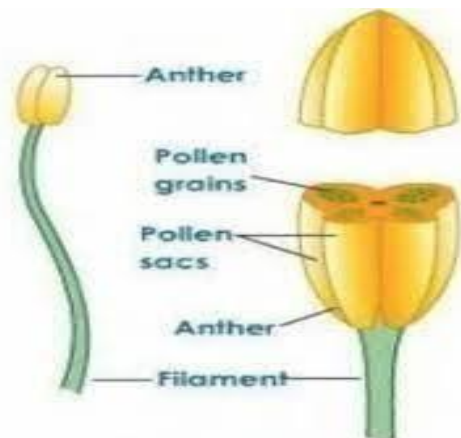
Each microsporangium surrounded by four wall layers

- * Epidermis
 - * Endothecium
 - * Middle layer.
 - * Tapetum.
- } Protects the inner tissues.
- Nourishes the developing pollen grain.

The center of each microsporangium contains homogenous cells called **sporogenous tissues**.

Microsporogenesis:

- * The process of formation of microspores from pollen mother cell through meiosis is called microsporogenesis.
- * The sporogenous tissue of microsporangium differentiated into microspore mother cell or pollen mother cell.
- * Each microspore mother cell undergoes meiosis and gives rise to haploid microspore tetrad.
- * On dehydration microspore tetrad dissociated to form four microspores. * Each microspore developed into a pollen grain.



[Video link for Microsporogenesis](#)

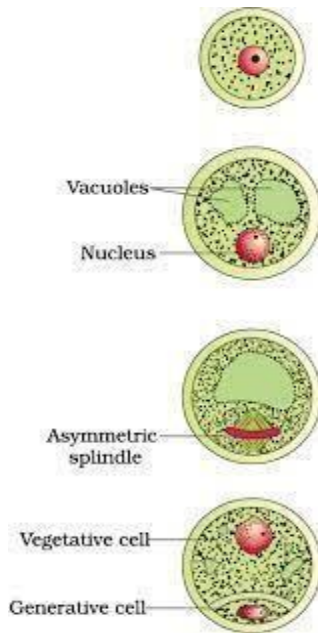
https://drive.google.com/file/d/1oARpDAhFiVjnCFHWyBcKcsIHf4IEvNyr/view?usp=share_link

<https://www.youtube.com/watch?v=Vus-IgBrIV8>



PPT link for Microsporogenesis and structure of pollen grain

<https://docs.google.com/presentation/d/1m7C99e6twj35bFdRTjHwm1d6eXzjd98O/edit?usp=sharing&oid=107171444976724466844&rtpof=true&sd=true>



(a) Stages of a microspore maturing into a pollen grain (b) Enlarged view of pollen grain tetrad

The Pistil:

Pistil has three parts the **stigma**, **style** and **ovary**. Inside the ovary is the **ovarian cavity (locule)**. **Megasporangia** or **ovules** arise from the placenta. The number of ovule inside the ovary may be **single** or **many**.

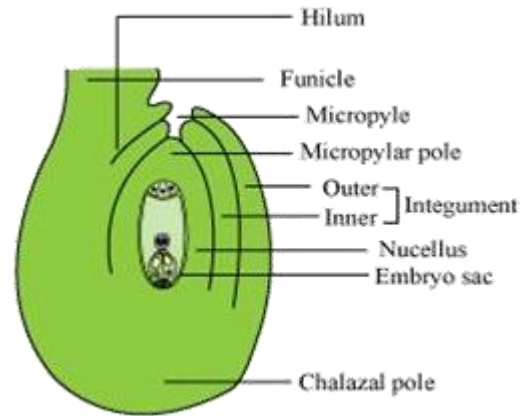
The Megasporangium (Ovule):

Megasporangium is attached to the placenta of locule with a stalk called **funicle**. The body of the ovule fused with the funicle in the region called **hilum**. **Hilum** is the junction between the funicle and ovule. Each ovule has one or two protective envelopes called integuments with an opening called **micropyle**.

Pistil

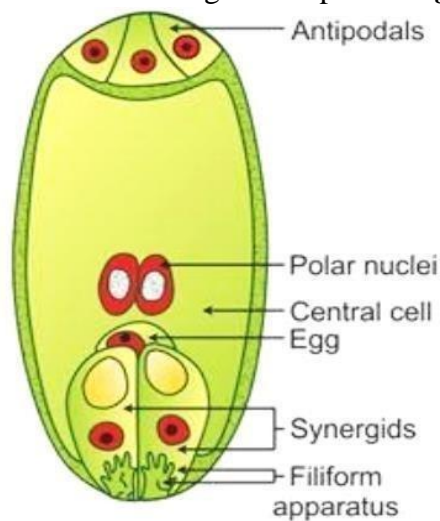


Anatropous Ovule



Megasporogenesis:

- * The process of formation of **megaspores** from the **megaspore mothercell** is called **Megasporogenesis**.
- * In the centre of the ovule there is a mass of tissue called **nucellus**.
- * Cells of nucellus have abundant reserve food materials.
- * One cell of the nucellus towards micropylar end differentiated into **megaspore mother cell** (MMC).
- * It is a large **diploid cell**, dense **cytoplasm** with **prominent nucleus**.
- * The MMC undergo **meiotic** division resulting four haploid **megaspores**.



Mature Embryo Sac

PPT Link for Megasporogenesis <https://docs.google.com/presentation/d/10Cpgs8y17bGxC-BQKv89sws2BOROAAQ9/edit?usp=sharing&ouid=107171444976724466844&rtpof=true&sd=true>

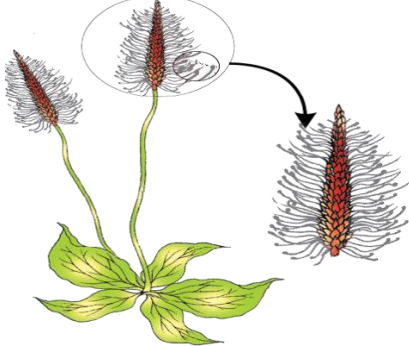
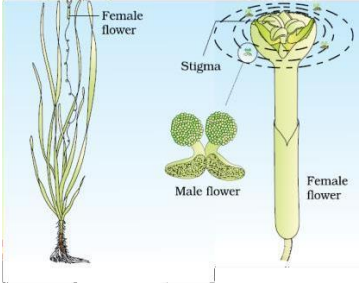

Pollination:

Transfer of pollen grains from the anther to the stigma of a pistil is termed as pollination.

Autogamy	Geitonogamy	Xenogamy
Pollination within same flower.	Pollination between two flowers of the same plant.	Transfer of pollen grains from the anther to the stigma of different plant.
Self-Pollination	Pollination by pollinating agent.	It is commonly called as cross-pollination.
Genetically similar plants are produced	Genetically similar to the autogamy.	It brings genetically different types of pollen grains to the stigma and genetically different plants are produced.

Kinds of pollination:

Anemophily	Hydrophily	Entomophily
Pollinating agent is wind.	Pollination by water.	Pollinating agent is insect particularly bees are the dominant biotic agents for pollination.
Produces more number of pollen to compensate the uncertainties of pollination.	<i>Vallisneria, Hydrilla</i> and <i>Zostera</i> are the common example for Hydrophily.	flowers are very large, colorful, fragrant and rich in nectar.
Flowers with well exposed stamens.	Pollen grains released into the surface of water and carried to the stigma by air current as in <i>Vallisneria</i> .	Small flowers present in cluster to make them conspicuous.
Large feathery stigma to trap air-borne pollen grains.	This type of pollination is very rare, mostly monocot. In sea grass the flowers remained submerged .	Flower pollinated by flies and beetles secrete foul odours.
Contains single ovule in one ovary and numerous flower	Pollen grains are long, ribbon like and carried	Contains single ovule in one ovary and

packed into an inflorescence e.g. corn cob.	passively inside the water	
Pollen grains are light and non-sticky.	Pollen grains are protected from wetting by mucilaginous covering.	
		

Viola, *Oxalis* and *Commelina* produce two types of flowers:

Chasmogamous: With exposed anther and stigma

Cleistogamous: With closed anther and stigma.

Cleistogamous flower is invariably **autogamous** and **assured seed** set even in the absence of the pollinator.

Agents of pollination:

Outbreeding Devices:

- * **Pollen released and stigma receptivity is not synchronized.**
- * **Spatial separation of anthers and stigmas**
- * **Anther and stigma are placed at different positions.**
- * **Self incompatibility.**
- * **Production of unisexual flowers.**

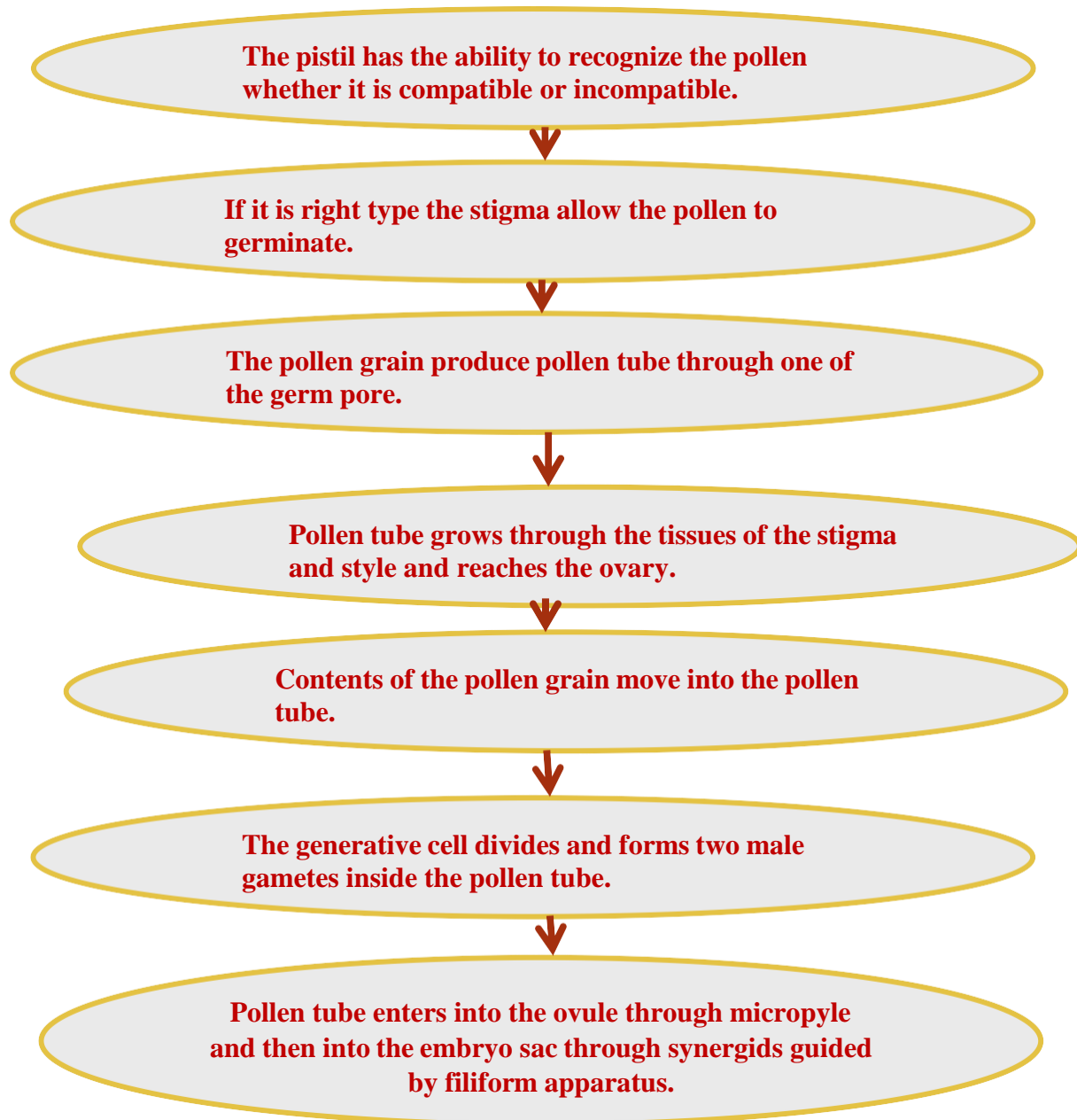
[PPT Link for Double fertilisation](https://drive.google.com/file/d/1KHyulpTc-cWR8hfwy4Un7R4JRR6PNG8Z/view?usp=sharing)

<https://drive.google.com/file/d/1KHyulpTc-cWR8hfwy4Un7R4JRR6PNG8Z/view?usp=sharing>

[Video link for Double fertilization](https://www.youtube.com/embed/dgFY7WUTASQ)

<https://www.youtube.com/embed/dgFY7WUTASQ>

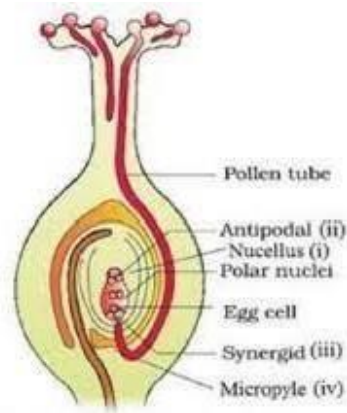
Pollen pistil Interaction: All the events – from pollen deposition on the stigma until pollen tubes enter the ovule – are together referred as **pollen-pistil interaction**.



Double fertilization:

- * After entering one of the synergids, the pollen tube releases two male gametes into the cytoplasm of the synergids.
- * **Syngamy:** one of the male gamete fused with egg cell, to form a diploid **zygote**.
- * Two polar nuclei of central cell fused to form a diploid **secondary nucleus**.

- * **Triple fusion:** The second male gamete fused with the secondary nucleus to form a triploid **primary endosperm nucleus**.
- * Since two type of fusion, syngamy and triple fusion take place in the embryo sac the phenomenon is termed as **double fertilization**.
- * The central cell after triple fusion becomes **primary endosperm cell** and developed into the **endosperm**.
- * The zygote developed into an embryo.



Longitudinal section of a pistil showing growth of pollen tube

POST- FERTILIZATION : STRUCTURE AND EVENTS

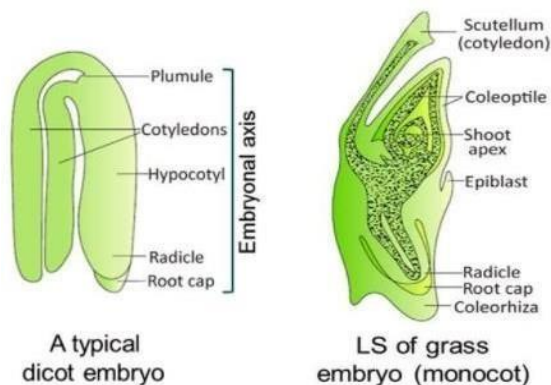
Events of endosperm and embryo development, maturation of ovule into seed and ovary into fruit, are collectively termed as **post-fertilization events**.

Endosperm:

- * Development of endosperm takes place before the embryo development. * Primary endosperm cell divides repeatedly to form a triploid endosperm.
- * PEN undergoes successive nuclear division to give rise to free nuclei. This is called free-nuclear endosperm.

Embryo:

- * Zygote formed and placed at the micropylar end of the embryo sac and undergoes cell division and develop into embryo.



APOMIXIS AND POLYEMBRYONY.

- Apomixis is very common in Asteraceae and grasses.
- Seeds are produced without fertilization.
- Apomixis is a type of asexual reproduction which mimics the sexual reproduction.
- Diploid egg cell is formed without meiosis and develops into seed without fertilization.
- In *Citrus* and *Mango* the nucellar cells start dividing, protrude into the embryo sac and develop into embryo.
- Ovule having more than one embryo is termed as **polyembryony**.
- Hybrid plants are developed by apomixis to maintain the genetic identity.

CHAPTER 2

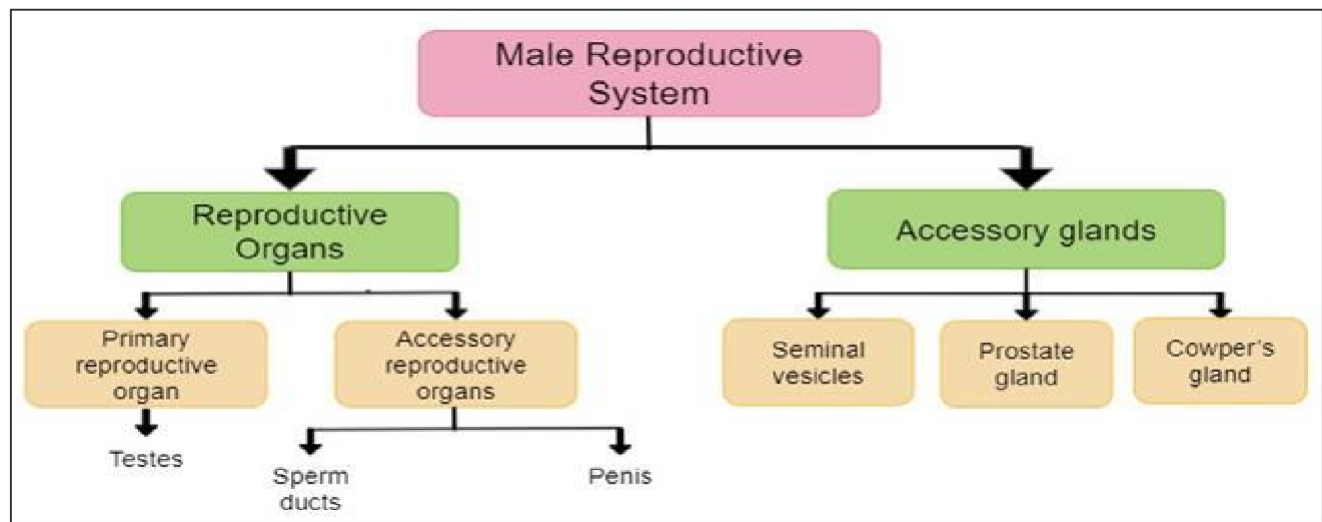
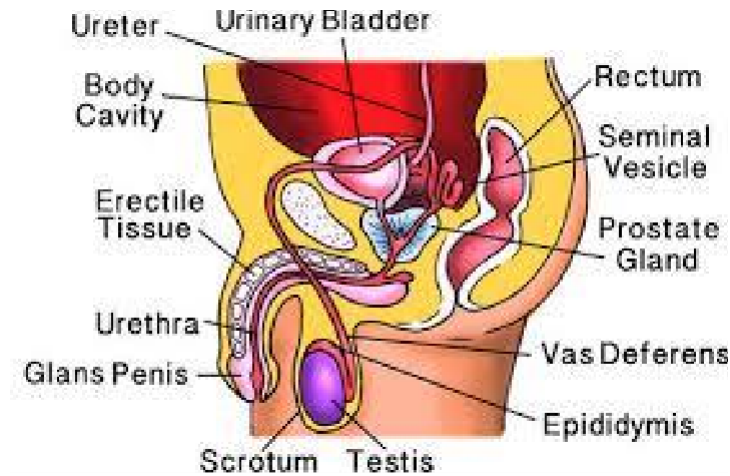
HUMAN REPRODUCTION

THE MALE REPRODUCTIVE SYSTEM.

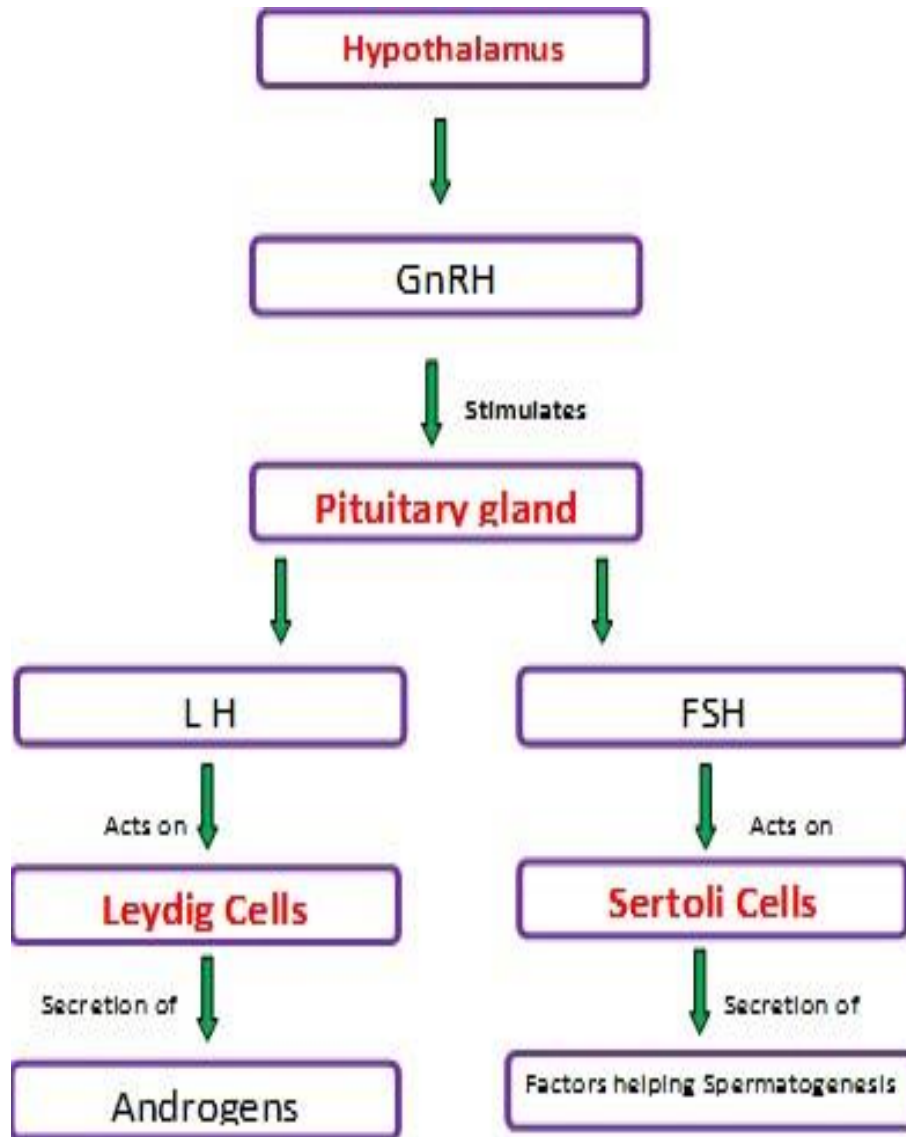
Male reproductive system includes a pair of testes, accessory ducts, accessory glands and external genitalia

Testes:

Testes is located outside the abdominal cavity within a pouch called **scrotum**. Scrotum provides **low temperature** required for spermatogenesis. Each testis has about 250 compartments called **testicular lobules**. Each lobule contains one to three seminiferous tubules. Male germ cell undergoes **meiosis** and produce **sperm**. Sertoli cells provide **nutrition** to the germ cell and the sperm. In between the seminiferous tubule there is **interstitial cell** or **Leydig cells** that produce testicular hormones called **androgen (testosterone)**.

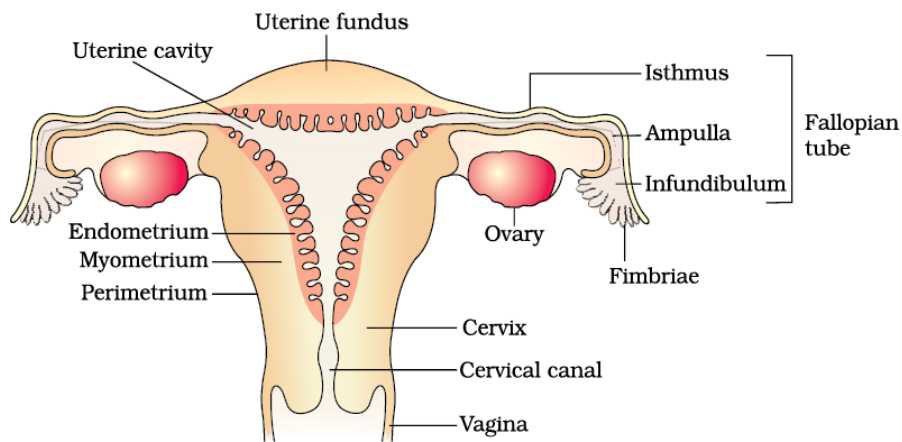


Hormones involved in the regulation of Spermatogenesis



THE FEMALE REPRODUCTIVE SYSTEM

The female reproductive system includes a **pair of ovaries, a pair of oviduct, uterus and cervix, vagina, external genitalia and a pair of mammary gland.**



Oviduct:

- * Oviducts, uterus and vagina constitute the female accessory ducts.
- * Each fallopian tube is about 10-12 cm long and extends from the periphery of each ovary to the uterus.
- * Close to the ovary the oviduct has a funnel shaped structure called **infundibulum**.
- * The edges of the infundibulum possess finger-like projections called **fimbriae**, which helps in collection of the ovum after ovulation.
- * The infundibulum leads to a wider part of the oviduct called **ampulla**. * The last part of the oviduct is called **isthmus** which joined to uterus.

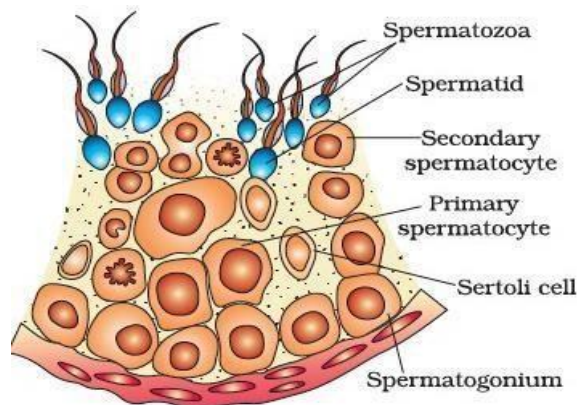
Uterus:

- * Attached the pelvic wall by ligaments.
- * The uterus opens into vagina through a narrow cervix.
- * The lumen of cervix is called cervical canal.
- * Cervical canal along with vagina form the birth canal.
- * The wall of the uterus has three layers of tissues **Perimetrium, Myometrium and Endometrium**.
- * Endometrium undergoes cyclical changes during menstrual cycle.
- * Myometrium exhibits strong contraction during delivery of the baby.

GAMETOGENESIS: (formation of gametes) Spermatogenesis:

Link for Spermatogenesis:

https://drive.google.com/file/d/1fiTw5LSOkXIRu_FbodaTJIAYRrwKAs9x/view?usp=sharing



Sectional view of seminiferous tubule

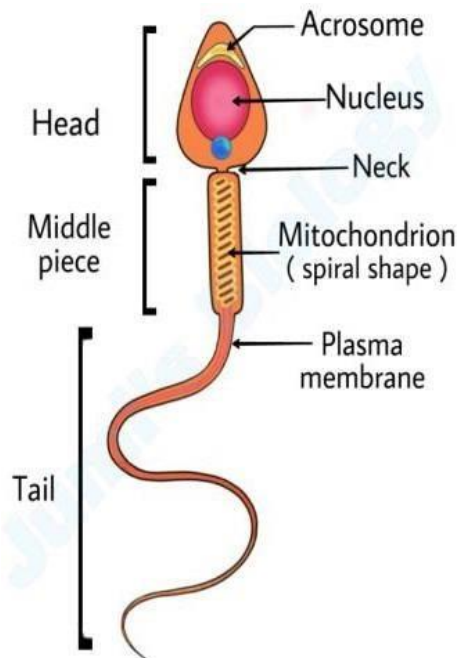
Hormonal control of spermatogenesis:

- * This process is initiated at puberty due to secretion of gonadotrophins releasing hormone (GnRH)
- * GnRH secreted from hypothalamus and stimulates anterior pituitary to secrete two gonadotrophins. Luteinizing hormone (LH) and Follicle stimulating Hormone (FSH).
- * LH acts on Leydig cells and stimulates synthesis of androgens.
- * Androgen stimulates spermatogenesis.
- * FSH acts on Sertoli cells and stimulates spermatogenesis in other ways.

Structure of sperm:

- * Ultrastructure of sperm consists of a **head**, **neck**, a **middle piece** and a **tail**.
- * Whole body of sperm surrounded by plasma membrane.
- * The sperm head contains an elongated haploid nucleus.
- * Above the nucleus a cap-like structure is present called **acrosome**.
- * The acrosome contains **enzymes** which help in fertilization of ovum.
- * The middle piece contains **mitochondria**, which provide energy for movement of tail that facilitates sperm motility.
- * Sperm released from seminiferous tubules enters into accessory ducts.
- * On their way fluids from seminal vesicle and prostate gland are added which collectively are called as **Semen**.

Link for spermatogenesis- Video:



<https://www.youtube.com/embed/6fBa8UqEano>

Structure of Sperm

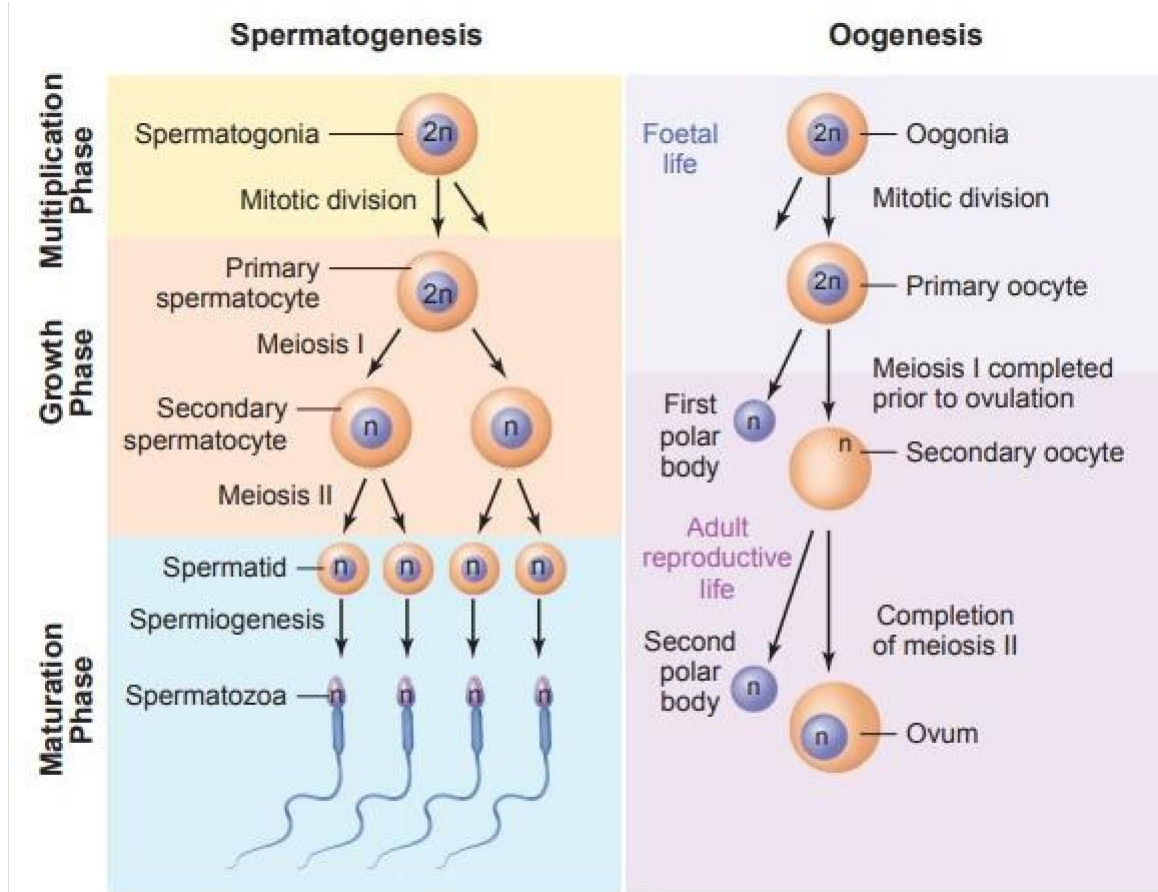
Oogenesis:

Formation of a mature female gamete or ovum is called **oogenesis**.

Link for Oogenesis:

<https://drive.google.com/file/d/14nIrhCzc8ZFALyjVcBU7YWvqggbTrSRc/view?usp=sharing>

Link for oogenesis- Video: <https://www.youtube.com/embed/hKa57JPfKDE>



Gametogenesis

Menstrual cycle:

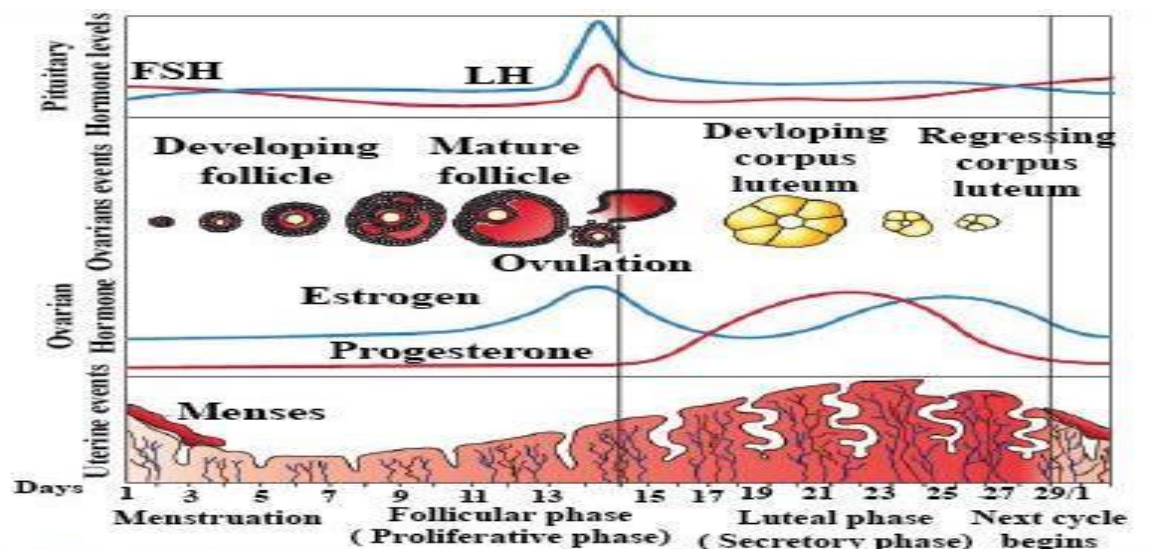


Figure 3.9 Diagrammatic presentation of various events during a menstrual cycle

- * Reproductive cycle of female primates is called **menstrual cycle**.
- * The first menstruation begins at puberty is called **Menarche**.
- * Menstrual cycle repeated at an average interval of 28/29 days. * One ovum is released in the middle of each menstrual cycle.

Video of Menstrual cycle

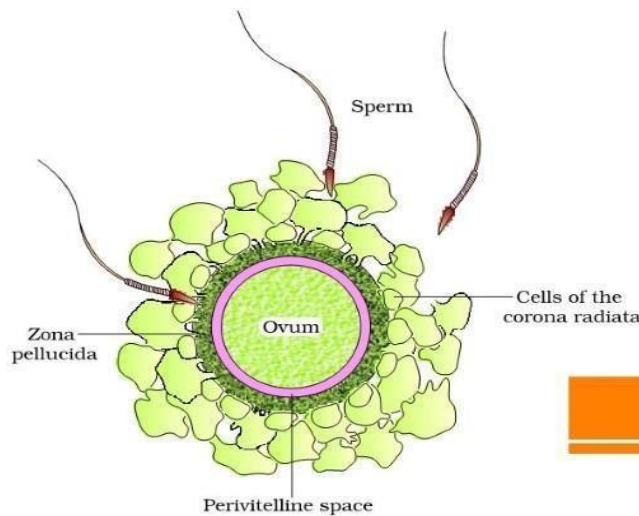
<https://www.youtube.com/embed/ZNM8KsSQerk>

Menstrual cycle has four phases:

- i) Menstrual phase, ii) Follicular phase, iii)Ovulatory phase and iv)Luteal phase.

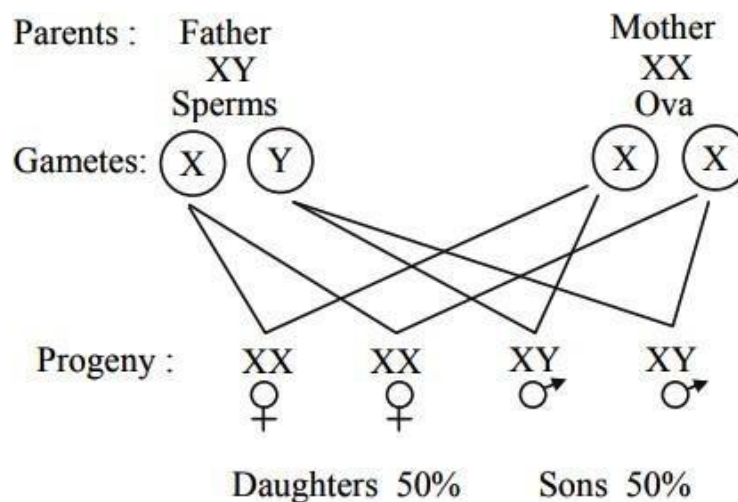
Fertilisation:

Fertilisation



Sex determination:

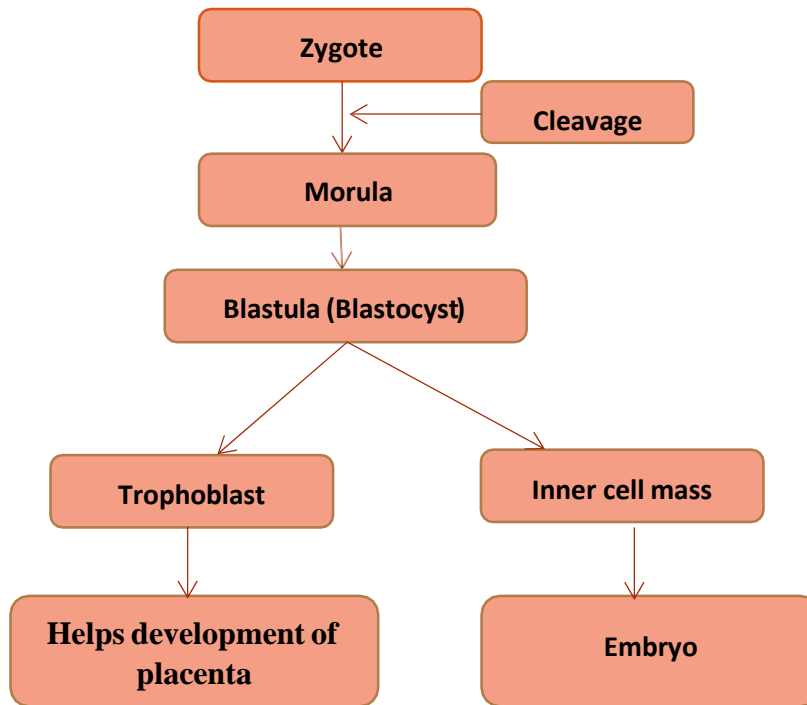
- * Sex of a baby has been decided during fertilization and in the zygote.
- * Sex is determined by the sex-chromosomes present in gametes.
- * Human female contain two XX chromosomes.
- * Human male contain XY chromosomes.
- * All the female gametes produced with only 'X' chromosome.
- * Sperms produced 'X' and 50 % with 'Y'
- * After fertilization carries XX or XY
- * Zygote with XX develop into female and XY chromosome male.



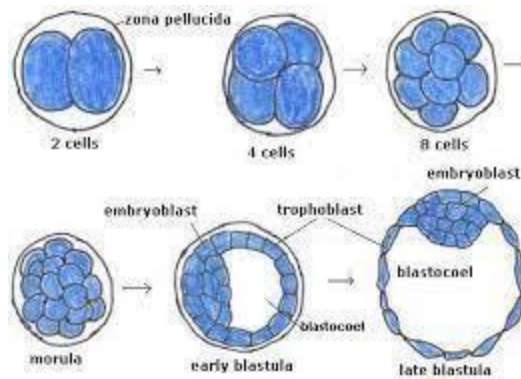
by male, 50% with 'Y' chromosome. zygote either chromosomes. female and with develops into

Sex determination in Human beings

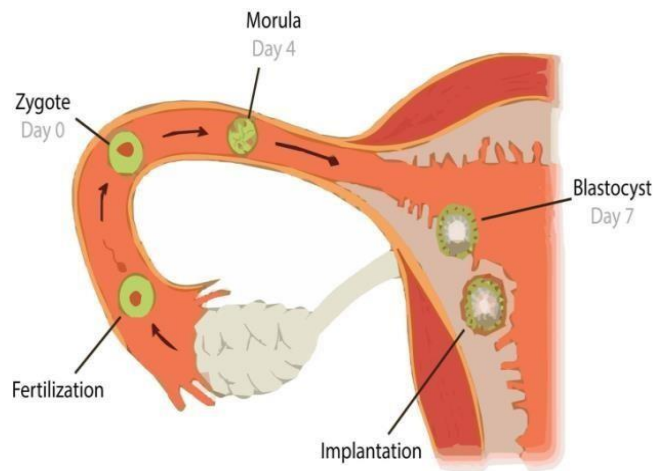
Cleavage: Repeated mitotic division of the zygote without growth resulting a multicellular ball like embryo is called **cleavage**.



Cleavage and formation of blastocyst



Implantation: The attachment of blastocyst in the uterine endometrium is called Implantation..



Pregnancy and embryonic development:

- * After implantation, finger like projections appears on the trophoblast called **chorionic villi**.
- * Chorionic villi surrounded by uterine tissue and maternal blood.
- * chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between developing embryo (foetus) and maternal body called **placenta**.

Function of placenta:

- * The embryo connected to the placenta by umbilical cord, which transports substances to and from the embryo.
- * Facilitate transport of oxygen and nutrient from mother to embryo.
- * Removes CO₂ and waste material from the embryo.
- * Acts as endocrine gland and produces several hormones like: Human chorionic gonadotrophins (hCG), Human placental lactogen (hPL), Estrogen, Progesterone and Relaxin produced from the ovary in the later stage of pregnancy.

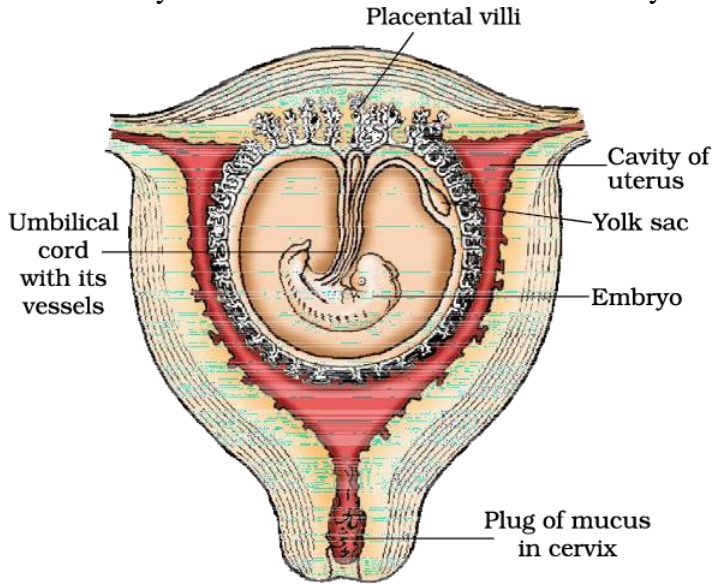
Embryonic development:

- * After implantation the inner cell mass of blastocyst differentiated into an outer layer called **ectoderm** and an inner layer called **endoderm**.
- * **Mesoderm** differentiated in-between ectoderm and endoderm.
- * The inner cell mass thus called **stem cells**, having potency to produce all types of cell, tissues and organs by differentiation.

Organogenesis:

- * Formation of different organs in the embryo is called **organogenesis**.
- * Human pregnancy lasts for **9 months**.
- * After one month of pregnancy **heart** is formed in the embryo.
- * By the end of 2nd month the foetus develops **limbs and digits**.
- * By the end of 12 weeks (**first trimester**) most of organ system is formed (limbs and external genitalia are well developed).
- * First movement of foetus and appearance of hairs observed in 5th month.

- * By the end of 24th week (**2nd trimesters**) the body is covered with fine hairs, eye-lids separate, and eyelashes are formed.
- * By the end of 9 months the foetus is fully developed and is ready for delivery.



PARTURATION:

The period of pregnancy is called gestation period. (9 months).

- Ejection or expulsion or delivery of foetus is called **parturition**.
- Parturition is due to vigorous contraction of **uterine Myometrium**.
- The signal of parturition is originated from the fully developed foetus and the placenta which induces mild contraction of uterus called **fetal ejection reflex**.
- Fetal ejection reflex triggers the release of **Oxytocin** from pituitary.
- Oxytocin induces stronger contraction of uterine endometrium.
- Stimulatory reflex continues stronger contraction leads to expulsion. □ After delivery the placenta is also expelled out of the uterus.

Abbreviations	Expanded form
IUCD	Intra Uterine Contraceptive Device
RCH	Reproductive and Child Health care
STD	Sexually Transmitted Disease

HIV	Human Immuno deficiency virus.
AIDS	Acquired immuno deficiency syndrome
CDRI	Central Drug Research Institute
MMR	Maternal Mortality Rate
IMR.	Infant mortality rate
MTP	Medical Termination of Pregnancy
VD	Venereal Disease
RTI	Reproductive Tract Infection
PID	Pelvic Inflammatory Disease
ART	Assisted Reproductive Technologies
IVF	In Vitro Fertilisation
ZIFT	Zygote Intra Fallopian Transfer
AI	Artificial insemination
IUI	Interna uterine insemination.
ET	Embryo transfer
IUT	Intra uterine transfer
ICSI	Intra Cytoplasmic Sperm Injection

CHAPTER 3

REPRODUCTIVE HEALTH

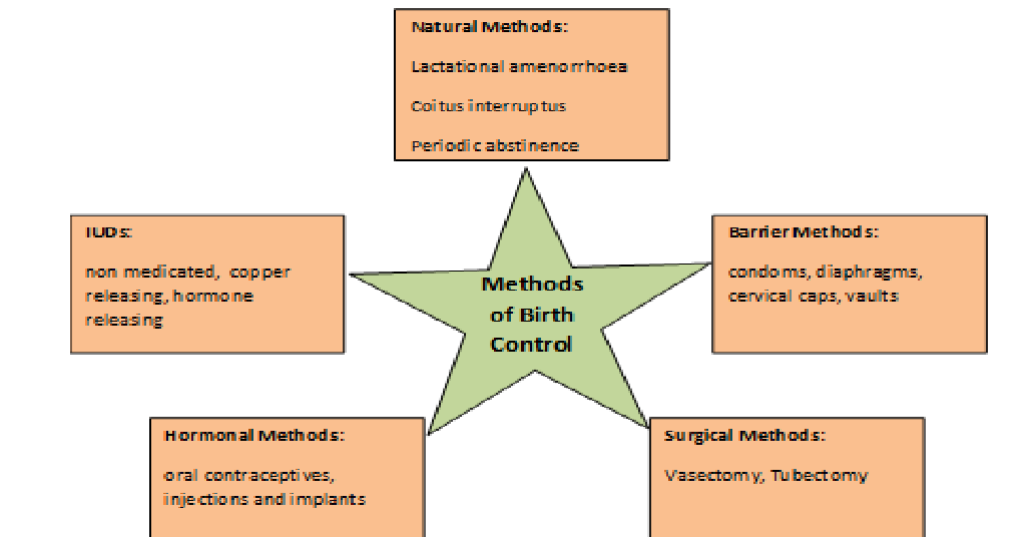
POPULATION EXPLOSION AND BIRTH CONTROL:

- * Increased health facilities, better living conditions are the cause of population explosion.
- * Out of 6 billion world population 1 billion are Indians.
- * Rapid decline in death rate, **maternal mortality rate (MMR)** and **infant mortality rate (IMR)** are major cause of population growth.
- * Indian population growth rate is around 1.7 percent.

Characteristics of ideal contraceptive.

- * User friendly.
- * Easily available.
- * Effective
- * Nor or least side – effects.
- * No way interferes with sexual drive.

BIRTH CONTROL METHODS:



Natural methods: Principle of working: Avoiding chances of ovum and sperms meeting. i) **Periodic abstinence** ii) **Withdrawal or coitus interruption**

iii) **Lactational amenorrhea**

Barrier methods: Principle of working: prevents physical meeting of sperm and ovum. **Condoms, Diaphragm, cervical caps and vaults.**

Intra Uterine Devices: Eg. Non-medicated IUDs e.g. Lippes loop, Copper releasing IUDs (CuT, Cu7, Multiload 375), Hormone releasing IUDs (Progestasert, LNG-20).

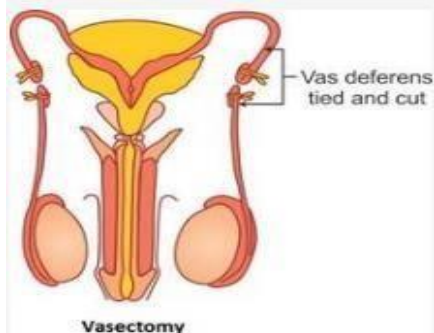
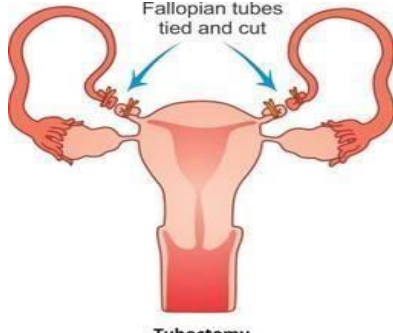
Principle of working:

- * Increase phagocytosis of sperm within the uterus.
- * Cu ion released suppresses sperm motility and fertilizing capacity of sperm.
- * Hormone releasing IUDs make the uterus unsuitable for implantation and the cervix hostile to the sperm.

Oral contraceptives: Principle of working:

- * Inhibit ovulation, Inhibit implantation.
- * Alter the quality of cervical mucus to prevent/retard entry of sperms. * **Saheli-** a non steroidal preparation used as oral contraceptive pills.

Surgical methods:

Vasectomy	Tubectomy
Sterilization process in male. A small part of the vas deferens is removed or tied up.	Sterilization process in female. A small part of the fallopian tube is removed or tied up.
	

MEDICAL TERMINATION OF PREGNANCY:

Intentional or voluntary termination of pregnancy before full term is called **medical termination of pregnancy (MTP)** or **induced abortion**.

INFERTILITY: The couple unable to produce children inspite of unprotected sex.

In case there no corrections are possible, some special technologies used to have children called **assisted reproductive technologies (ART)**.

Assisted reproductive technologies:

- (a) **In vitro fertilization:**
- (b) **Embryo transfer: ZIFT- Zygote intra fallopian transfer. IUT- Intra Uterine transfer** (embryo with more than 8 blastomeres).
- (c) **Gamete intra fallopian transfer- GIFT** (d) **Intra cytoplasmic sperm injection (ICSI):** (e) **Artificial insemination (AI)**

UNIT VII – GENETICS AND EVOLUTION

CHAPTER 4

PRINCIPLES OF INHERITANCE AND VARIATION















PRINCIPLES OF INHERITANCE AND VARIATION

- * **Genetics:** deals with the inheritance, as well as the variation of characters from parents to offsprings.
- * **Inheritance:** is the process by which characters are passed on from parent to progeny. * **Variation:** is the degree by which progeny differ from their parents.

MENDEL'S LAWS OF INHERITANCE:

- * Gregor Mendel. Conducted hybridization experiments on garden peas for seven years (1856 – 1863) and proposed laws of inheritance.
- * Mendel conducted artificial pollination/cross pollination experiments using several true-breeding pea lines.
- * A true breeding line is one that, having undergone continuous self-pollination for several generations.
- * Mendel selected 14 true-breeding peas' plant varieties, as pair's which were similar except for one character with contrasting traits.

True breeds selected by Mendel

Traits	Shape of seeds	Colour of seeds	Colour of pods	Shape of pods	Plant height	Position of flowers	Flower colour
Dominant trait	Round 	Yellow 	Green 	Full 	Tall 	At leaf junction 	Purple 
Recessive trait	Wrinkled 	Green 	Yellow 	Flat, constricted 	Short 	At tips of branches 	White 

Seven pairs of contrasting traits in pea plant

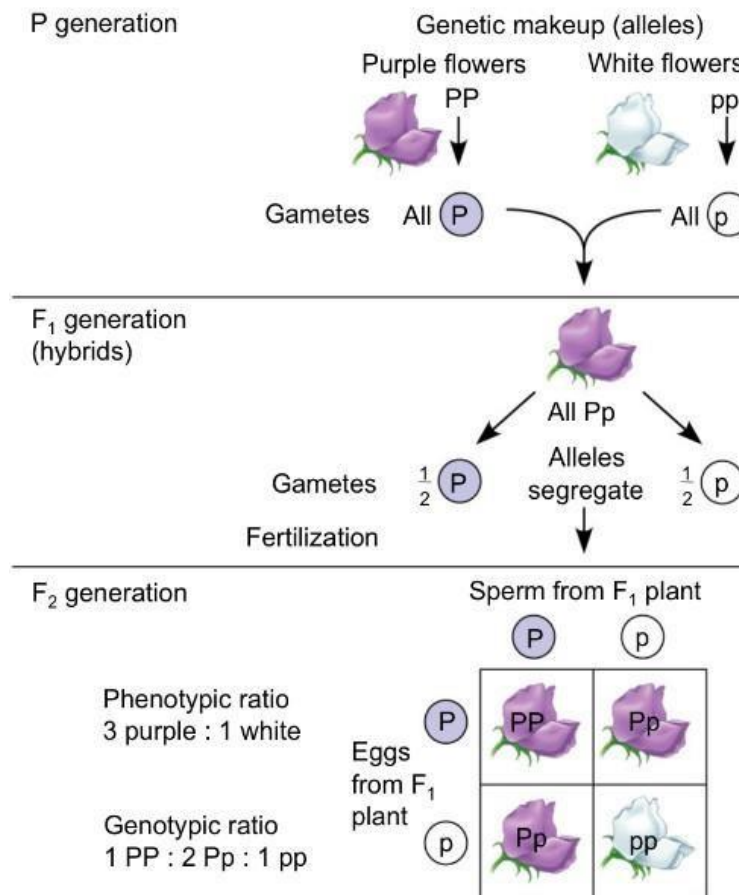
INHERITANCE OF ONE GENE: (Monohybrid cross)

- * Mendel crossed tall and dwarf pea plants to study the inheritance of one gene.
- * He collected the seeds produced as a result of this cross and grew them to generate plants of the first hybrid generation. This generation is called **filial progeny** or the **F₁**.
- * Mendel observed that all the F₁ progeny plants are tall, like one of its parents; none were dwarf.

- * He made similar observations for the other pairs of traits – he found that the F₁ always resembled either one of the parents, and that the trait of the other parent was not seen in them.
- * The tall and dwarf traits were identical to their parental type and did not show any **blending**, that is all the offsprings were either tall or dwarf, none were of in between height.
- * Similar results were obtained with the other traits that he studied: only one of the parental traits was expressed in the F₁ generation while at the F₂ stage both the traits were expressed in the proportion of 3:1.
- * The contrasting traits did not show any blending at either F₁ or F₂ stage. **Mendel's proposition:**
- * Mendel proposed that something was being stably passed down, unchanged, from parent to offspring through the gametes, over successive generations. He called these things as '**factors**'. * Now a day we call them as **genes**.
- * Gene is therefore are the **units of inheritance**.
- * Genes which codes of a pair of contrasting traits are known as **alleles**, i.e. they are slightly different forms of the same gene.
- * Mendel then self – pollinated the tall F₁ plants and to his surprise found that in the F₂ generation some of the offsprings were 'dwarf; the character that was not seen in the F₁ generation was now expressed.
- * The proportion of plants that were dwarf was 1/4th of the F₂ plants while 3/4th of the F₂ plants were tall.

Law of Dominance:

- Characters are controlled by discrete units called factors.
- Factors occur in pairs.
- In a dissimilar pair of factors one member of the pair dominates (dominant) the other (recessive).



Terminologies used in Genetics

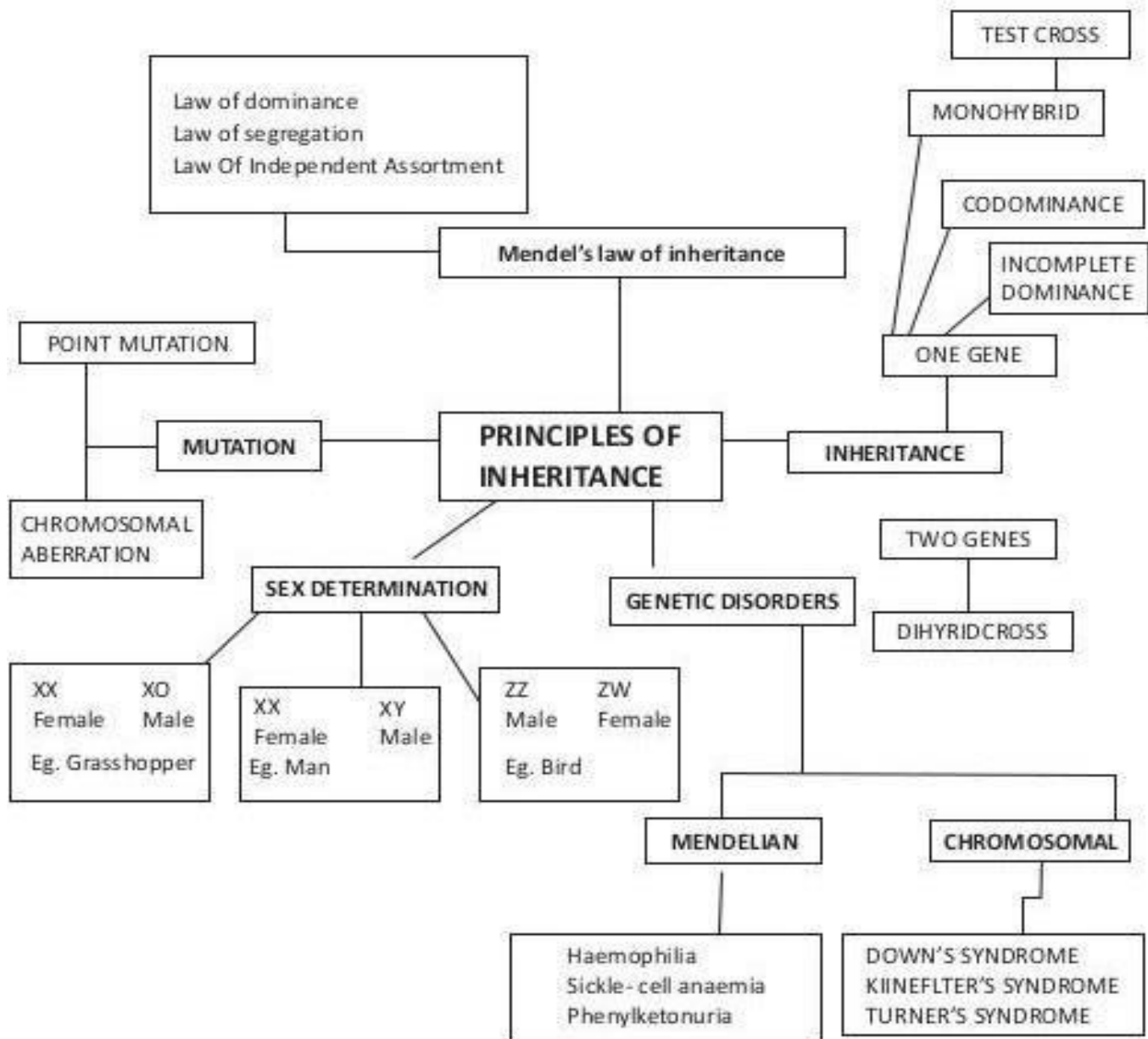
Genetic Terms	Definition	Example
Allele	Different forms of a gene, which produce variations in a genetically inherited trait.	Different alleles produce different hair colors— brown, blond, red, black, etc.
Genes	Genes are parts of DNA and carry hereditary information passed from parents to children.	Genes contain blue-print for each individual for her or his specific traits.
Dominant	Dominant version (allele) of a gene shows its specific trait even if only one parent passed the gene to the child.	When a child inherits dominant brown-hair gene form(allele) from dad, the child will have brown hair.
Recessive	Recessive gene shows its specific trait when both parents pass the gene to the child.	When a child inherits recessive blue-eye gene form (allele) from both mom and dad, the child will have blue eyes.
Homozygous	Same allelic pairs of genes. One from mother and other from father.	Inheriting the same blue eye gene form from both parents result in a homozygous gene.
Heterozygous	Two different forms of a gene— one from mom and the other from dad are different.	Inheriting different eye color gene forms from mother and father result in a heterozygous gene.
Genotype	Internal heredity information that contain genetic code.	Blue eye and brown eye have different genotypes—one is coded for blue and the other for brown.
Phenotype	Outwardly expressed traits or characteristics.	Either having or not having a widow's peak are phenotypes.
Mendelian Inheritance	A simple genetic rule where a gene only comes in dominant or recessive forms.	Some genetic traits follow Mendelian Inheritance, while other genetic traits follow different inheritance patterns or rules.

Law of Segregation:

- The alleles do not show any blending and that both the characters are recovered as such in the F₂ generation though one of these is not seen at the F₁ stage.
- The parents contain two alleles during gamete formation; the factors or alleles of a pair segregate or separate from each other such that a gamete receives only one of the two factors.
- Homozygous parent produces all gametes that are similar i.e contain same type of allele.
- Heterozygous parents' produces two kinds of gametes each having one allele with equal proportion.

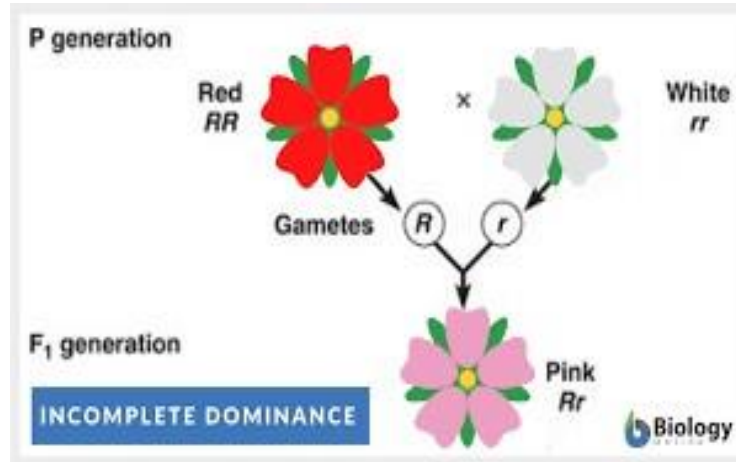
Incomplete dominance:

**CHAPTER – 5 : PRINCIPLES OF INHERITANCE AND VARIATION
(CONCEPT MAP)**



- When a cross between two pure breed is done for one contrasting character, the F₁ hybrid phenotype does not resemble either of the two parents and was in between the two, called **incomplete dominance**.
- Inheritance of flower color in the **dog flower (snapdragon or Antirrhinum sp.)** Is a good example of incomplete dominance?

- F₂ generation phenotypic ratio is 1:2:1 instead of 3:1 as Mendelian monohybrid cross. □ Genotypic ratio of F₂ generation is 1:2:1.



For Mendel's Laws of Inheritance click the following link: <https://www.youtube.com/embed/mD0Onu2ArGA>
For Deviations from Mendelian Laws click the link given below.
<https://drive.google.com/file/d/1OYeU7D48jbOkouen6Mc3yiNzXhB-wKVr/view?usp=sharing>

Co – dominance:

- * F₁ resembled either of the two parents (**complete dominance**).
- * F₁ offspring was in-between of two parents (**incomplete dominance**).
- * F₁ generation resembles both parents (**co-dominance**).
- * Best example of co-dominance is the ABO blood grouping in human.
- * ABO blood group is controlled by the **gene I**.
- * The plasma membrane of the RBC has sugar polymers (antigen) that protrude from its surface and the kind of sugar is controlled by the **gene-I**.
- * The gene I has three alleles **I^A, I^B** and **i**.
- * The alleles **I^A** and **I^B** produce a slightly different form of sugar while allele **i** doesn't produce any sugar.
- * Each person possesses any two of the three I gene alleles.
- * **I^A** and **I^B** are completely dominant over **i**.
- * When **I^A**, and **I^B** present together they both express their own types of sugar; this because of co-dominance. Hence red blood cells have both A and B type sugars.

Genotype	Blood type
I^AI^A	A
I^AI^B	AB
I^Ai	A
I^BI^B	B
I^Bi	B
ii	O

Multiple Allelism:

- * Example of ABO blood grouping produces a good example of multiple alleles. * There are more than two alleles. i.e. three allele governing the same character in a population.

A single gene product may produce more than one effect:

Eg. Starch synthesis in pea seeds is controlled by one gene. It has two alleles **B** and **b**. Starch is synthesized effectively by **BB** homozygote and therefore, large starch grains are produced. The '**bb**' homozygous has less efficiency hence produce smaller grains. After maturation of the seeds, **BB seeds** are **round** and the **bb seeds** are **wrinkle**. **Heterozygous (Bb)** produce round seed and so B seems to be dominant allele, but the starch grains produced are of intermediate size. If starch grain size is considered as the phenotype, then from this angle the alleles show incomplete dominance.

INHERITANCE OF TWO GENES: (Dihybrid Cross)

Law of independent Assortment:

When two characters (dihybrid) are combined in a hybrid, segregation of one pair of traits is independent of the other pair of traits.

CHROMOSOMAL THEORY OF INHERITANCE:

- * Proposed by **Walter Sutton** and **Theodore Boveri** in 1902.
- * The behavior of chromosomes was parallel to the behavior of genes and used chromosome movement to explain Mendel's laws.
- * Sutton united the knowledge of chromosomal segregation with Mendelian principles and called it the **chromosomal theory of inheritance**.
 - Chromosome and genes are present in pairs in diploid cells. ○ Homologous chromosomes separate during gamete formation (meiosis) ○ Fertilization restores the chromosome number to diploid condition.
 - The chromosomal theory of inheritance claims that, it is the chromosomes that segregate and assort independently.

Linkage: Physical association of genes on a chromosome.

Recombination: The generation of **non-parental** gene combinations.

POLYGENIC INHERITANCE:

The inheritance one trait by three or more genes are called **polygenic inheritance**. In a polygenic trait the phenotype reflects the contribution of each allele i.e. the effect of each allele is additive.

Eg. Human skin colour.

Eg: Inheritance of Human skin colour-

Link for explanations as PPT- <https://drive.google.com/file/d/14SqO36KUMrNZ9wX6axUvEJDs0CCMzDPQ/view?usp=sharing>

Link for Video:

https://www.youtube.com/embed/yMN_wbRb38M

(Darkest) AAB₂CC

X

aabbcc (Fairest) (P)



AaBbCc (Intermediate) (F1)

AaBbCc X AaBbCc

F2



	ABC	ABc	AbC	Abc	aBC	aBc	abC	abc
ABC	AAB ₂ CC 6	AAB ₂ Cc 5	AABbCC 5	AAbbCc 4	AaB ₂ CC 5	AaB ₂ Cc 4	AaBbCC 4	AaBbCc 3
ABc	AAB ₂ Cc 5	AAB ₂ cc 4	AABbCc 4	AAbbcc 3	AaB ₂ Cc 4	AaB ₂ cc 3	AaBbCc 3	AaBbcc 2
AbC	AABbCC 5	AABbCc 4	AAbbCC 4	AAbbCc 3	AaBbCC 4	AaBbCc 3	AabbCC 3	AabbCc 2
Abc	AABbCc 4	AABbcc 3	AAbbCc 3	AAbbcc 2	AaBbCc 3	AaBbcc 2	AabbCc 2	Aabbcc 1
aBC	AaB ₂ CC 5	AaB ₂ Cc 4	AaBbCC 4	AaBbCc 3	aaB ₂ CC 4	aaB ₂ Cc 3	aaBbCC 3	aaBbCc 2
aBc	AaB ₂ Cc 4	AaB ₂ cc 3	AaBbCc 3	AaBbcc 2	aaB ₂ Cc 3	aaB ₂ cc 2	aaBbCC 2	aaBbCc 1
abC	AaBbCC 4	AaBbCc 3	AabbCC 3	AabbCc 2	aaBbCC 3	aaBbCc 2	aabbCc 2	aabbcc 1
abc	AaBbCc 3	AaBbcc 2	AabbCc 2	Aabbcc 1	aaBbCc 2	aaBbcc 1	aabbCc 1	aabbcc 0

PLEIOTROPY:

- * A single gene can exhibit multiple phenotypic expression, such gene is called **pleiotropic gene**.
- * The mechanism of pleiotropy in most cases is the effect of a gene on metabolic pathways which contributes towards different phenotypes.
- * **Phenylketonuria** a disease in human is an example of pleiotropy.
- * This disease is caused due to **mutation** in the gene that code for the enzyme **phenyl alanine hydroxylase**.
- * **Phenotypic expression characterized by:** Mental retardation, reduction in hairs and reduction in skin pigmentation.

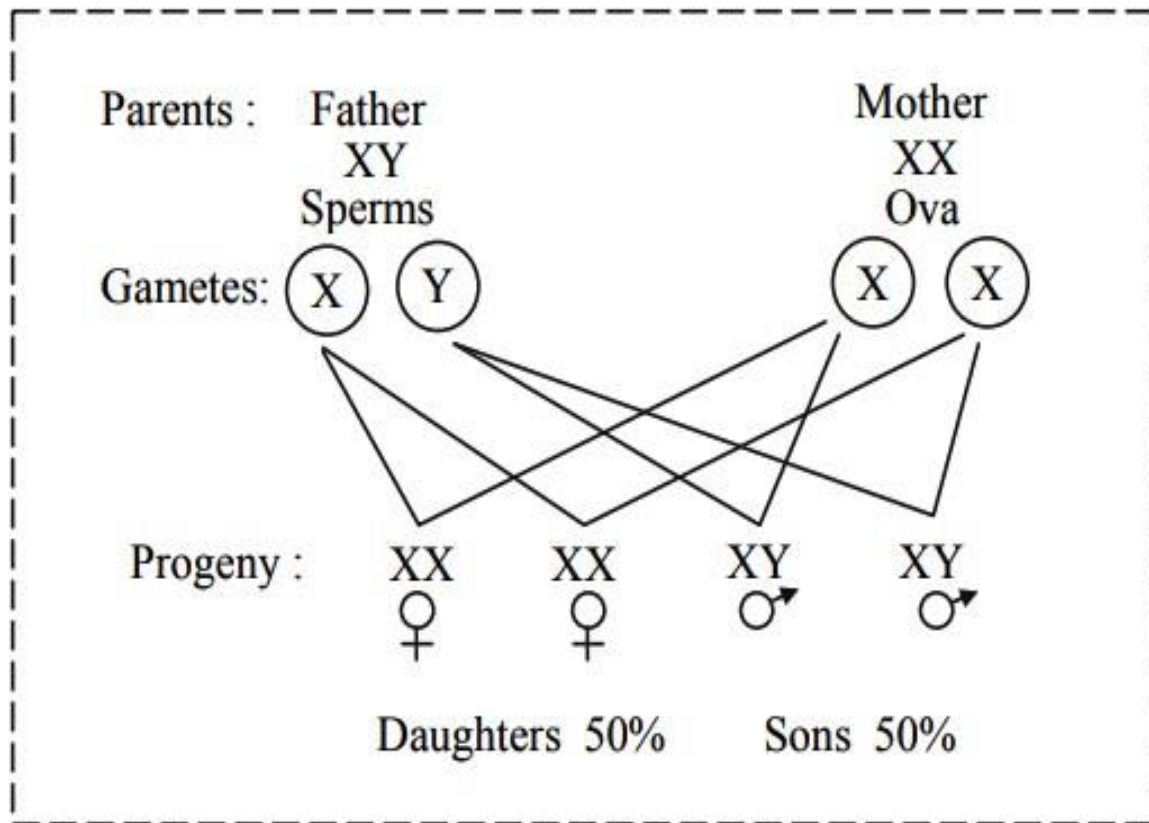
SEX DETERMINATION:

Sex-determination of grass hopper:

- * Sex-determination in grasshopper is **XX-XO type**.
- * All egg bears one 'X' chromosome along with autosomes.
- * Some sperms (50%) bear's one 'X' chromosome and 50% do not.
- * Egg fertilized with sperm (with 'X' chromosome) became female (22+XX).
- * Egg fertilized with sperm (without 'X' chromosome) became male (22 + X0)

Sex determination in Human beings (XX-XY type):

- * Both male and female have the same number of chromosomes.
- * Female have autosomes and a pair of X chromosomes. (AA+ XX)
- * Male have autosomes and one large 'X' chromosome and one very small 'Y-chromosomes. (AA+XY)
- * This is called **male heterogamety** and **female homogamety**.



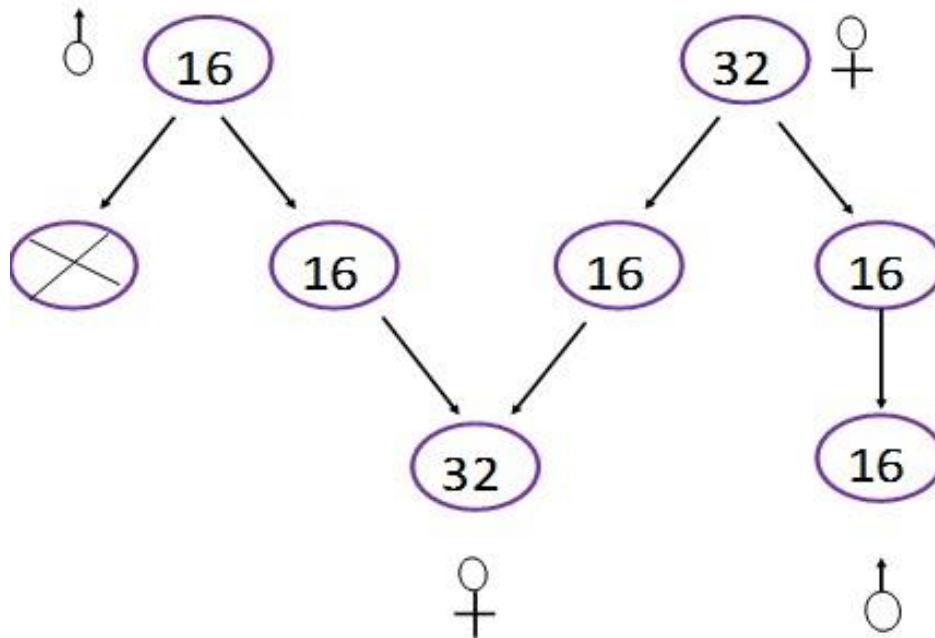
Sex determination in birds:

- * Female birds have two different sex chromosomes designated as **Z** and **W**.
- * Male birds have two similar sex chromosomes and called **ZZ**.
- * Such type of sex determination is called **female heterogamety** and **male homogamety**.

Sex determination in Honey bee:

- * Sex determination in honey bee based on the number of sets of chromosomes an individual receives.
- * An offspring formed from the fertilization of a sperm and an egg developed into either queen (female) or worker (female).
- * An unfertilized egg develops as a male (drone), by means of parthenogenesis.
- * The male have half the number of chromosome than that of female.
- * The female are diploid having 32 chromosomes and males are haploid i.e. having 16 numbers of chromosomes.
- * This is called **haplodiploid sex determination system**.
- * Male produce **sperms by mitosis**, they don't have father and thus cannot have sons, but have **grandsons**.

Sex Determination in Honey Bee



Pedigree Analysis:

- Analysis of traits in several of generations of a family is called the **pedigree analysis**.
- In the pedigree analysis the inheritance of a particular trait is represented in the family tree over generations.

GENETIC DISORDERS:

Hemophilia:

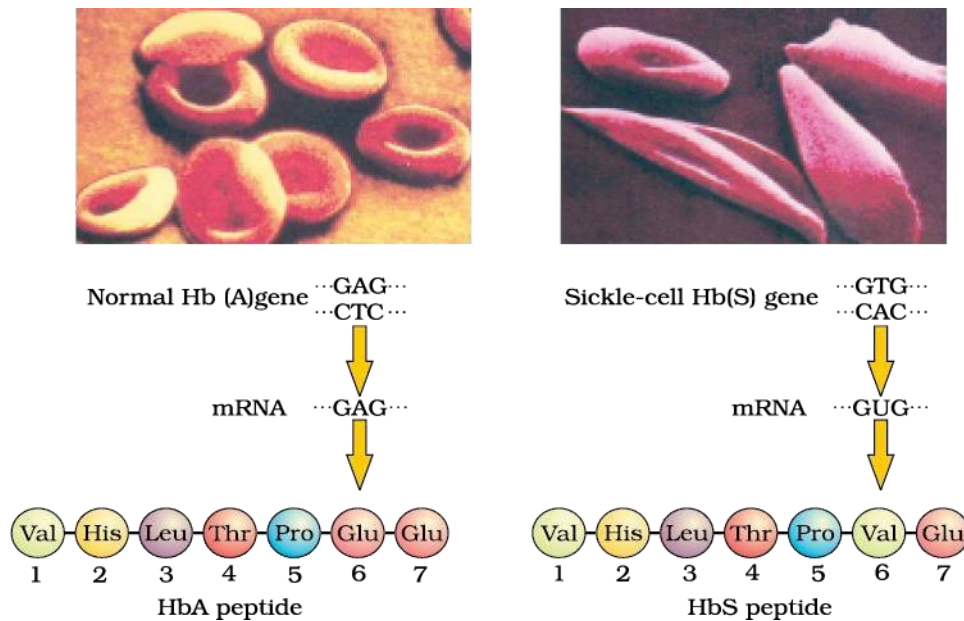
In this disease a single protein that is a part of the cascade of proteins involved in the clotting of blood is affected. Due to this in an affected individual a simple cut will result in non-stop bleeding.

- * Sex linked recessive disease.
- * The diseases transmitted from unaffected carrier female to some of the male progeny.
- * Female becoming hemophilic is extremely rare because mother of such a female at least carrier and the father should be hemophilic.
- * Affected transmits the disease only to the son not to the daughter. * Daughter can receive the disease from both mother and father.

Sickle cell anaemia:

- * This is an autosomes linked recessive trait.
- * The defect is caused due to substitution of Glutamic acid (Glu) by Valine (Val) at the sixth position of the beta globin chain of the haemoglobin molecule.
- * Substitution of amino acid takes place due to the single base substitution at the sixth codon of the beta globin gene from GAG to GUG.

- * Transmitted from parents to the offspring when both the parents are carrier for the gene (heterozygous).
- * This disease is controlled by single pair of allele, HbA, and HbS.
- * There are three possible genotypes (HbA HbA, HbA HbS, and HbSHbS).
- * Only homozygous individuals for HbS (HbS HbS) show the diseased phenotype.
- * Heterozygous (HbA HbS) individuals appear unaffected but they are carrier of the disease as there is 50 percent probability of transmission of the mutant gene to the progeny.



Phenylketonuria:

- * Autosomal recessive trait.
- * Inborn error of metabolism.
- * The affected individual lack one enzyme called phenyl alanine hydroxylase that converts the amino acid phenyl alanine to tyrosine.
- * In the absence of the enzyme phenyl alanine accumulated and converted into phenylpyruvic acid and other derivatives.
- * Accumulation of these results in mental retardation.
- * These derivatives excreted through kidney.

Thalassemia

- * Autosomal recessive blood disorder.
- * Reduce synthesis of haemoglobin.
- * Abnormal haemoglobin causing anemia.
- * Alpha- thalassemia is caused due to mutation in chromosome number 16: HbA1 and HbA2 genes of each parent.
- * Beta- thalassemia is caused due to mutation in chromosome number 11: HbB gene of each parent.

Chromosomal disorders:

- * Caused due to absence or excess or abnormal arrangement of one or more chromosome.
- * Failure of segregation of chromatids during cell division cycle results in the gain or loss of chromosome(s), called **Aneuploidy**.
- * Failure of cytokinesis after telophase stage of cell division results in an increase in a whole set of chromosome in an organism and this phenomenon is called **polyploidy**.

Trisomy: additional copy of a chromosome may be included in an individual ($2n+1$).

Monosomy: an individual may lack one of any one pair of chromosomes ($2n-1$) **Down**

syndrome:

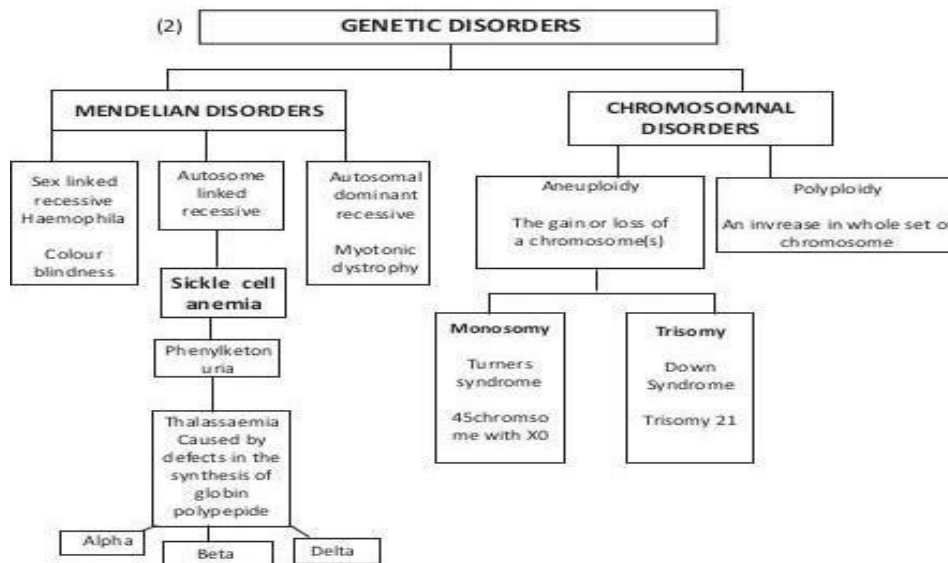
- * Caused due to presence of an additional copy of the chromosome number **21 (trisomy of 21)**.
- * This disorder was first described by **Langdon Down (1866)**.
 - o Short stature with small round head.
 - o Furrowed tongue
 - o Partially opened mouth
 - o Palm is broad with characteristic palm crease.
 - o Physical, psychomotor and mental development is retarded.

Klinefelter's syndrome:

- * Caused due to the presence of an additional copy of X-chromosome resulting into a karyotype of 47, ($44+XXY$).
- o Overall masculine development.
- o Also develop feminine character (development of breast i.e. Gynaecomastia)
- o Individuals are sterile.

Turner's syndrome:

- * Caused due to the absence of one of the X- chromosomes i.e. **45 ($44 + X0$)** * Such females are sterile as ovaries are rudimentary.
- * Lack of other secondary sexual characters.



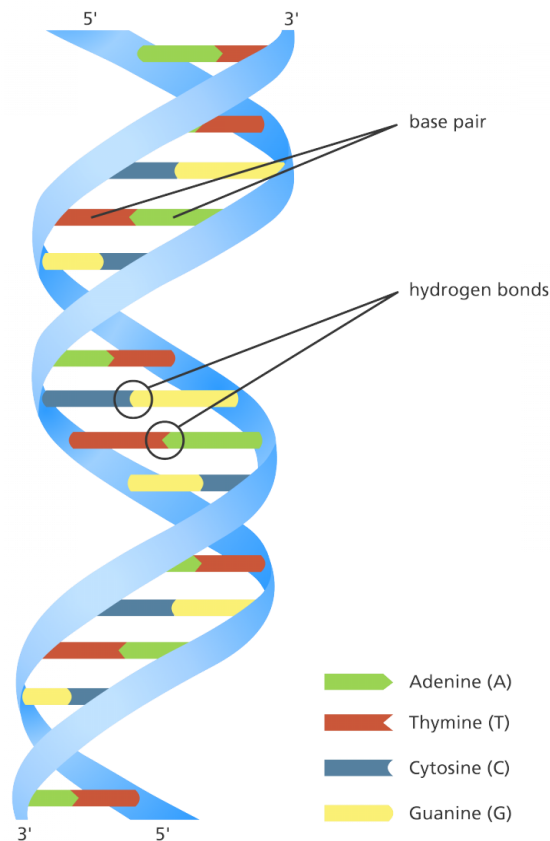
CHAPTER – 5

MOLECULAR BASIS OF INHERITANCE

THE DNA:

- DNA is a long polymer of deoxyribonucleotides.
- The length of the DNA depends on, number of nucleotide pair present in it. □
Characteristics of the depend on the length

organism
of the DNA.

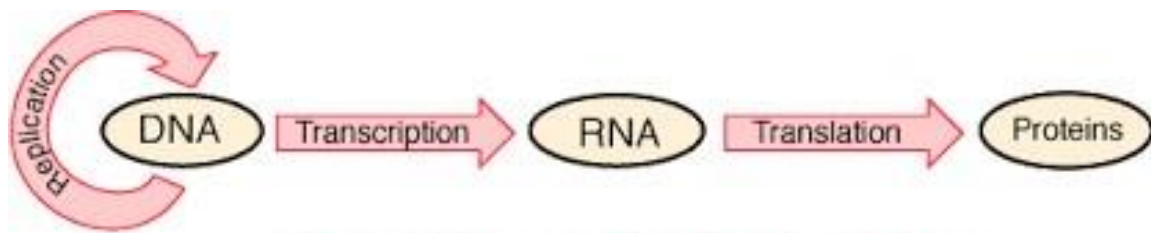


Structure of polynucleotide chain:

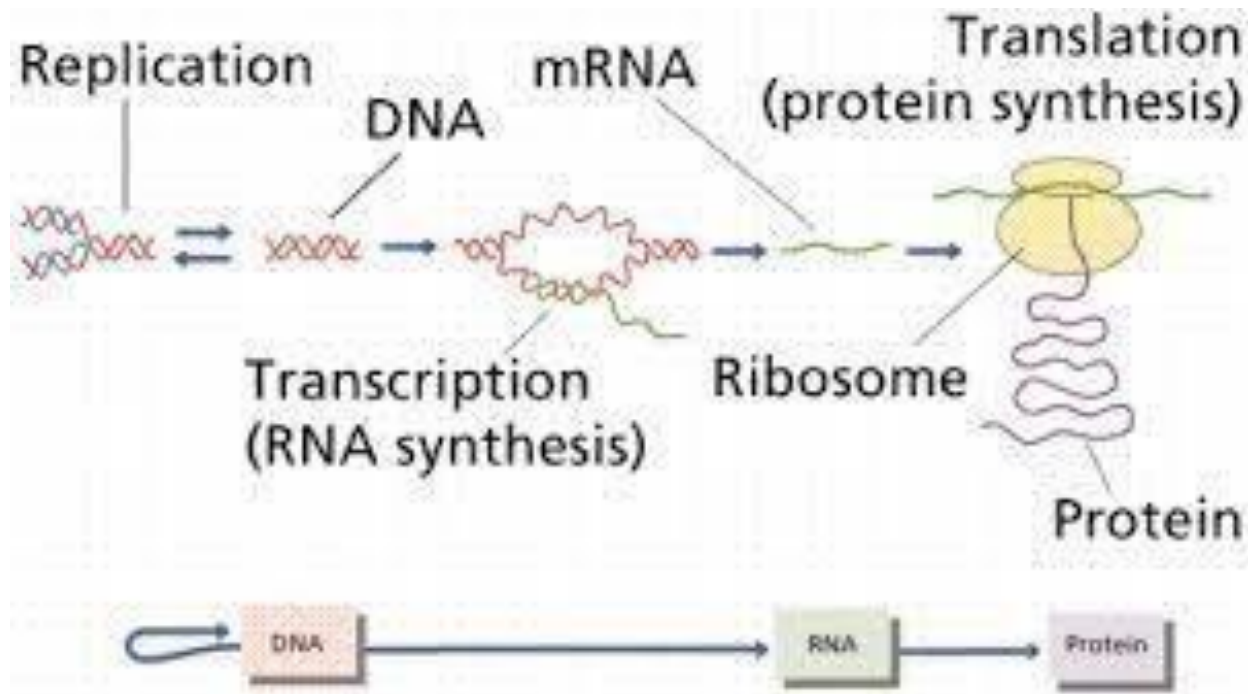
- * A nucleotide has three component:-
 - i) A nitrogen base
 - ii) A pentose sugar (ribose in RNA and deoxyribose in DNA)
 - ii) A phosphoric acid.
- * There are two types of nitrogen bases:
 - i) **Purines** (Adenine and Guanine)
 - ii) **Pyrimidines** (Cytosine, Uracil and Thymine)
- * Adenine, Guanine and Cytosine is common in RNA and DNA.
- * Uracil is present in RNA and Thymine is present in DNA in place of Uracil.
- * Pentose sugar is **ribose** in RNA and **Deoxyribose** in DNA.
- * A nitrogen base attached to the pentose sugar at C¹ of pentose sugar by **N-glycosidic** linkage to form a nucleoside.

- * Phosphoric acid attached to the nucleoside by **Phosphodiester linkage** a corresponding nucleotide is formed. (Ribonucleotide or deoxyribonucleotides depending on the sugar unit).
- * Two nucleotides are joined by 3'-5' Phosphodiester linkage to form dinucleotide.
- * More than two nucleotides joined to form polynucleotide chain.
- * The backbone of the polynucleotide chain is sugar and phosphate. * Nitrogen bases linked to the sugar (ribose or deoxyribose) * In RNA Uracil is found in place of thymine.

Central dogma of Molecular Biology: Flow of genetic information.

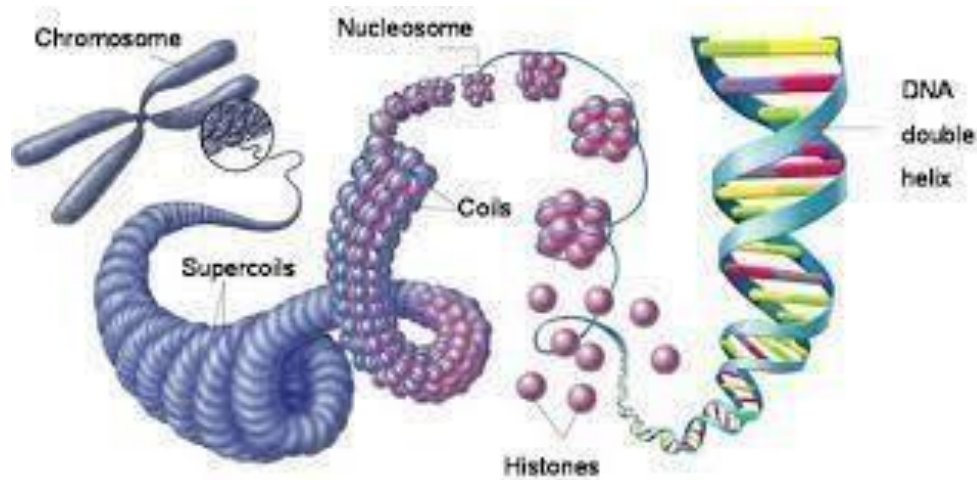


Central dogma of molecular biology



Packaging of DNA Helix:

Distance between two conjugative base pairs is 0.34nm, the length of the DNA in a typical mammalian cell will be 6.6×10^9 bp \times 0.34×10^{-9} /bp, it comes about 2.2 meters.



Packaging in prokaryotes:

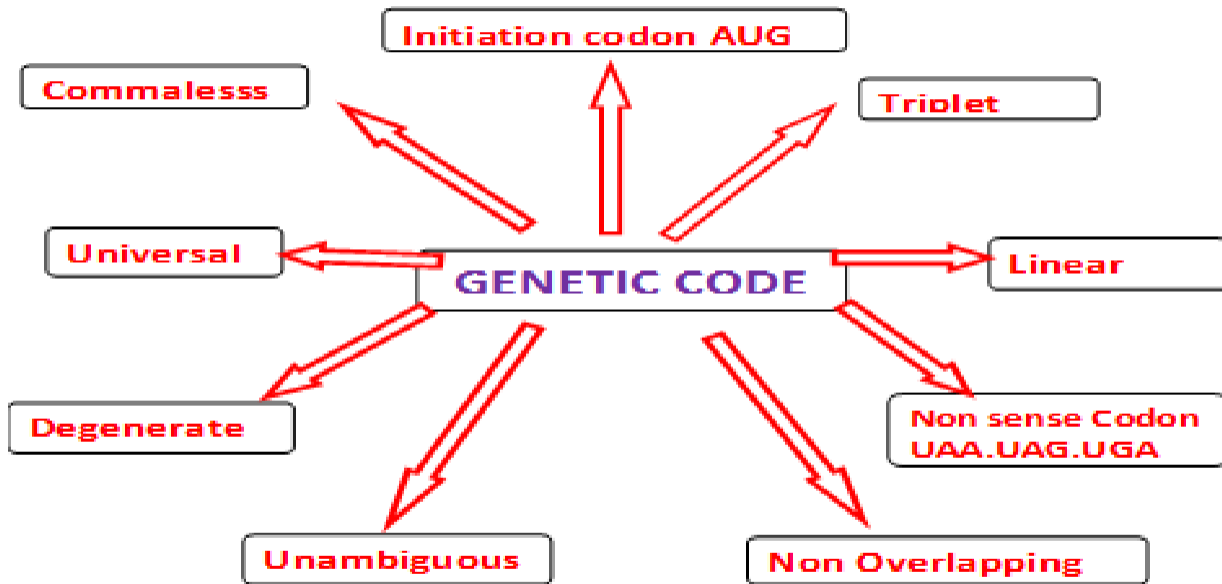
- * They do not have definite nucleus.
- * The DNA is not scattered throughout the cell.
- * DNA(negative) is held together with some proteins(positive) in a region is called 'nucleoid'. The DNA in nucleoid is organized in large loops held be proteins.

Packaging in Eukaryotes:

- * There is a set of positively charged, basic protein called **Histones**.
- * Histones are positively charged due to rich in basic amino acids like **Lysine** and **arginine**.
- * Histones are organized to form a unit of eight molecules called **histone octamer**.
- * Negatively charged DNA wrapped around positively charged histone octamer to form a structure called **nucleosome**.
- * The nucleosomes are seen as '**beads-on-string**' structure when viewed under electron microscope.
- * The chromatin is packaged to form **chromatin fibers** that are further coiled and condensed at metaphase stage to form **chromosome**.
- * Packaging at higher level required additional set of proteins called **Non-histone Chromosomal (NHC) proteins**.
- * In a typical nucleus some loosely coiled regions of chromatin (light stained) is called **euchromatin**.
- * The chromatin that more densely packed and stains dark are called **Heterochromatin**.
- * Euchromatin is **transcriptionally active** chromatin and heterochromatin is inactive.

GENETIC CODE- Salient Features:

CONCEPT MAP OF GENETIC CODE

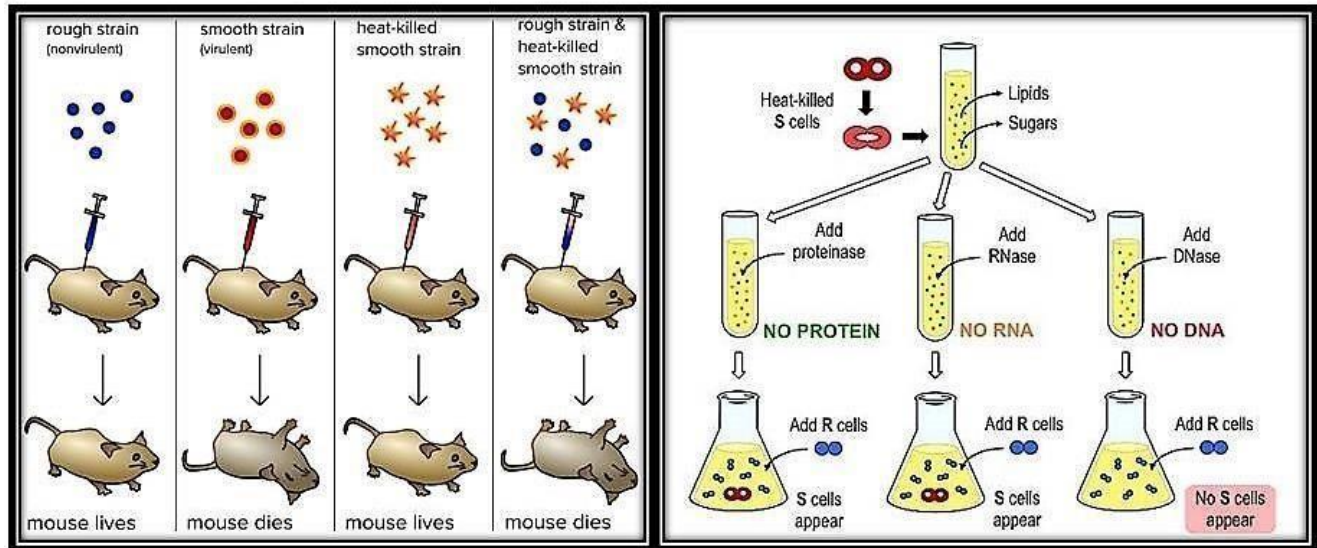


THE SEARCH OF GENETIC MATERIAL:

Transforming principle:

Experiment:

- * Given by **Frederick Griffith** in 1928.
- * His experiment based on *Streptococcus pneumoniae* (caused pneumonia).
- * There is change in physical form of bacteria.
- * There are two colonies of bacteria:
- * Smooth shiny colonies called **S strain**.
- * Rough colonies called **R strain**.



GRRIFITH'S EXPERIMENT

OSWALD AVERY'S EXPERIMENT

Conclusion of experiment:

- * R – Strain bacteria had somehow been **transformed** by the heat killed S-Strain bacteria.
- * Some '**transforming principle**', transferred from heat killed S-Strain bacteria, had enabled the R-Strain to synthesize smooth polysaccharide coat and become virulent (S Strain).
- * The transformation of R-Strain to S-Strain is due to transfer of **Genetic material**.
- * However the biochemical nature of genetic material was not defined from his experiment. * Protein of heat killed S-Strain is not the genetic material * RNA of heat killed S-Strain is not the genetic material.
- * DNA of heat killed S-Strain is the genetic material, because DNA digested with DNase mixed with R-strain unable to transform R-Strain to S-Strain.

Biochemical characterization of transforming principle:

- * Biochemical nature of transforming principle was discovered by **Oswald Avery, Colin Macleod and Maclyn McCarty**. (1933-44)
- * They purified biomolecules (proteins, DNA and RNA) from the heat killed S cells to see which one could transform live R cells to S cells.
- * Heat killed S-Strain + protease + Live R-Strain → transformation.
- * Heat killed S-Strain + RNase + Live R-Strain → transformation.
- * Heat killed S-Strain + DNase + Live R-Strain → transformation.

The Genetic Material is DNA:

- * 'DNA is the genetic material' is proved by **Alfred Hershey and Martha Chase** (1952).
- * They worked on the virus that infects bacteria called **bacteriophage**.
- * During normal infection the bacteriophage first attaches the bacteria cell wall and then inserts its genetic material into the bacterial cell.
- * The viral genetic material became integral part of the bacterial genome and subsequently manufactures more virus particle using host machinery.
- * Hershey and Chase worked to discover whether it was protein or DNA from the viruses that entered the bacteria.

Experiment : (Blenders experiment)

- * They grew some viruses on a medium having **radioactive phosphorus** and some others on medium having **radioactive sulfur**.
- * Viruses grown in **radioactive Phosphorus** have **radioactive DNA** but not radioactive protein because Phosphorus present in DNA not in protein.
- * Viruses grown in **radioactive sulfur** have **radioactive protein** not radioactive DNA because sulfur present in protein but not in DNA.
- * **Infection:** radioactive phages were allowed to attach to E.coli bacteria; the phages transfer the genetic material to the bacteria.
- * **Blending:** the viral coats were separated from the bacteria surface by agitating them in a blender.
- * **Centrifugation:** The virus particles were separated from the bacteria by spinning them in a centrifuge machine.

Observation:

- * Bacteria infected with viruses that had radioactive DNA were radioactive and no radioactivity in the supernatant.
- * Bacteria infected with viruses that had radioactive protein were not radioactive, but radioactivity found in the supernatant.

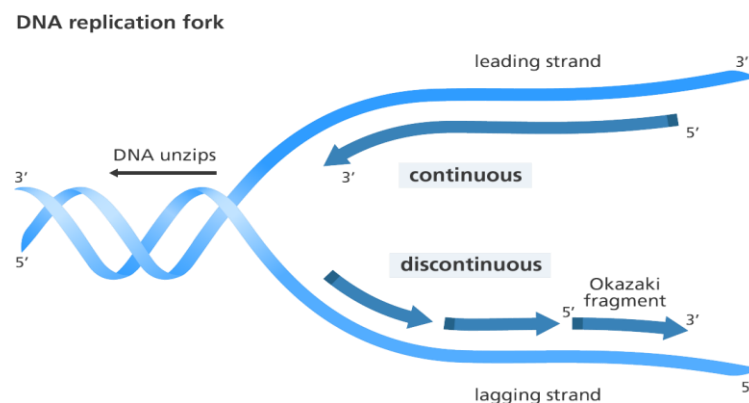
Conclusion of Experiment:

- * **DNA is the infecting agent that made the bacteria radioactive hence DNA is the genetic material not the protein.**

Harshey and chase Experiment: Link for the video <https://www.youtube.com/embed/i4511RslGwM>

REPLICATION: THE PROCESS:

- * **Watson and Crick** proposed a scheme for replication of DNA.
- * The Original statement that “It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material (Watson and Crick, 1953)
- * The scheme suggested that the two strands would separate and act as template for the synthesis of new complementary strands.
- * New DNA molecule must have one parental strand and one new strand.
- * This scheme of replication is called **Semiconservative** type of replication.



Experimental Proof of semiconservative nature of replication:

- * It is now proved experimentally that replication is semiconservative type.

- * It was first shown in *Escherichia coli* and subsequently in higher organism.
- * **Mathew Messelson** and **Franklin Stahl** performed the following experiment in 1958.

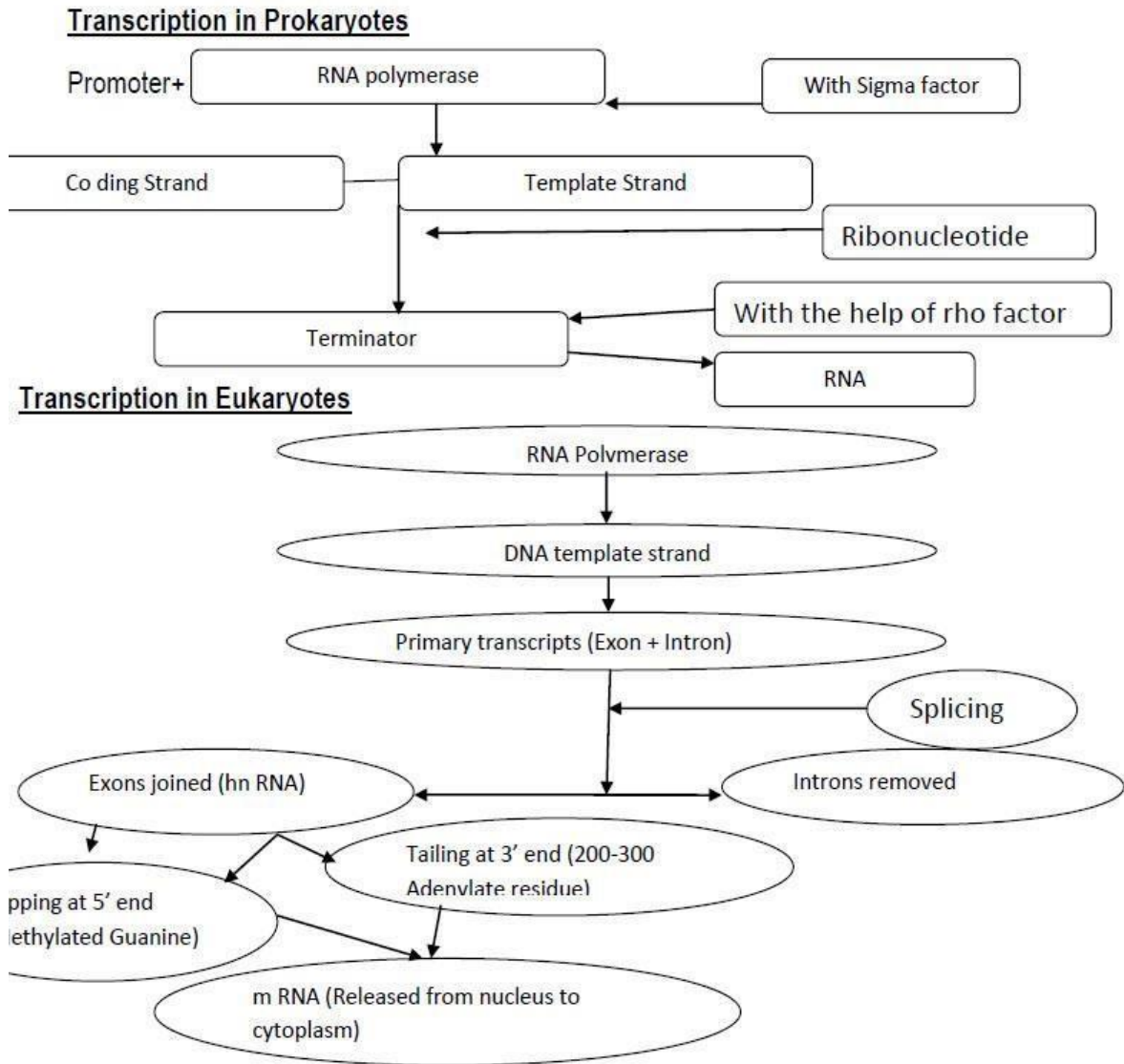
Link for Semiconservative mode of DNA replication video:

<https://www.youtube.com/embed/4gdWOWjioBE>

STEPS OF THE EXPERIMENTS:

- * They grew *E.coli* in $^{15}\text{NH}_4\text{Cl}$ medium for many generations. (^{15}N is heavy nitrogen not radioactive element)
- * The result was that ^{15}N was incorporated into newly synthesized DNA and other nitrogen containing compound as well.
- * This heavy DNA molecule could be distinguished from normal DNA by centrifugation in a cesium chloride (CsCl) density gradient.
- * Then they transferred the *E.coli* into a medium with normal $^{14}\text{NH}_4\text{Cl}$ and let them grow. (*E.coli* divides in 20 minutes)
- * They took samples at definite time intervals as the cells multiplied, and extracted the DNA that remained as double-stranded helices.
- * Various samples were separated independently on **CsCl gradients** to measure the densities of DNA.
- * The DNA that was extracted from the culture one generation after the transfer from ^{15}N to ^{14}N medium had a **hybrid** or **intermediate density**.
- * DNA extracted from the culture after another generation (after 40 min.) was composed of equal amount of this hybrid DNA and of 'light' DNA. **Experiment by Taylor and colleagues:**
- * Used **radioactive thymidine** to detect distribution of newly synthesized DNA in the chromosomes.
- * They performed the experiment on *Vicia faba* (faba beans) in 1958.
- * They proved the semiconservative nature of DNA replication in eukaryotes.

TRANSCRIPTION:

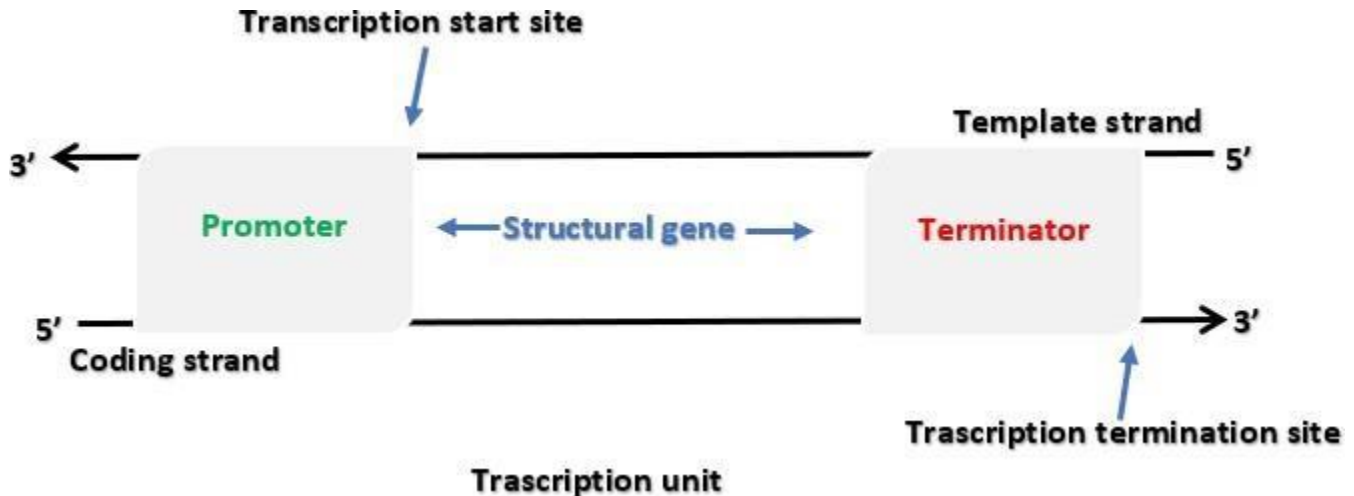


‘The process of copying genetic information from one strand of the DNA into RNA is termed as transcription’.

Transcription vs. Replication:

- * Principle of **complementarity** governs the process of transcription except Adenosine of DNA forms base pair with the **Uracil** instead of thymine. During replication Adenine pairs with **thymine** instead of uracil.
- * During replication once started the **whole DNA** is duplicated, whereas transcription takes place only a **segment of DNA**.
- * In replication **both strand** acts as template, where as in transcription only **one strand** is acts as template to synthesize RNA.
- * In replication **DNA copied** from a DNA, where as in transcription **RNA copied** from the DNA.
- * Only one strand is acting as template for transcription. If both strand of DNA acts as template, they would code for RNA molecule with different sequences and in turn if they code for proteins, the sequence of amino acids in the protein would be different. Hence one segment of DNA would be coding for two different proteins.
- * The two RNA molecules if produced from simultaneously would be complementary to each other, hence will form double stranded RNA. This would prevent RNA translation into protein. **Transcription unit:**

- * A transcription unit in DNA consists of three regions:
- * A promoter * The structural gene * A terminator.
- * **DNA dependent RNA polymerase** catalyses the polymerization in only one direction that is 5'→3'.



Process of transcription: prokaryotes.

There is a single **DNA dependent RNA polymerase** that catalyses transcription or synthesis of all three types of RNAs in prokaryotes. The process of transcription completed in three steps: **Initiation, Elongation and Termination.**

There are **three** different types of RNA polymerases in eukaryotes.

- RNA polymerase I** transcribes **rRNA (28S, 18S, and 5.8S)**
 - RNA polymerase II** transcribes **heterogeneous nuclear RNA (hnRNA).**
 - RNA polymerase III** transcribes **tRNA, 5srRNA and snRNA.**
- **Post transcriptional processing: (occurs inside the nucleus)**

(a) Splicing:

Primary transcript (**hn RNA**) consists of both **exons** (coding) and **introns** (non coding) and required to be processed before translation. Therefore the introns are removed and exons are joined in a defined order. This process is called splicing. This is catalyzed by **SnRNP**, introns removed as **spliceosome**.

(b) Capping: An unusual nucleotide called **methyl guanosine triphosphate** is added to the 5' end of hnRNA.

(c) Tailing: Adenylate residues (200-300) are added at 3' end of hnRNA in a template independent manner. The processed hnRNA is now called mRNA and transported out of the nucleus for translation.

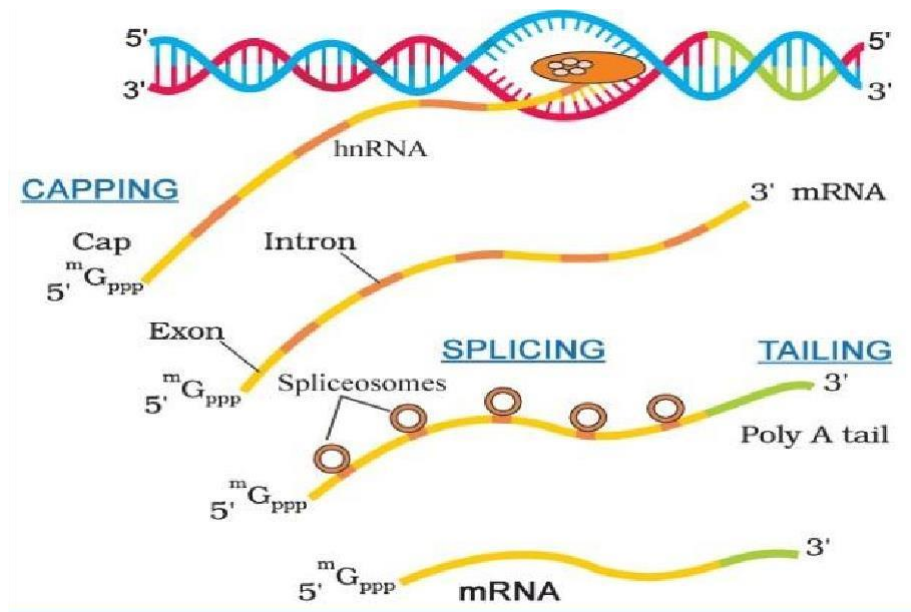


Fig. Transcription in eukaryotes

tRNA-the Adaptor molecule:

- * The tRNA is called sRNA (soluble RNA) * It acts as an adapter molecule. Reads the code on one end and binds to specific amino acid at the other end.
- * tRNA has an **anticodon loop** that base complementary to the codon.
- * It has an **amino acid acceptor end** to which it binds with amino acid.
- * Each tRNA bind with specific amino acid i.e 61 types of tRNA found.
- * One specific tRNA with anticodon UAC called **initiator tRNA**.
- * **There is no tRNA for stop codons. (UAA, UGA, UAG)** * The secondary structure is like clover-leaf.
- * The actual structure of tRNA is compact, looks like inverted 'L'.

Link for Transcription, Translation - From DNA to Protein- Video

<https://www.youtube.com/embed/gG7uCskUOrA>

Link for PPT- From DNA to Protein-

https://docs.google.com/presentation/d/19-d119DyY1VE5q0rjDVPDSR7uvWeK3n9/edit?usp=share_link&oid=107171444976724466844&rtpof=true&sd=true

TRANSLATION:

- * It refers to polymerization of amino acids to form a polypeptide.
- * The number and sequence of amino acids are defined by the sequence of bases in the mRNA.
- * The amino acids are joined by **peptide bond**.
- * Amino acids are activated in the presence of ATP and linked to their specific tRNA is called **charging of tRNA** or **aminoacylation of tRNA**.
- * Ribosome is the cellular factory for protein synthesis.
- * Ribosome consists of structural rRNA and 80 different proteins.
- * In inactive state ribosome(70S) present in two subunits:- * Large sub unit 50S and small sub unit 30S

Initiation:

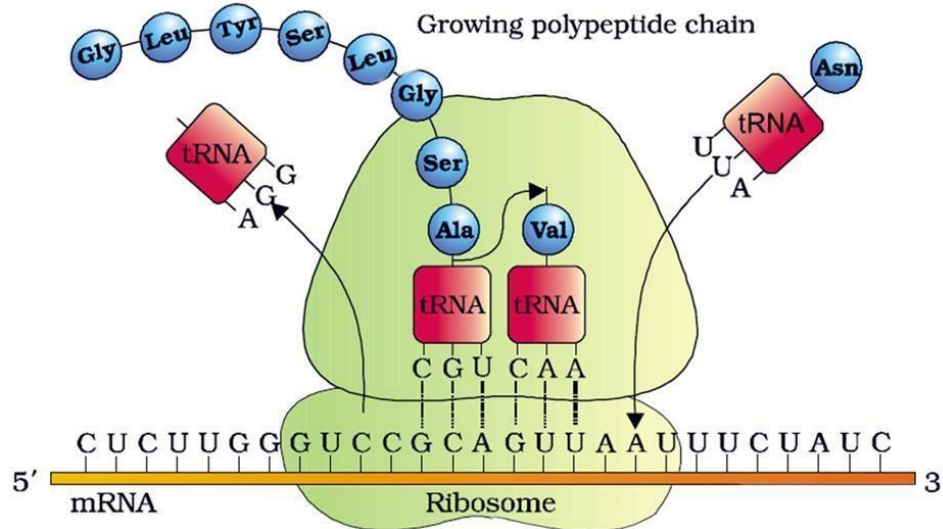
- The process of translation or protein synthesis begins with attachment of mRNA with small subunit of ribosome.
- The ribosome binds to the mRNA at the start codon (AUG). □ AUG is recognized by the initiator tRNA.

Elongation:

- Larger subunit attached with the initiation complex.
- Larger subunit has two site 'A' site and 'P' site.
- Initiator tRNA accommodated in 'P' site of large subunit, the subsequent amino-acyl-tRNA enters into the 'A' site.
- The subsequent tRNA selected according to the codon of the mRNA.
- Codon of mRNA and anticodon of tRNA are complementary to each other.
- Formation of peptide bond between two amino acids of 'P' and 'A' site, catalyzed by **ribozyme**, (23S rRNA in bacteria)
- The moves from codon to codon along the mRNA called **translocation**.

Termination:

- Elongation continues until a stop codon arrives at 'P' site.
- There is no tRNA for stop codon.
- A **release factor** binds to the stop codon.
- Further shifting of ribosome leads to separation of polypeptide.
- An mRNA also has some additional sequences that are not translated called **untranslated regions (UTR)**.



Link for Transcription, Translation - From DNA to Protein- Video

<https://www.youtube.com/embed/gG7uCskUOrA>

Link for PPT- From DNA to Protein-

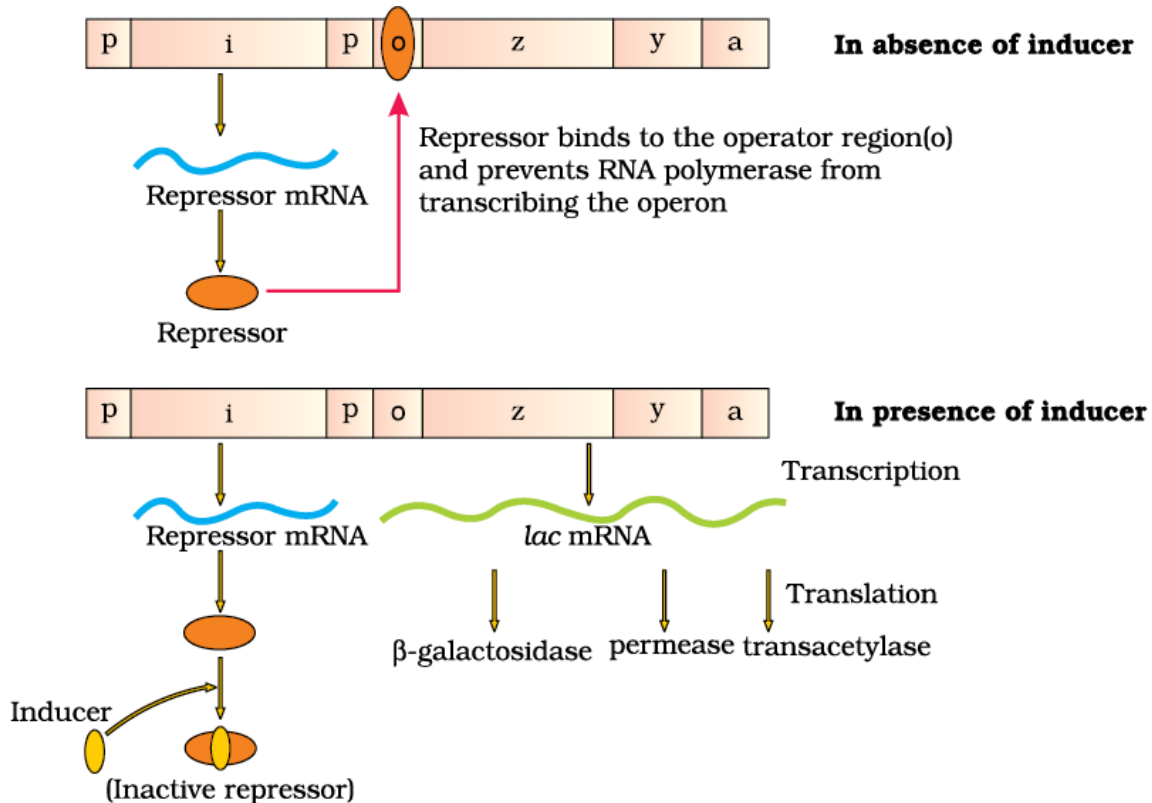
https://docs.google.com/presentation/d/19-d1I9DyY1VE5q0rjDVPDSR7uvWeK3n9/edit?usp=share_link&oid=107171444976724466844&rtpof=true&sd=true

REGULATION OF GENE EXPRESSION:

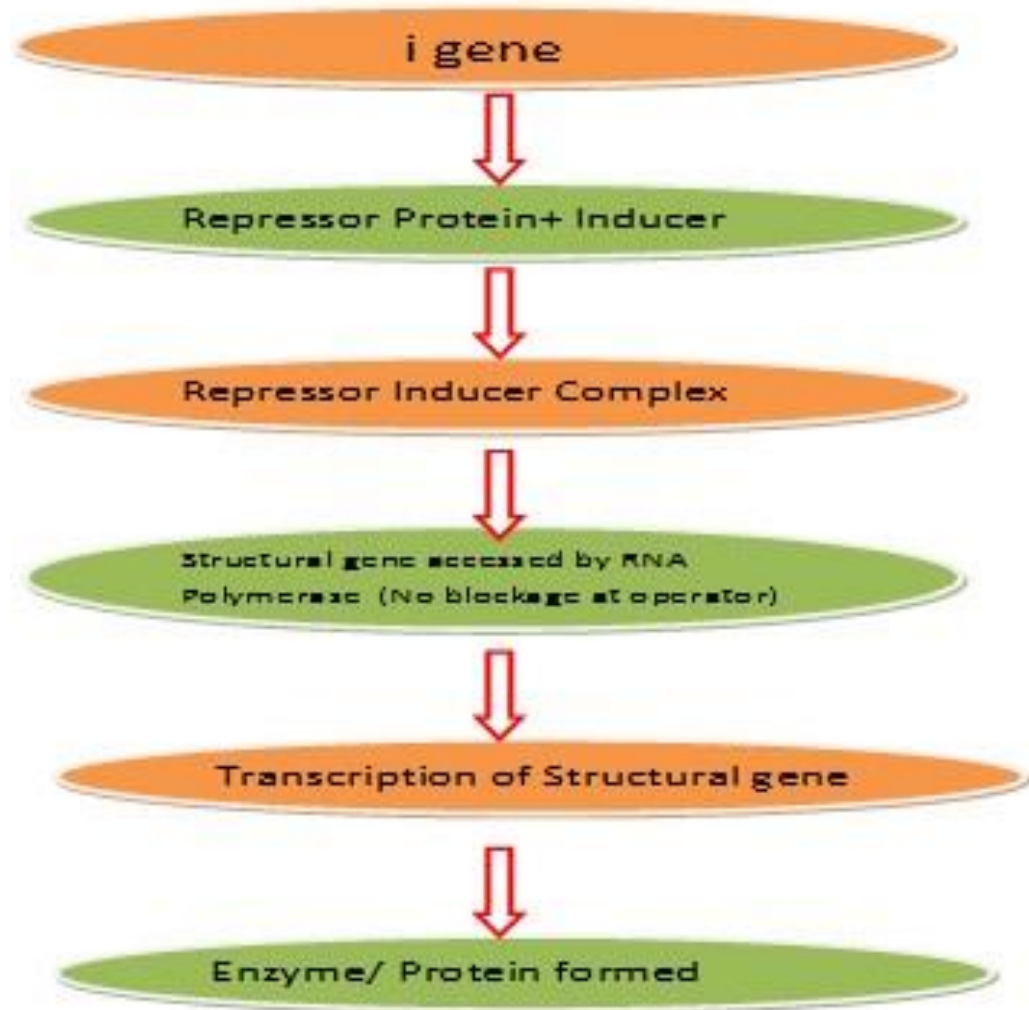
- Regulation of gene expression in eukaryotes takes place in different level:
- Transcriptional level (formation of primary transcript)
- Processing level (regulation of splicing)
- Transport of mRNA from nucleus to the cytoplasm.
- Translational level.
- In prokaryotes control of rate of transcriptional initiation is the predominant site for control of gene expression.
- The activity of RNA polymerase at the promoter is regulated by accessory proteins, which affects its ability to recognize the start site.
- The regulatory proteins can acts both positively (activators) or negatively (repressor)
- The regulatory proteins interact with specific region of DNA called **operator**, which regulate the accessibility of RNA polymerase to promoter.

Lac operon:

- **Francois Jacob and Jacques Monod** first to describe a transcriptionally regulated system of gene expression.
- A polycistronic structural gene is regulated by common promoter and regulatory genes. Such regulation system is common in bacteria and is called **operon**.
- Lac operon consists of:-
 - One regulator gene (i-gene)
 - Three structural genes (z,y,a)
 - Operator. (binding site of repressor protein)
 - Promoter.(binding site of the RNA polymerase)

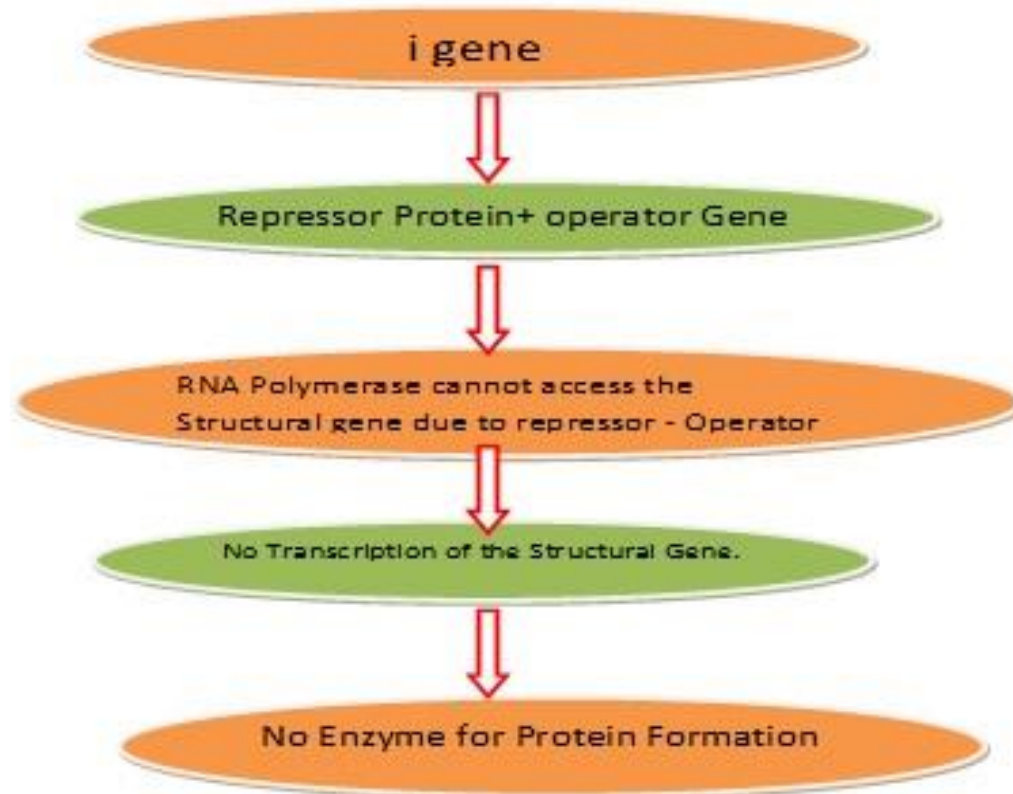


CONCEPT MAP OF LAC OPERON
SWITCH ON CONDITION



CONCEPT MAP OF LAC OPERON

SWITCH OFF CONDITION



HUMAN GENOMIC PROJECT:

- Genetic make-up of an organism or an individual lies in the DNA sequences.
- Two individual differs in their DNA sequences at least in some places.
- Finding out the complete DNA sequence of human genome. □ Sequencing human genome was launched in 1990.

Goals of HGP:

- Identify all the approximately 20,000 – 25,000 genes in human DNA.
- Determine the sequence of all 3 billion chemical base pairs.
- Store this information in data bases.
- Improve tools for data analysis.
- Transfer related technologies to other sectors, such as industries.

Address the ethical, legal, and social issues (ELSI) that may arise from the project.

Methodology:

- To identify all the genes that expressed as RNA referred as **Expressed Sequence Tags (ESTs)**.
- Simply sequencing the whole set of genome that contained all the coding and non-coding sequence, and later assigning different regions in the sequence with functions called **Sequence Annotation**.
- The commonly used hosts for sequencing were bacteria and yeast and vectors were called as **BAC** (bacterial artificial chromosome) and **YAC** (yeast artificial chromosome).

SALIENT FEATURES:

- Largest human gene – dystrophin (2.4 million bases).
- 99% nucleotide bases are exactly same in all people.
- More than 50% genes functions are unknown
- Less than 2% of genome codes for protein.
- Chromosome 1 has most number of genes (2968), y has fewest genes(231)
- 1.4 million locations where single base nucleotide differences (snips) occur in humans

DNA FINGER PRINTING:

- DNA finger printing is a very quick way to compare the DNA sequences of any two individuals.
- DNA fingerprinting involves **identifying differences in some specific regions in DNA** called **repetitive DNA**, because in these sequences, a small stretch of DNA is repeated many times.
- During centrifugation the bulk DNA forms major peak and the other **small peaks** are called **satellite DNA**.
- Depending on base composition (A:T rich or G:C rich), length of segment, and number of repetitive units, the satellite DNA classified into many types, such as mini –satellite and micro – satellite.
- These sequences dose not code for any proteins.
- These sequences show high degree of polymorphism and form basis of DNA fingerprinting.
- Polymorphism in DNA sequence is the basis of genetic mapping of human genome as well as of DNA fingerprinting.
- **Polymorphism** (variation at genetic level) arises due to mutations.
- If an inheritable mutation is observed in a population at high frequency it is referred as **DNA polymorphism**.

The process:

- DNA fingerprinting was initially developed by **Alec Jeffreys**.
- He used satellite DNA as the basis of DNA fingerprinting that shows very high degree of polymorphism. It was called as **Variable Number Tandem Repeats.(VNTR)**
- **Different steps of DNA fingerprinting are:-**
 - **Isolation of DNA.**
 - **Digestion of DNA by restriction endonucleases.**
 - **Separation of DNA fragments by gel electrophoresis.**
 - **Transferring (blotting) of separated DNA fragments to synthetic membranes, such as nitrocellulose or nylon.**
- **Double stranded DNA made single stranded.**
- **Hybridization using labeled VNTR probe.**
- **Detection of hybridized DNA fragments by autoradiography.**
 - The VNTR belongs to a class of satellite DNA referred to as mini-satellite.
 - The size of VNTR varies from 0.1 to 20 kb.
 - After hybridization with VNTR probe the autoradiogram gives many bands of different sizes. These bands give a characteristic pattern for an individual DNA. It differs from individual to individual.
 - The DNA from a single cell is enough to perform DNA fingerprinting.

Applications:

- Test of paternity.
- Identify the criminals.
- Population diversity determination.
- Determination of genetic diversity.

Chapter 6- EVOLUTION

Evolution is a process that results in heritable changes in population spread over many generations leading to diversity of organisms on earth.

ORIGIN OF LIFE:

The Big Bang theory:

The Big Bang theory states that a huge explosion occurred, the universe expanded, temperature came down and hydrogen and helium were formed later. The galaxies were then formed due to condensation of gases under gravitation. A singular huge explosion unimaginable in physical term. In the solar system of the Milky Way galaxy, earth was supposed to have been formed about 4.5 billion years back.

Conditions prevailed in the primitive atmosphere:

- * There was no atmosphere on primitive earth.
- * Water vapor, methane, carbon dioxide and ammonia released from molten mass covered the surface.
- * The UV rays from the sun broke up water into Hydrogen and oxygen and lighter H₂ escaped. * Oxygen combined with ammonia and methane to form water, CO₂ and others.
- * The ozone layer was formed.
- * As it cooled, the water vapor fell as rain, to fill all the depressions and form oceans. * Life appeared 500 Million years after the formation of earth.

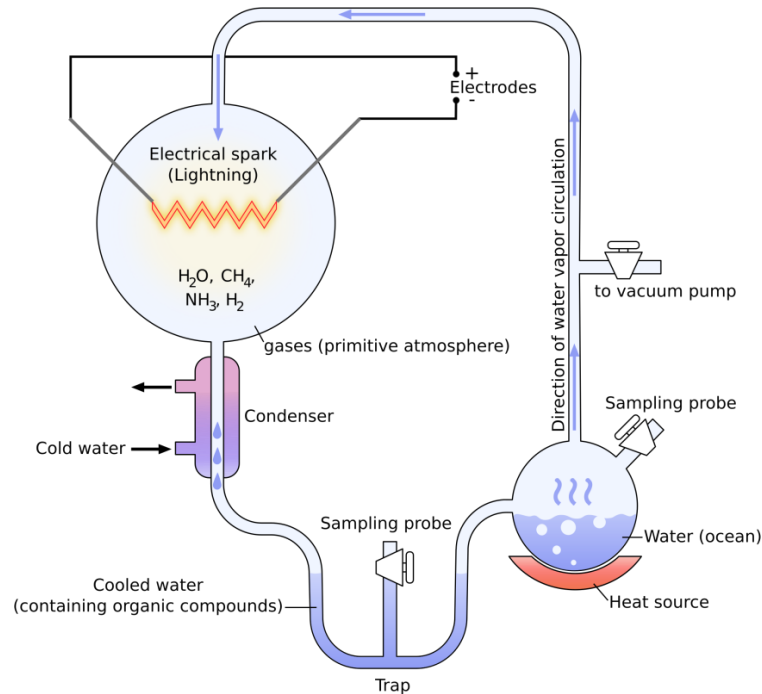
Theories of Origin of life:

- (i) Theory of special creation states that God created life by his divine act of creation.
- (ii) Theory of panspermia/cosmozoic theory, given by early Greek thinkers states that the spores or panspermia came from outer space and developed into living forms.
- (iii) Theory of spontaneous generation states that life originated from decaying and rotting matter like straw, mud, etc. (a) Louis Pasteur rejected the theory of spontaneous generation and demonstrated that life came from pre-existing life. (b) In his experiment, he kept killed yeast cells in pre-sterilised flask and another flask open into air. The life did not evolved in the former but new living organisms evolved in the second flask.
- (iv) Theory of chemical evolution or Oparin-Haldane theory states that life originated from pre-existing non-living organic molecules and that formation of life was preceded by chemical evolution. The conditions on the earth that favoured chemical evolution were very high temperature, volcanic storms and reducing atmosphere that contained CH₄, NH₃, water vapour, etc. **Urey and Miller experiment:**

In 1953, S.L. Miller an American Scientist created similar primitive earth conditions in a laboratory and simulated the primitive earth.

- * **The conditions created for simulating the primitive earth were** - High temperature, Volcanic storms and Reducing atmosphere containing CH₄, NH₃ etc.
- * He created **electric discharge** in a closed flask to raise temperature upto 800oC as it was in primitive earth.
- * Used CH₄ H₂, NH₃ and water vapor inside the flask.
- * He observed the formation of **amino acids**.

- * Miller observed the synthesis of amino acids from simple inorganic chemicals in simulated condition in the laboratory.
- * In similar experiments others observed, formation of sugars, nitrogen bases, pigment and fats.
- * Analysis of meteorite content also revealed similar compounds indicating that similar processes are occurring elsewhere in space.



Theory of biogenesis:

- * The first non-cellular forms of life could have originated 3 billion years back.
- * They would have been giant molecules (RNA, proteins, Polysaccharides, etc).
- * These capsules reproduced their molecules perhaps, named as **coacervates**.
- * The first cellular form of life did not possibly originate till about 2000 million years ago.
- * The first cellular forms of life were probably unicellular.
- * All life forms were in water environment only.
- * This theory of **biogenesis** from **non-living molecules** was accepted by majority.

EVOLUTION OF LIFE FORMS – A THEORY:

- Conventional religious literature tells us about the **theory of special creation**.

The theory of special creation has three connotations: -

- All the living organisms (species types) that we see today were created as such.
- The diversity was always the same since creation and will be same in future.
- Earth is about 4000 years old.

Challenge to special creation theory:

- Observation made during a sea voyage in a sail ship called H.M.S. Beagle round the world. Charles Darwin concluded that existing life forms share similarities to varying degrees not only among themselves but also with life forms that millions of years ago.
- Many such life forms exist anymore. There had been extinctions of different life forms in the years gone by just as new forms of life arose at different periods of history of earth.
- There has been gradual evolution of life forms.
- Any population has built in variation in characteristics.

- Those characteristics which enable some to survive better in natural conditions (climate, food, physical factors, etc) would outbreed others that are less-endowed to survive under such natural condition.
- Survival of the fittest. The fitness according to Darwin refers ultimately and only leaves more progeny than others.
- These, therefore, will survive more and hence are selected by nature. He called it as **natural selection**.
- **Alfred Wallace**, a naturalist who worked in **Malay Archipelago** had also come to similar conclusions around the same time.

The geological history of earth closely correlates with the biological history of earth.\

EVIDENCES FOR EVOLUTION

Paleontological evidence:

- * Fossils are remained of hard parts of life-forms found in rocks.
- * Different-aged rock sediments contain fossils of different life-forms who probably died during the formation of the particular sediment.
- * They represent the extinct organisms (e.g. Dinosaurs).
- * A study of fossils in different sedimentary layers indicates the geological period in which they existed.
- * The study showed that life-forms varied over time and certain life forms are restricted to certain geological time-span.
- * Hence new lives have arisen at different times in the history of earth. * All this called **Paleontological evidence**.

Comparative anatomy and morphological evidence:

- * Comparative anatomy and morphology shows similarities and differences among organisms of today and those that existed years ago.

Divergent evolution:

- * Whale, bats, cheetah and human share similarities in the pattern of bones of forelimbs.
- * These forelimbs perform different functions in these animals, they have similar anatomical structure – all of them have humerus, radius, ulna, carpals, metacarpals and phalanges in their forelimbs.
- * Hence in these animals, the same structure developed along different directions due to adaptation to different needs.
- * This is **divergent evolution** and these structures are **homologous**.
- * Homology indicates common ancestry.
- * Other examples of homologous organ are vertebrate hearts and brains.
- * **Thorn of Bougainvillea** and **tendrils of Cucurbit** represent homology.

Convergent evolution:

- * Wings of butterfly and of birds look alike.
- * They are anatomically similar structure though they perform **similar function**.
- * Hence **analogous** structures are a result of **convergent evolution**.
- * **Eye of octopus and eye of mammals**.
- * **Flippers of Penguins and Dolphins**.
- * **Sweet potato (root modification) and potato (stem modification)**.

Biochemical evidences:

- * Similarities in proteins and genes performing a given function among diverse organisms give clues to common ancestry.

Embryological support for evolution:

- * Proposed by **Ernst Haeckel** based upon observation of certain features during embryonic stage common to all vertebrates that are absent in adult.

- * The embryos of all vertebrates including human develop a row of vestigial gill slits just behind the head but it is a functional organ only in fish and not found in any other adult vertebrates.
- * This is **disproved** on careful study performed by **Karl Ernst von Baer**. He noted that embryos never pass through the adult stages of other animals.

Evolution by natural selection:

- * Based on observation of moth population in England made in 1850.
- * Before industrialization set in, it was observed that there were more white-winged moths on trees than dark-winged or melanised moths.
- * After industrialization i.e. 1920 there were more dark-winged moths in the same area i.e. the proportion was reversed.

Evolution by anthropogenic action:

- * Excess use of herbicides, pesticides etc., has only resulted in selection of resistant varieties in a much lesser time scale.
- * This is also true for microbes against which we employ antibiotics or drugs against eukaryotic organisms/cell.
- * Hence resistance organisms/cells are appearing in a time scale of months or years and not in centuries.
- * These are the examples of evolution by **anthropogenic action**.
- * **Evolution is a stochastic process based on chance events in nature and chance mutation in the organisms.**

ADAPTIVE RADIATION

Darwin's Finches:

Link for the Video of Adaptive Radiation:

<https://www.youtube.com/embed/rMCP2n7VXH8>



- * In Galapagos Islands Darwin observed small black birds later called Darwin's Finches.
- * He realized that there were many varieties of finches in the same island.
- * All the varieties, he came across, evolved on the island itself.
- * From the original seed-eating features, many other forms with altered beaks arose, enabling them to become insectivorous and vegetarian finches
- * This process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called **adaptive radiation**.

Australian marsupial:

- * A number of marsupials each different from the other evolved from an ancestral stock. But all within the Australian island continent.
- * When more than one adaptive radiation appeared to have occurred in an isolated geographical area (representing different habitats), one can call this **convergent evolution**.
- * **Placental mammals** in Australia also exhibit adaptive radiation in evolving into varieties of such placental mammals each of which appears to be 'similar' to a corresponding **marsupial** (e.g. placental wolf and Tasmanian wolf-marsupial).

BIOLOGICAL EVOLUTION:

- * The essence of Darwinian Theory about evolution is natural selection.
- * The rate of appearance of new forms is linked to the life cycle or the life span.
- * There must be a genetic basis for getting selected and to evolve.
- * Some organisms are better adapted to survive in an otherwise hostile environment.
- * Adaptive ability is inherited.
- * It has genetic basis.
- * Fitness is the end result of the ability to adapt and get selected by nature.
- * **Branching descent and natural selection are the two key concepts of Darwinian Theory of Evolution.**

Lamarck theory of evolution: (theory of inheritance of acquired characters)

- * French Naturalist Lamarck had said that evolution of life forms had occurred but driven by use and disuse of organs.
- * He gave the example of Giraffes who in an attempt to forage leaves on tall trees had to adapt by elongation of their necks.
- * They passed on this acquired character of elongated neck to succeeding generations. * Giraffes, slowly over the years, came to acquire long necks.

MECHANISM OF EVOLUTION:

- * In the first decade of twentieth century, **Hugo De Vries** based on his work on **evening primrose** brought forth the idea of **mutations**.
- * Mutation is the large difference arising suddenly in a population.

How De Vries theory of mutation differs from Darwin's theory of natural selection?

- * It is the mutation which causes evolution and not the minor variations that Darwin talked about.
- * Mutations are random and directionless while Darwinian variations are small and directional.
- * Evolution for Darwin was gradual while De Vries believed mutation caused speciation and hence called it **saltation** (single step large mutation).

HARDY – WEINBERG PRINCIPLE:

- * In a given population one can find out the frequency of occurrence of alleles of a gene on a locus.
- * This frequency is supposed to remain fixed and even remain the same through generations.
- * Hardy-Weinberg principle stated it using algebraic equations.
- * The principle states that allele frequencies in a population are stable and is constant from generation to generation.
- * The gene pool (total genes and their alleles in a population) remains a constant. This is called **genetic equilibrium**:
- * Sum total of all the allelic frequencies is 1.
- * $(p + q)^2 = p^2 + 2pq + q^2 = 1$.
- * When frequency measured, differs from expected values, the difference (direction) indicates the extent of evolutionary change.

* Disturbance in genetic equilibrium, or i.e. change of frequency of alleles in a population would then be interpreted as resulting in evolution.

* Five factors are known to affect Hardy-Weinberg equilibrium:

i) Gene migration or gene flow.

ii) Genetic drift. iii) Mutation. iv)

Genetic recombination. v) Natural selection.

* **Gene migration:** When migrations of a section of population to another place occur, gene frequencies change in the original as well as in the new population. New genes /alleles are added to the new population and these are lost from the old population.

* **Gene flow:** Gene migration occurs many time is termed as gene flow.

* **Genetic drift:** change in gene frequency takes place by chance.

* **Founder effect:** sometimes the change in allelic frequency is so different in the new sample of population that they became a different species. The original drifted population becomes **founder species** and the effect is called **founder effect**.

Operation of natural selection on different trait:

□ Natural selection can lead to:

○ **Stabilization:** in which more individuals acquire mean character value.

○ **Directional changes** i.e. more individuals acquire value other than the mean character value.

○ **Disruption:** more individuals acquire peripheral character value at both ends of the distribution curve.

ORIGIN AND EVOLUTION OF MAN:

* About 15 mya primates called *Dryopithecus* and *Ramapithecus* were existing.

* They were hairy and walked like gorillas and chimpanzees.

* *Ramapithecus* was more **man like** while *Dryopithecus* was more **ape-like**.

* Few fossils of man-like bones have been discovered in Ethiopia and Tanzania.

* Two mya *Australopithecines* probably lived in East African grasslands.

* The first human-like being the hominid and was called *Homo habilis*.

* Fossils discovered in Java in 1891 revealed the next stage i.e. *Homo erectus* about 1.5 mya.

* **Neanderthal man:**

* *Homo sapiens:* Arose in Africa and moved across continents and developed distinct races.

Evolution video: <https://www.youtube.com/embed/RTX9si5RBb0>

Chapter 8 - HUMAN HEALTH AND DISEASE

HEALTH: - Health is defined as the state of complete physical, mental and social wellbeing.

DISEASE: - Disease is the condition when the functioning of one or more organs or systems of the body is / are adversely affected

* Factors important to maintain good health:-

Good Health can be attained by the following: - *

Balanced Diet

* Personal Hygiene

* Regular Exercise

* Good Habit

* Awareness about diseases

* Vaccination

* Proper waste disposal

* Control of vectors

* Consumption of hygienic (clean) food and water **Types of Diseases**

SL	COMMUNICABLE/INFECTIOUS DISEASES	NON COMMUNICABLE / NON INFECTIOUS DISEASES
1	These are the diseases that are easily transferred from diseased to a healthy person	These are the diseases that are not transferred from diseased to a healthy person
2	They are caused by pathogens eg. Bacteria, Viruses, Fungi, Helminthes , Protozoa etc	They are caused due to genetic factors, nutritional deficiencies, unhealthy life styles etc.

Some common Infectious Diseases:

* BACTERIAL DISEASES: - Pneumonia, T.B. , Cholera , Typhoid etc.

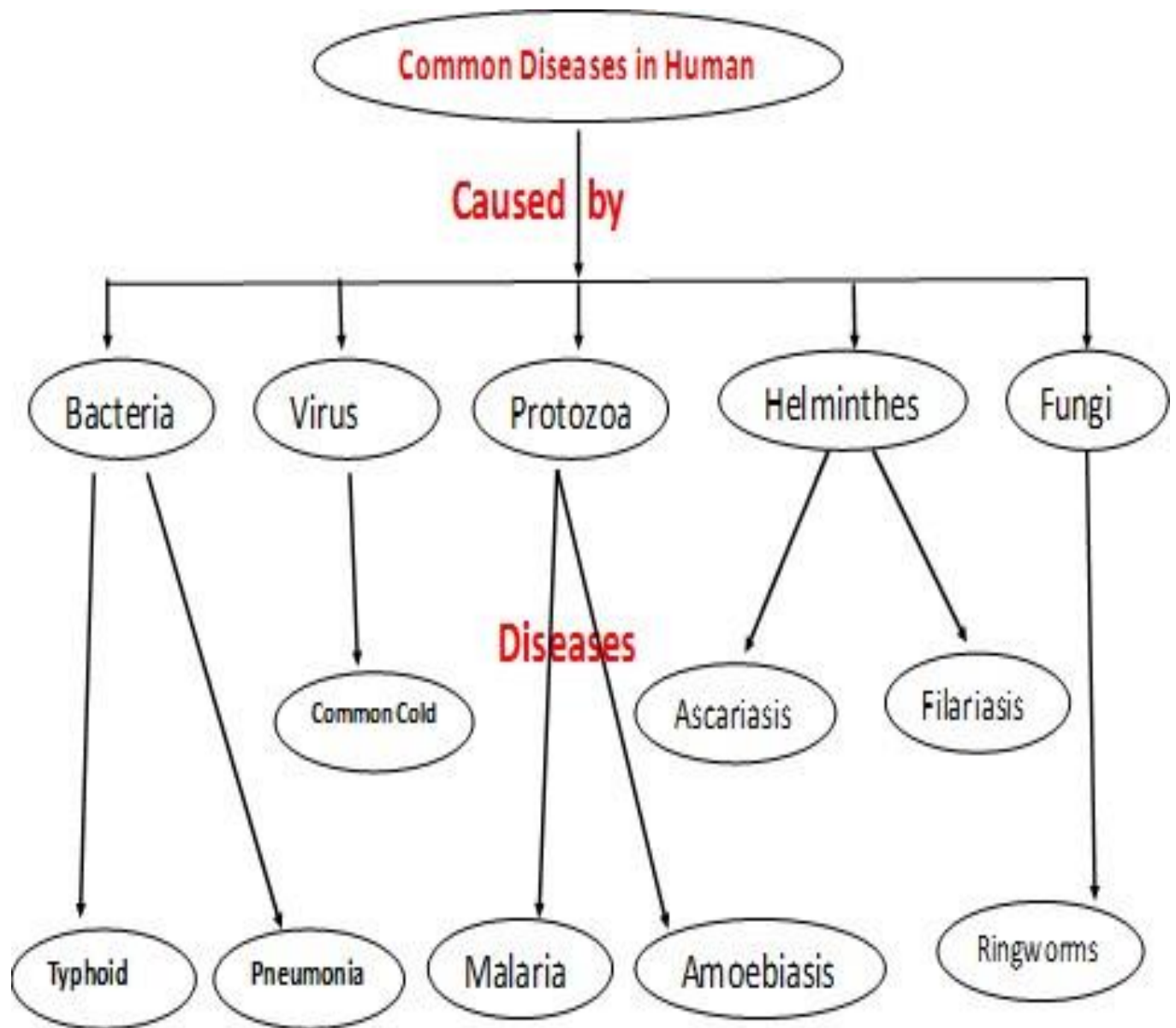
* VIRAL DISEASES :- Common Cold, AIDS , Chikungunya , Dengue,

Hepatitis, Polio, Measles

* FUNGAL DISEASES :- Ring worm

* PROTOZOAL DISEASES :- Amoebiasis , Malaria

* HELMINTHIC DISEASES :- Ascariasis , Filariasis , Taeniasis * VIRAL DISEASES :-



COMMON COLD: - Causal Organism: - Rhinoviruses

Organs Affected: - Nasal & Respiratory passages

Spreads By:-

- i. Droplets released during cough & sneezing by an infected person.
- ii. Contaminated objects / articles.

Symptoms:-

- i. Nasal congestion & discharge
- ii. Sore throat
- iii. Cough
- iv. Tiredness
- v. Headache

vi. Hoarseness

* **DENGUE**

* Causal Organism :- Dengue Virus

Organs Affected :-

Spreads By: - Bite of *Aedes aegypti* mosquito.

Symptoms :-

- i. Fever
 - ii. Headache
 - iii. Muscle & joint Pain
 - iv. Characteristic skin rash (like measles)
 - v. In severe cases it becomes haemorrhagic fever, where the platelet count of blood decreases
- Prevention: - By controlling the vector mosquito.

CHIKUNGUNYA

* Causal Organism :-Alpha Virus having ss RNA as its genome

Organs Affected :-

Spreads By: - Bite of *Aedes aegypti* mosquito.

Symptoms :- High

- i. fever
- ii. Rashes on the trunk
- iii. Nausea
- iv. Vomiting
- v. Multiple joint pain

Prevention & Control :-

Mosquito control is the effective prevention method.

TYPHOID

* Causal Organism :- *Salmonella typhi* (Bacteria)

Organs Affected: - Small Intestine. Intestinal perforations leading to death may occur in severe cases.

Spreads By :- Contaminated food and water

Symptoms :-

Sustained high fever (103 – 104 ° F)

- i. Stomach Pain
- ii. Loss of appetite
- iii. Constipation
- iv. Headache
- v. How to Confirm :- Widal Test

PNEUMONIA

Causal Organism :- i) *Streptococcus pneumoniae* & ii) *Haemophilus influenzae*

* Organs Affected: - Lung Alveoli. Alveoli become filled with a fluid, resulting in severe difficulty in breathing / respiration.

Spreads By :-

- (i). Droplets from an infected person
- (ii). Sharing the contaminated articles

Symptoms :-

- i. Fever
- ii. Headache
- iii. Cough
- iv. Chills
- v. In severe cases , the lips and fingernails may turn greyish

MALARIA (a protozoal disease)

Causal Organism :- *Plasmodium* species

- * *P. malariae*
- * *P. vivax*
- * *P. falciparum* (Malignant malaria)

Organs Affected :-

Spreads By: - Bite of Female Anopheles mosquito that transfers the Sporozoites (Infectious stage) of Plasmodium. Symptoms :-

- i. High fever and chill

Prevention & Control :-

Disease can be controlled by eradicating the mosquitoes & avoiding mosquito bite by using mosquito repellents, mosquito nets etc.

Treatment: - Use of Chloroquins.

LIFE CYCLE OF MALARIAL PARASITE :-

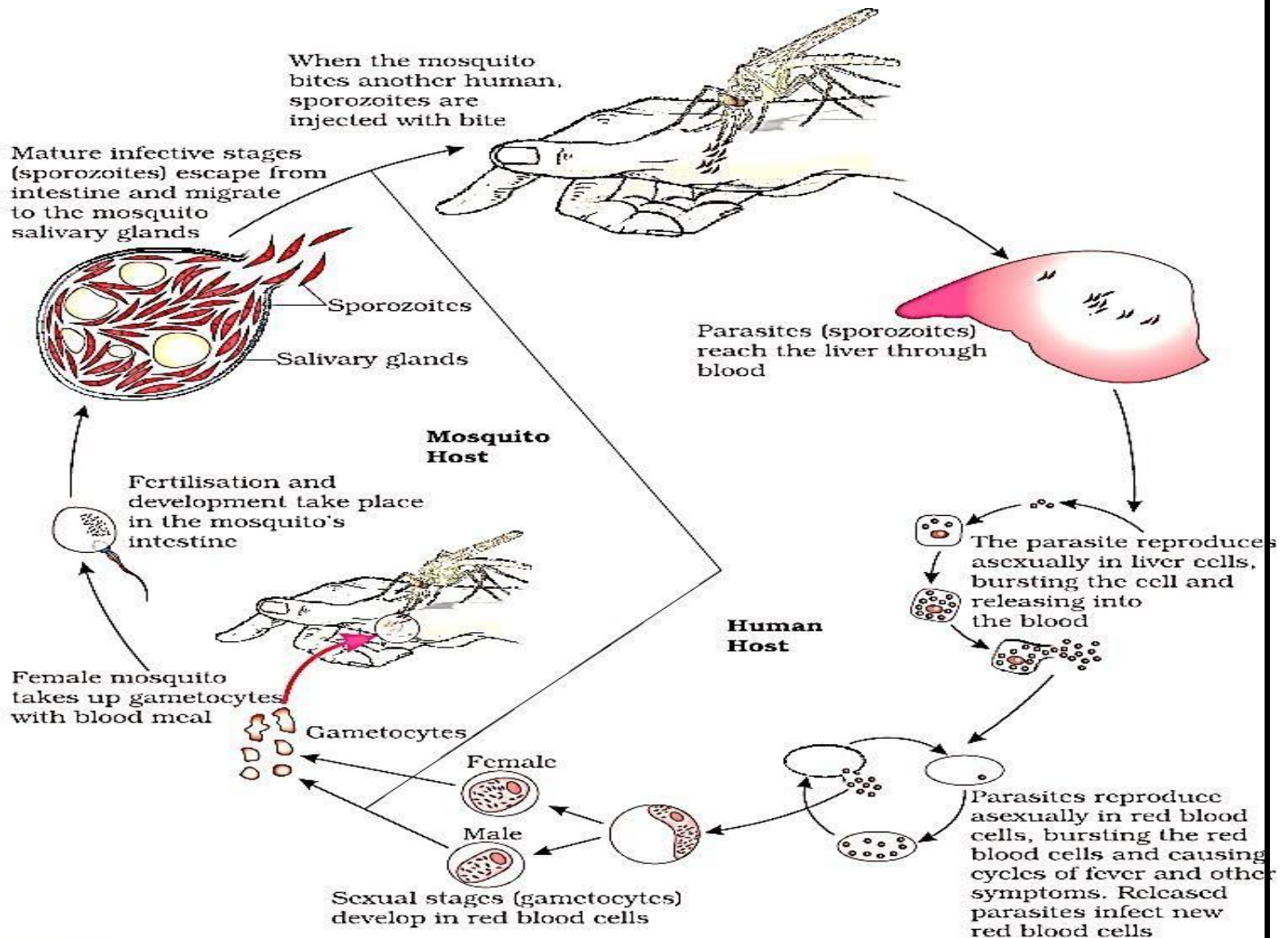
1. The sporozoites enter the body at the bite of mosquito, reach the liver through blood and multiply within the liver cells.
2. Such liver cells burst and release the parasites into blood.
3. In the blood the parasite attacks RBCs, multiply asexually and cause their rupture. The rupture of RBC releases a toxin called Haemozoin , which is responsible for the recurring High Fever and the Chill
4. Sexual stages (Gametocytes) develop in the red blood cells.
5. The parasite then enters the female anopheles mosquito along with the blood when it bites the infected person.
6. Further development occurs in the stomach wall of the mosquito
7. The gametes fuse to form a zygote.
8. The zygote undergoes further development in the body of the mosquito to form sporozoites.
9. The Sporozoites are transported to and stored in the Salivary gland of the mosquitoes and are transferred to the human body during the bite of the mosquito.

Common Diseases: <https://www.youtube.com/embed/YA9KiI7gW5Q>

PPT for Common Human Diseases:

https://docs.google.com/presentation/d/1qznWGDl_9nFvPzjrV_8o2Vv4giwvDtK_/edit?usp=sharing&ouid=107171444976724466844&rtpof=true&sd=true

[8o2Vv4giwvDtK_/edit?usp=sharing&ouid=107171444976724466844&rtpof=true&sd=true](https://docs.google.com/presentation/d/1qznWGDl_9nFvPzjrV_8o2Vv4giwvDtK_/edit?usp=sharing&ouid=107171444976724466844&rtpof=true&sd=true)



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Figure 8.1 Stages in the life cycle of *Plasmodium*

AMOEBIC DYSENTRY (Protozoal Disease)

- * Causal organism :- Entamoeba histolytica
- * Mode of Dispersal :- Through contaminated food and water.
- * House flies act as mechanical carriers and transfer the parasite from the faeces of infected person to the food articles and water.
- * Organ Affected : The parasite resides in the large intestine.
- * Symptoms :
- * i) Abdominal pain and cramps.
- * Stool with excess mucus and blood clots.
- * Constipation alternating with diarrhoea.

* **RING WORM (FUNGAL DISEASE)**

* Causal Organism: Microsporium , Epidermophyton , and Trichophyton.

* Symptoms :

* i) Dry scaly lesions on skin , nails , and scalp.

ii) Lesions are accompanied by itching.

Ringworms are generally acquired from soil or by direct contact.

ASCARIASIS (HELMINTHIC DISEASE)

Causal Organism :- Ascaris lumbricoides (Round Worm)

i) Symptoms :-

ii) Blockage of the intestinal passage

iii) Anaemia

iv) Abdominal / Muscular pain

v) Internal bleeding

Nausea and

headache Mode of

Dispersal :

Through contaminated food and water as eggs of parasite excreted by the infected person contaminate soil, plants and water

* **FILARIASIS (ELEPHANTIASIS) Protozoal Disease**

* Causal Organism : (Filarial Worm) *Wuchereria bancrofti* and *W. malayi*

* Mode of Dispersal : Through the bite of Female Culex Mosquito

* Symptoms :-

* i) They normally cause inflammation of the organs in which they live for many years. ii) They normally affect the lymph vessels, of the lower limbs, causing them to swell like that of an Elephant, hence called Elephantiasis.

* iii) Genital Organs may also be affected leading to gross deformation.

PREVENTION & CONTROL OF INFECTIOUS DISEASES :-

* i) Maintenance of personal hygiene.

* Maintenance of Public hygiene.

* Eradication of vectors and their breeding places.

* Vaccination and immunisation for disease like Polio, Diphtheria, tetanus etc. Use

* of antibiotics and drugs to treat the infected person.

AIDS : ACQUIRED IMMUNODEFICIENCY SYNDROME

* Causal Organism: HIV (Human Immunodeficiency Virus) a

* retrovirus Transmission of HIV occurs in one or more of the

* following ways: i) By sexual contact with the infected person.

* ii) Transfusion of the contaminated blood and blood products. iii) Sharing of infected needles.

* iv) From infected mother to the developing baby (inside uterus) through placenta.

*
*
*

Following individuals are at high risk of getting the disease:
i) Those who have multiple sexual partners. ii) Drug addicts taking the drugs intravenously.

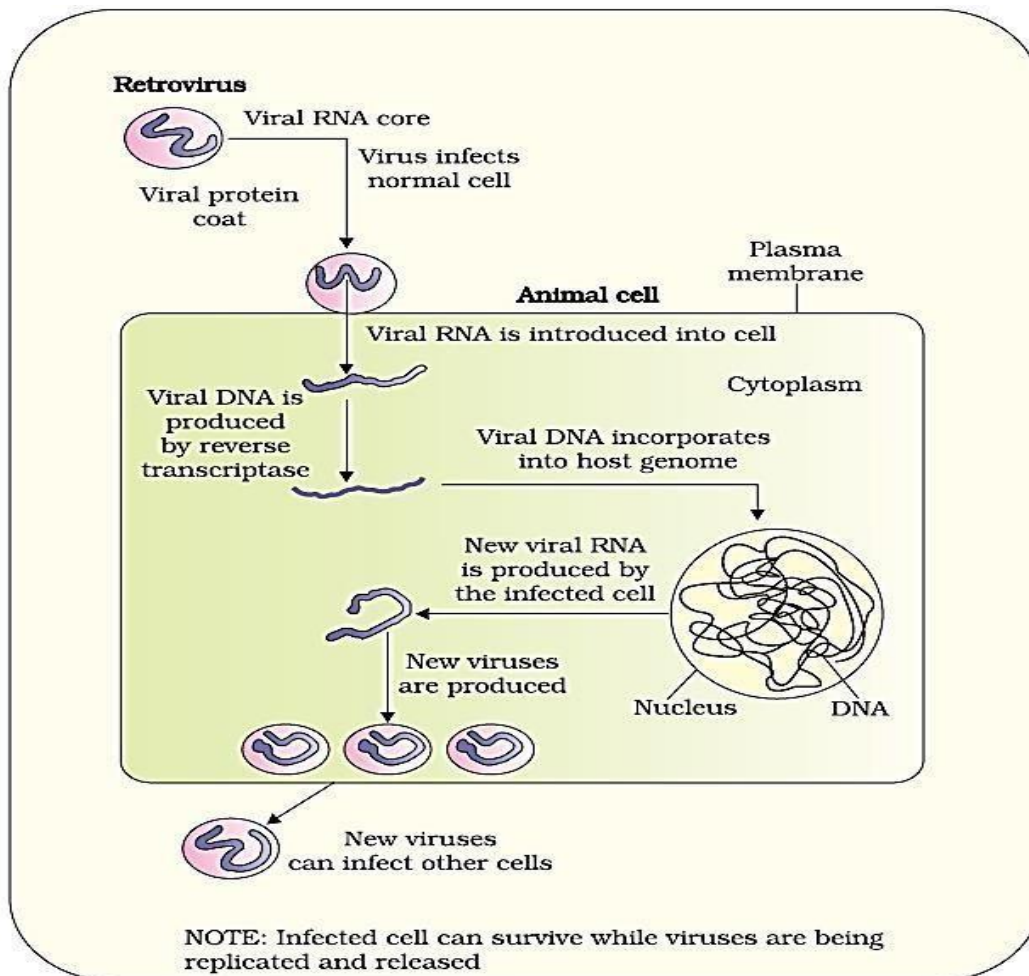


Figure 8.6 Replication of retrovirus

* iii) Individuals who require repeated blood transfusion.

* iv) Children born to an infected woman.

* **LIFE CYCLE OF HIV :-**

* i) The Virus after getting into the body of a person, enters the Macrophages.

* ii) The RNA replicates and DNA is formed by Reverse Transcriptase.

* The viral DNA gets incorporated with the host cell DNA and directs the infected cell to produce the viral particles.

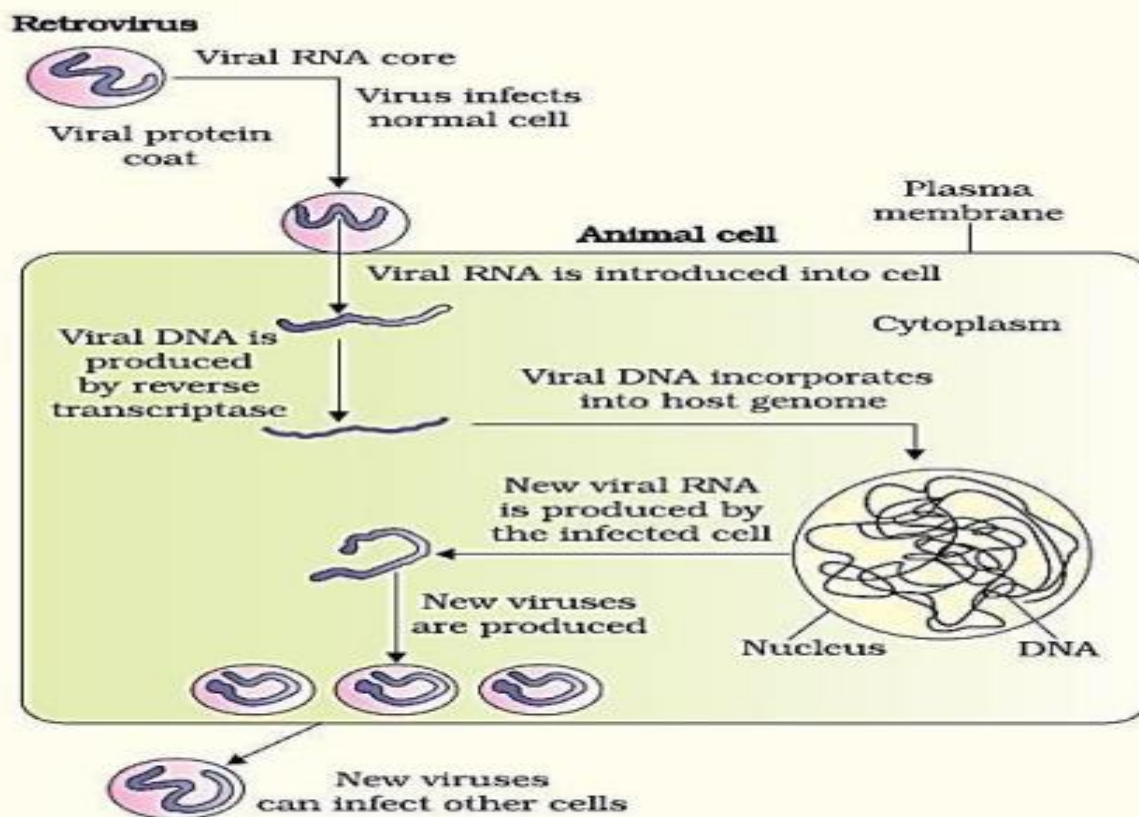
* The Macrophages continue to produce Virus particles

* The virus then enters the helper T-Lymphocytes (TH), replicates and forms the progeny viruses.

* The progeny viruses released in the blood attack other helper T- Lymphocytes and there is a progressive decrease in the number of helper T-Lymphocytes in the body of the infected persons.

* The person becomes easily infected by bacteria like Mycobacterium, viruses and even parasites like Toxoplasma.

* The person is unable to protect himself / herself against any infection.



NOTE: Infected cell can survive while viruses are being replicated and released

Figure **Replication of retrovirus**

- * **Prevention of AIDS :**
- * NACO (National AIDS Control Organization) and Non-governmental organisations are trying their best to educate people about AIDS.
- * WHO (World Health Organisation) has started a number of programmes to prevent spreading of HIV infection. Some such steps are :-
- * i) Ensuring use of disposable needles & syringes.
- * ii) Checking blood for HIV
- * iii) Free distribution of condoms and advocating safe sex.
- * iv)Controlling drug abuse.
- * v) Promoting regular check-up for HIV susceptible populations etc.
- * **DIAGNOSIS OF AIDS :**
- * By ELISA Test :(Enzyme – Linked Immuno Sorbant Assay)

TREATMENT: Treatment with anti-retroviral drugs is only partially effective. They can only prolong the life of the patient but cannot prevent death.

CANCER: - GENERAL ACCOUNT

- * Transformation of normal cells into cancerous cells is induced by carcinogens.
- * Carcinogens are those physical, chemical , and biological agents which bring about uncontrolled proliferation of cells (Cancer) Types of Carcinogens :
- * i) Physical Carcinogens: Eg. U.V. Rays – rays, gamma rays.
- * ii) Chemical Carcinogens: Eg. Aniline dyes, chemicals present in tobacco smoke.
- * iii) Tumour viruses (Oncogenic Viruses)
- * Difference between cancerous cells and Normal Cells)
- * i) There is breakdown of the regulatory mechanism which control normal cells growth, cell division, and differentiation.
- * ii) Cancer cells do not show contact inhibition and show uncontrolled cell divisions.
- * iii) Cancer cells show Metastasis i.e. they detach from the tumours and move to distant sites through body fluids and develop secondary tumours.

TYPES OF TUMOURS:

- i) Benign Tumours :- They remain confined to their original location and do not spread to other parts. They cause little damage.
- ii) Malignant Tumours :-
 - a) They are masses of neoplastic / proliferating cells which grow rapidly, invade and damage the surrounding normal tissue/cells.
 - b) These cells compete with the normal cells for vital nutrients and disrupt the normal metabolism. c) These cells show the property of Metastasis.

DIAGNOSIS OF CANCER

- i) Biopsy and Histopathological studies of the tissue.
- ii) Blood and Bone Marrow Tests for increased cell counts as in Leukemia.
- iii) Use of techniques like Radiography, MRI (Magnetic Resonance Imaging) and CT – Scan (Computed Tomography) for cancer of internal organs. iv) Use of Antibodies against cancer specific antigens.

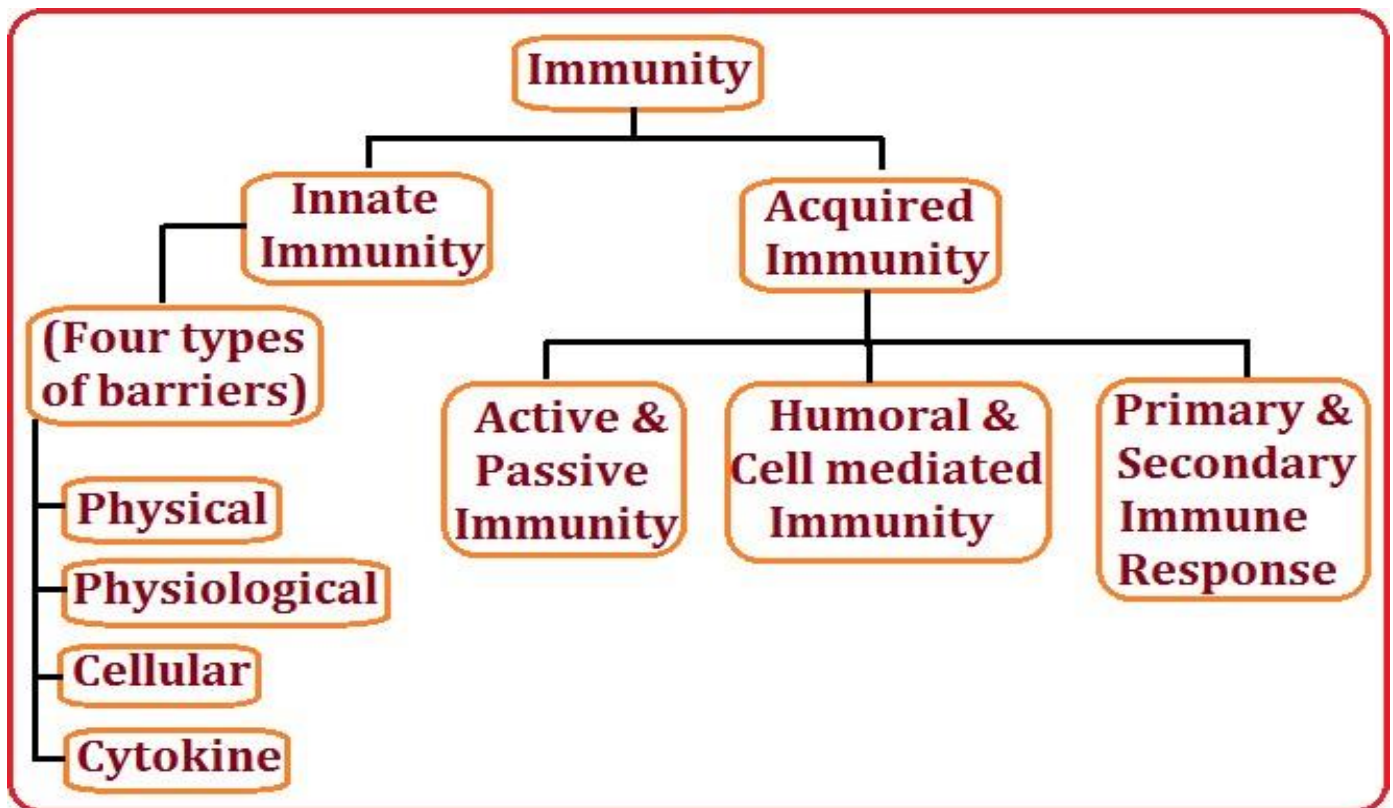
v) Applying principles of Molecular Biology to detect gene in individuals with inherited susceptibility to certain cancers.

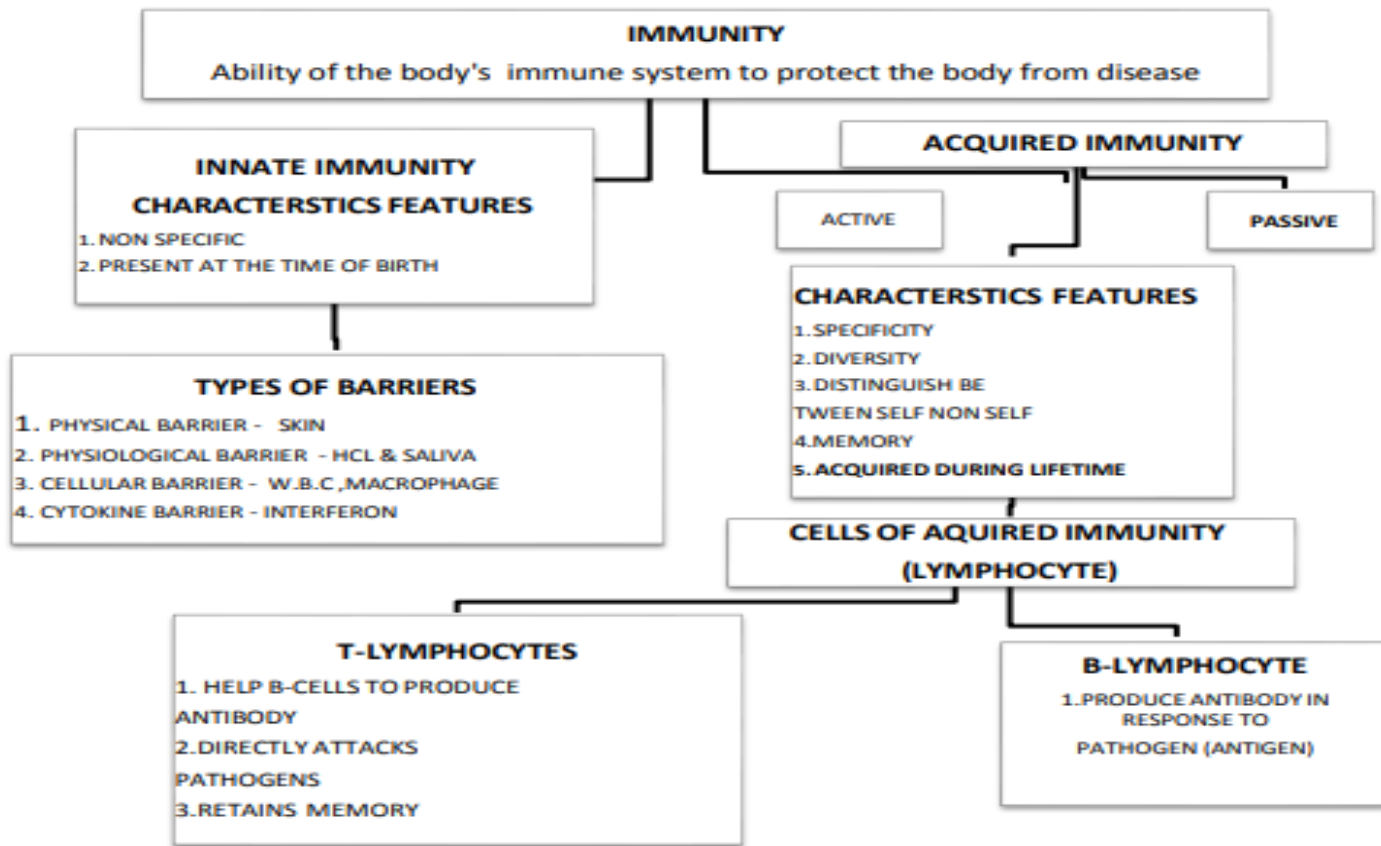
TREATMENT OF CANCER

- i) **SURGERY:** - The Tumour cells are surgically removed to reduce the load of cancerous cells.
- ii) **RADIOTHERAPY:** - The Tumour cells are irradiated wholly but taking care of the surrounding normal cells.
- iii) **CHEMOTHERAPY:** - Certain drugs are used to kill the cancerous cells, but majority of the drugs have side effects like hair loss. Anaemia, etc.
- iv) **IMMUNOTHERAPY:** - This involves the use of biological response modifiers like alpha interferon, which activate the immune system and help in destroying the tumour.

IMMUNE SYSTEM

Definition of Immunity: - It refers to the overall ability of a living body to fight against diseases.

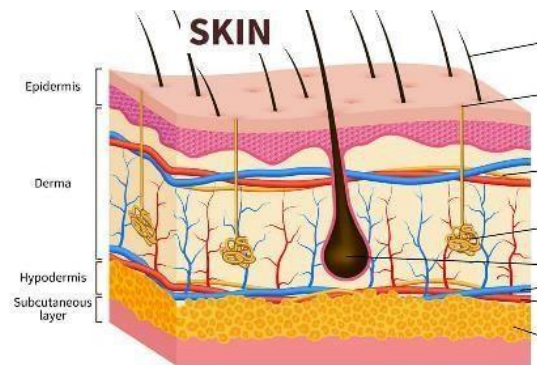


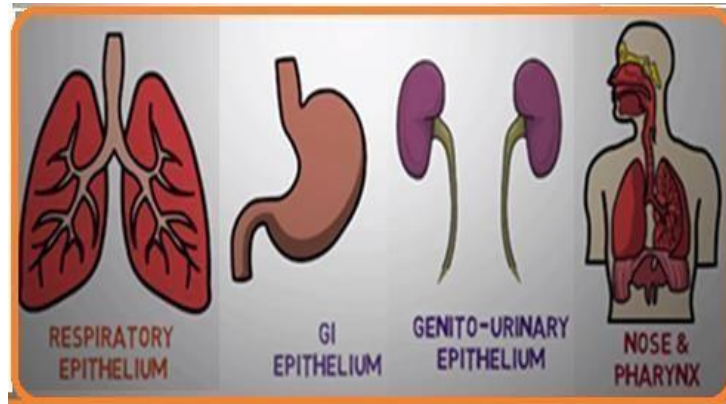


INNATE IMMUNITY: - It refers to all the defense elements with which an individual is born and is always available to protect the body. It is nonspecific and of four different types.

1. PHYSICAL BARRIERS:

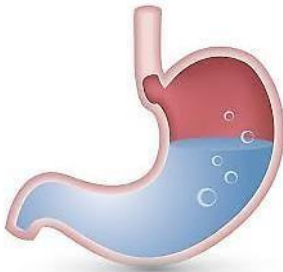
- i) The Skin - main barrier : (Surface Area=1.73 m²)
- ii) The mucus-coated epithelium lining of the
 - a) Respiratory, (b) Gastro-intestinal, (c) Urinogenital tracts



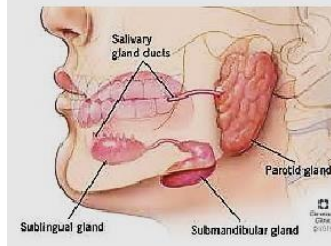


2. PHYSIOLOGICAL BARRIERS: They prevent microbial growth : Examples:

a) HCl in Stomach



b) Saliva (Lysozyme) in Mouth

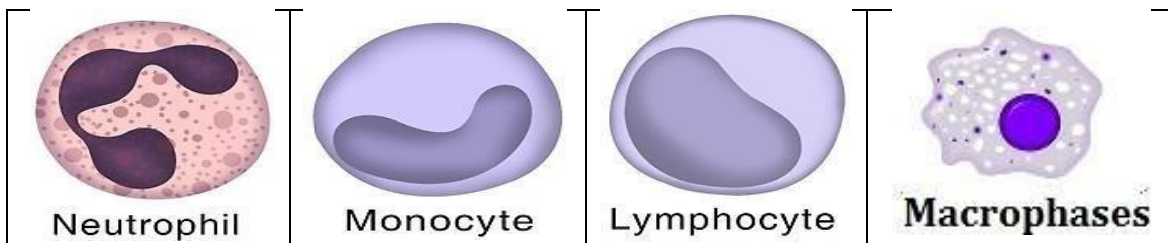


c) Tears (Lysozyme) in Eyes



3. CELLULAR BARRIER : They include the :

A. Leucocytes (WBC) which phagocytose and destroy the microbes.



4. CYTOKINE BARRIER: Interferons (Proteins) produced by viral infected cells and protect the non-infected cells from further viral infections.

ACQUIRED IMMUNITY: It refers to the immunity a person acquires after birth, either by contracting the disease or by vaccination.

Characteristic features of acquired immunity:

- i) **SPECIFICITY:** It is pathogen specific.
- ii) **MEMORY:** The memory cells produced during the first encounter with the pathogens evoke a heightened immune response in the further encounters.
- iii) Distinguishes between self and non self.

Types of Immunity Link for the video:

https://www.youtube.com/embed/odIdD_uwIPE

Immunity - Presentation:

<https://docs.google.com/presentation/d/1DdZLg1nNNyHY4ek90mdvIn5q0AVDt6E/edit?usp=sharing&oid=107171444976724466844&rtpof=true&sd=true>

TYPES OF IMMUNE RESPONSES:-

1. **PRIMARY IMMUNE RESPONSE :-** An Immune Response of low Intensity, when our body encounters a pathogen for the first time
2. **SECONDARY IMMUNE RESPONSE :-** (Anamnestic Response) A highly intensified Immune Response when our body encounters the same pathogen for the second time. Why? Because our body keeps a memory of the pathogen when encountered it for the first time.

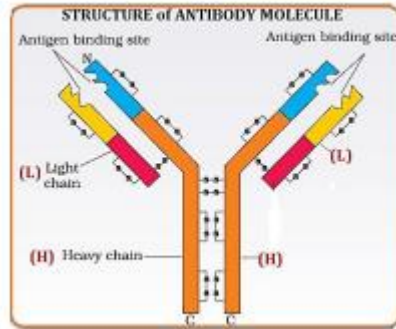
TYPES OF ACQUIRED IMMUNITY:

A) **HUMORAL or ANTIBODY MEDIATED IMMUNITY :-**

- i) It consists of the antibodies, that are circulating in the body fluids (Humors)
- ii) The antibodies produced by B- Lymphocytes in response to the antigens are collectively called Immunoglobins and are of various types like IgA, IgD, IgE, IgG, IgM .

ANTIBODY MOLECULE (Immunoglobins):

- i) Each antibody consists of four polypeptide chains, held together in the form of Y where the tips of two upper arms bind to the antigens in a lock and key manner to form antigen-antibody complex.
- ii) The two polypeptide chains are long and called heavy (H) chains, while the other two are short and called light (L) chains. Hence, the antibody is referred to H_2L_2 as H_2L_2 .



B) CELL MEDIATED IMMUNITY : CMI

It is mediated by T-Lymphocytes. There are two groups of T-Lymphocytes

- i) Cytotoxic / Killer T-Cells – which kill the specific target cell by a variety of mechanisms.
- ii) Helper T – cells: which activate the specific B-cells to produce antibodies. T-Lymphocytes are responsible for graft rejection.

On the basis of Involvement of body in the production of Antibodies, immunity is of two types:

a) Active Immunity and b) Passive Immunity.

Sl No.	Active Immunity	Passive Immunity
i)	When the antibodies are developed by our own cells in response to the antigens, it is called active immunity	When antibodies developed in other vertebrates in response to deliberate injection of antigen, are injected into our body, it constitutes passive immunity.
ii)	It takes time to develop immunity(slow response)	It shows fast response hence it is used when immune response has to be faster. E.g. in case of snake bite.
iii)	It stays in body for longer period.	It stays in body for short period.
	Example : a) Immunity developed during natural exposure to pathogens b) Immunity developed by vaccination.	Example : a) Immunity given to the infant by antibodies in colostrum b) Immunity given by Tetanus Antitoxin

VACCINATION:-

Vaccination is the process of introducing a preparation of antigenic proteins of pathogens or killed or inactivated /attenuated pathogens into the body, to generate the immune response / antibodies.

ALLERGY: - It refers to the exaggerated / hypersensitive response of the immune system to certain antigens in the environment.

ALLERGENS: - The substance / agent which causes the hypersensitive reaction of the immune system to certain antigens present in the environment.

Example: - Dust, Mites, Pollen Grains, Animal Dander etc.

The antibodies produced in response to allergens are Ig E type.

COMMON SYMPTOMS OF ALLERGY:-

Under the influence of allergens certain chemicals like Histamine and Serotonin are released from mast cells. These chemicals induce the symptoms of allergy.

- i) Sneezing (ii) Watery eyes (iii) Rashes (iv) Running nose (v) Difficulty in breathing.

CAUSES OF ALLERGY: Somehow, modern - day life style has resulted in lowering of immunity and more sensitivity to allergens. More & more children in metro cities of India suffer from allergies and asthma due to sensitivity to the environment.

Allergy is due to the release of chemicals like histamine and serotonin from the mast cells.

AUTOIMMUNITY:

Autoimmunity or autoimmune disorders are those disorders which are caused when the body's immune system goes off the track and start destroying 'Self Cells' and molecules.

Example: Hashimoto's Thyroiditis, Systemic Lupus, Rheumatoid Arthritis etc.

MAIN FUNCTIONS of IMMUNE SYSTEM

To recognize the foreign molecules (Antigens), respond to them and keep a memory of them.

COMPONENTS OF IMMUNE SYSTEM:-

1. Lymphoid Organs
2. Lymphoid Tissues
3. Lymphoid Cells
4. Soluble Molecules like Antibodies.

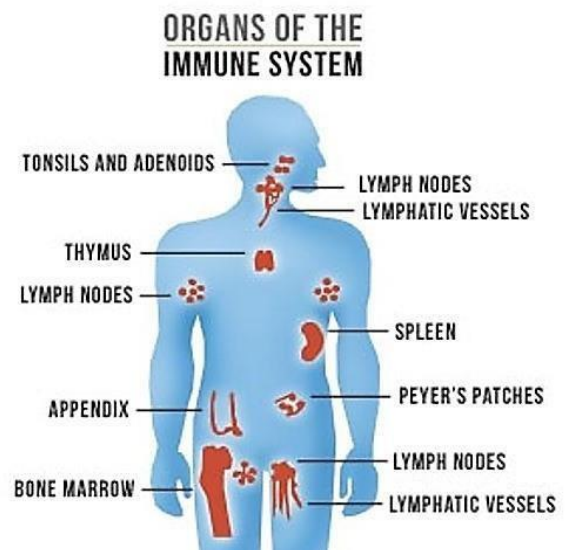
FUNCTIONS OF PRIMARY LYMPHOID ORGANS:-

1. Bone Marrow :- Here all kinds of blood cells are produced
2. Thymus: - Provides a micro environment for the development and maturation of lymphocytes.

FUNCTIONS OF SECONDARY LYMPHOID ORGANS:

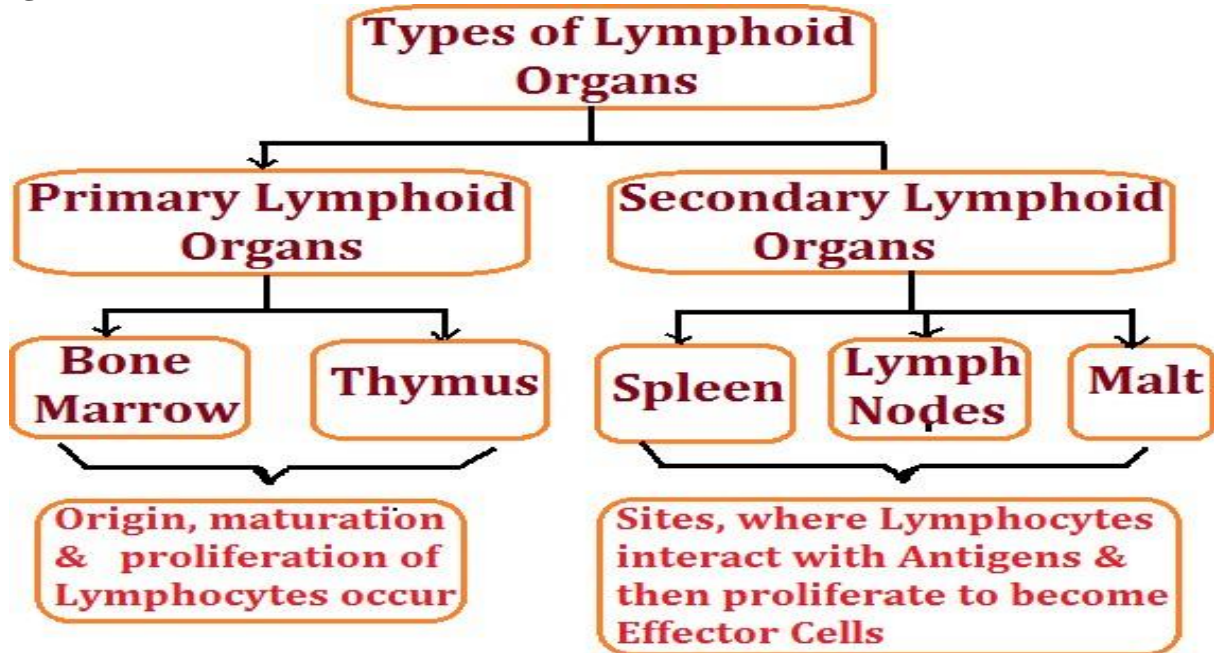
1. SPLEEN :-

i) It mainly contains lymphocytes and phagocytes. ii) It acts as filter of blood by trapping blood borne microbes iii) It also acts as a reservoir of Erythrocytes (RBCs)



2. **LYMPH NODES:** - They act as filters and trap the microbes that have entered the lymph.
3. **MALT:** - Mucosal Associated Lymphoid Tissues:- Lymphoid tissue located within the mucosal lining of the major tracts (respiratory , digestive, urogenital tracts) is called MALT.

Different types of lymphoid organs and their functions is being summarized by the help of following flow diagrams



Chapter 8- MICROBES IN HUMAN WELFARE

SL NO	NAME OF FOOD ITEM	MICROBE INVOLVED
01	CURD	LACTOBACILLUS & other LAB (Lactic Acid bacteria)
02	DOUGH (For Idli & Dosa)	Fermented by bacteria. Dough rises due to CO ₂ produced during fermentation.
03	DOUGH (For making Bread)	<i>Saccharomyces cerevisiae</i> (Bakers Yeast)
04	CHEESE a) Swiss Cheese has large holes due to production of CO ₂ b) Roquefort Cheese	<i>Propionibacterium sharmanii</i> . Ripened by growing a specific fungus in it.

SLN O	NAME OF PRODUCT	MICROBE INVOLVED
1	BEEVERAGES :- a)ETHANOL :- (By fermentation of fruit juices & malted cereals)	<i>Saccharomyces cerevisiae</i> (Yeast)
	Remark: - Type of alcoholic drink varies with the type of Raw material & nature of processing. a) With Distillation: - Whisky, Brandy & Rum. b) Without Distillation: - Beer & Wine.	
2	ANTIBIOTICS a)Penicillin :-	<i>Penicillium notatum</i> (Fungi)
	Remark: - Penicillin discovered by Alexander Fleming, while working on Staphylococci bacteria, but it was established as an effective drug by Ernst Chain & Howard Florey. The Three were awarded Nobel prize in medicine in 1945.	
3	ORGANIC ACIDS a) Citric Acid b) Acetic Acid c) Butyric Acid d) Lactic Acid	<i>Aspergillus niger</i> (Fungus) <i>Acetobacter aceti</i> (Bacterium) <i>Clostridium butylicum</i> (Bacterium) <i>Lactobacillus delbrueckii</i> (Bacterium)
4	ENZYMES a)Lipases b)Proteases & c)Pectinases d)Streptokinases	Used in detergent formulations. Used to clear fruit juices. A 'clot buster' produced by genetically modified <i>Streptococcus</i> .

Remark:-Streptokinase is used for removing blood clots in blood vessels of patients suffering from Myocardial Infractions.		
5	BIOACTIVE MOLECULES	
	a)Cyclosporin A (Used as Immuno suppressant)	<i>Trichoderma polysporum.</i> (Fungus)
	b)Statins (Used for lowering blood cholesterol)	<i>Monascus purpureus</i> (Yeast)
6	BIOGAS PRODUCTION	Methanogens like Methanobacterium
Remark: - Methanogens produce Methane, CO₂, H₂ & H₂S by acting over cellulosic compounds present in cattle dung. They are found in i) Anaerobic sludge, ii) Rumen of cattle, iii) Flooded Rice Fields, & iv) Marshy places.		
7	MICROBES AS BIOCONTROL AGENTS	It refers to the use of controlling pests that relies on natural predators
	a)Bacillus thuringiensis ----- b)Trichoderma ----- c)Baculoviruses (Genus : <i>Nucleopolyhedrovirus</i>) c)Ladybird (a beetle with red & black markings) d)Dragonfly -----	A bacterium whose spores are toxic to certain insect larvae (butterfly caterpillars) & kill them. A fungus (free living in soil & root ecosystems) is effective against several plant pathogens. They attack insects and other arthropods. These viruses are excellent candidates for species specific, narrow spectrum insecticidal applications, Useful in IPM in ecologically sensitive area Used to get rid of Aphids Used to get rid of Mosquitoes
8	MICROBES AS BIOFERTILIZERS	They fix atmospheric Nitrogen, Organic matter & other soil nutrients.
a	BACTERIA (Fix Atmospheric N ₂) i)Symbiotic Bacteria ----- ii)Free Living bacteria -----	<i>Rhizobium.</i> <i>Azotobacter & Azospirillum.</i>
b	CYANOBACTERIA	<i>Nostoc,oscillatoria,Anabaena,Aulosira.</i>
c	FUNGI/MYCORRHIZAE	Symbiotic association of fungi with the roots of higher plants. e.g. <i>Glomus</i>
Remark: - Mycorrhizae are beneficial in the following manner :- i)They absorb phosphorus & passes it on to the plant. ii)Provide resistance to root borne pathogens. iii)Tolerance to salinity. iv)Overall increase in the plant growth & development.		

A. MICROBES IN HOUSEHOLD PRODUCTS

B. MICROBES IN INDUSTRIAL PRODUCTS

Microbes in Human welfare:

https://www.youtube.com/embed/65sh_0kBuM8

SEWAGE TREATMENT: - Municipal waste water is called sewage which may contain large amount of organic matter & microbes (which may be Pathogenic) Therefore Sewage is Treated in Sewage Treatment Plant before it is released in the water bodies.

Sewage treatment consists of two steps:-

I. PRIMARY TREATMENT: - Physical process to remove insoluble large & small particles through Filtration & Sedimentation.

Filtration: - Sewage is passed through wire mesh to remove floating insoluble objects like polythene.

Sedimentation: - Sewage is then passed into grit chamber, where the grit (soil & small pebbles) are removed by sedimentation.

All the solids that settled, form the Primary Sludge and the supernatant forms the effluent which is taken to another tank for secondary treatment.

II. SECONDARY TREATMENT :- (Biological Treatment) Two step treatment.

AEROBIC TREATMENT:-

The primary effluent is passed into large aeration tank where it is constantly agitated mechanically and air is pumped into it. This allows vigorous growth of useful microbes into flocs (Flocs = Mass of bacteria + fungal hyphae)

While growing, these microbes consume the major part of the organic matter in the effluent. This significantly reduces the biochemical oxygen demand (BOD)

A) ANAEROBIC TREATMENT:-

i) The effluent is then passed into a tank where the bacterial flocs are allowed to sediment. This sediment is called activated sludge. ii) A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum. The remaining major part of the sludge is pumped into large tanks called anaerobic sludge digestors. Here, anaerobic bacteria grow and digest the sludge. During this digestion bacteria produce a mixture of gases called Biogas (Methane- 75%, CO₂, H₂ & H₂S)

BIOGAS PLANT: - Its technology was developed in India due to the efforts of IARI & KVIC.

Models of Biogas plant:-

a) Fixed Dome Type &

b) Floating Gas Holder Type.

BIOCONTROL AGENTS: - It refers to the use of controlling pests that relies on natural predators

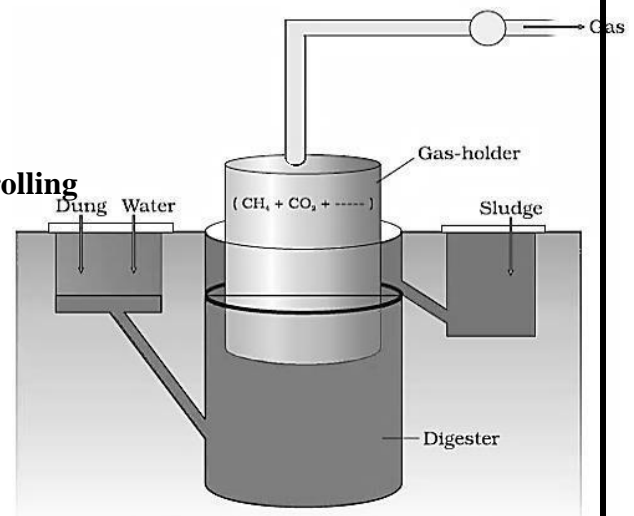


Figure 10.8 A typical biogas plant

Chapter 9 - BIOTECHNOLOGY: PRINCIPLES AND PROCESSES

Biotechnology deals with techniques of using live organisms or enzymes from organisms to produce products and processes useful to humans.

- ⊙ According to EFB, European Federation of Biotechnology -Biotechnology is defined as ‘The integration of natural science and organisms, cells, parts thereof, and molecular analogues for products and services’.
- ⊙ Current Definition: - It is used in a restricted sense today, to refer to such of those processes which use genetically modified organisms to achieve the same on a larger scale.
Further many other processes and techniques are also included in the biotechnology:-
 - i) Test tube baby programme.
 - ii) Synthesizing a gene and using it. iii) Developing a DNA vaccine.
 - iv) Correcting a defective gene (Gene Therapy).

The two core techniques that enabled the birth of modern biotechnology:-

- (i) **Genetic engineering:** Techniques to alter the chemistry of genetic material (DNA and RNA), to introduce these into host organisms and thus change the phenotype of the host organism.
- (ii) **Maintenance of sterile (microbial contamination-free) ambience** in chemical engineering processes to enable growth of only the desired microbe/eukaryotic cell in large quantities for the manufacture of biotechnological products like antibiotics, vaccines, enzymes, etc.

⊙ **Three basic steps in genetically modifying an organism — (i)**

Identification of DNA with desirable genes;

(ii) Introduction of the identified DNA into the host; (iii) Maintenance of introduced DNA in the host and transfer of the DNA to its progeny.

⊙ **Genetic engineering:-**

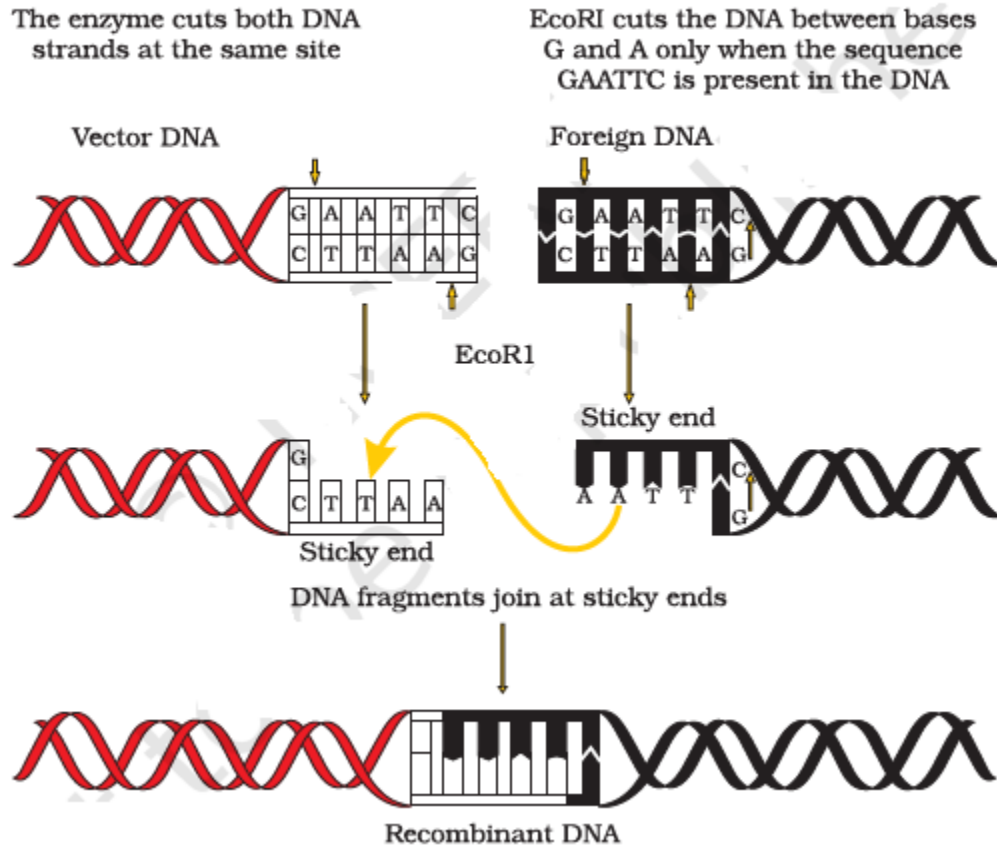
It involves the alteration of the genetic makeup of cell by deliberate and artificial means. It involves transfer or replacement of genes to create recombinant DNA.

TOOLS OF GENETIC ENGINEERING:-

1. Enzymes:-

<https://youtu.be/pMKhOCi7X8w>

Action of Restriction enzyme



Restriction Endonuclease enzyme(Molecular scissors)

- a) DNA Polymerase enzyme.
- b) **DNA Ligases (Molecular glues)**

2. Restriction enzymes

Restriction enzymes (R.E.) belong to a larger class of enzymes called **nucleases**. Each R.E functions by inspecting the length of a DNA sequence. Once it finds its specific recognition sequence, it will bind to the DNA and cut each of the two strands of the double helix at specific points in their sugar phosphate backbone. Each restriction endonuclease enzyme recognizes a specific palindromic sequence in the DNA.

e.g. 5'- GAATTC-3'
3'- CTTAAG- 5'

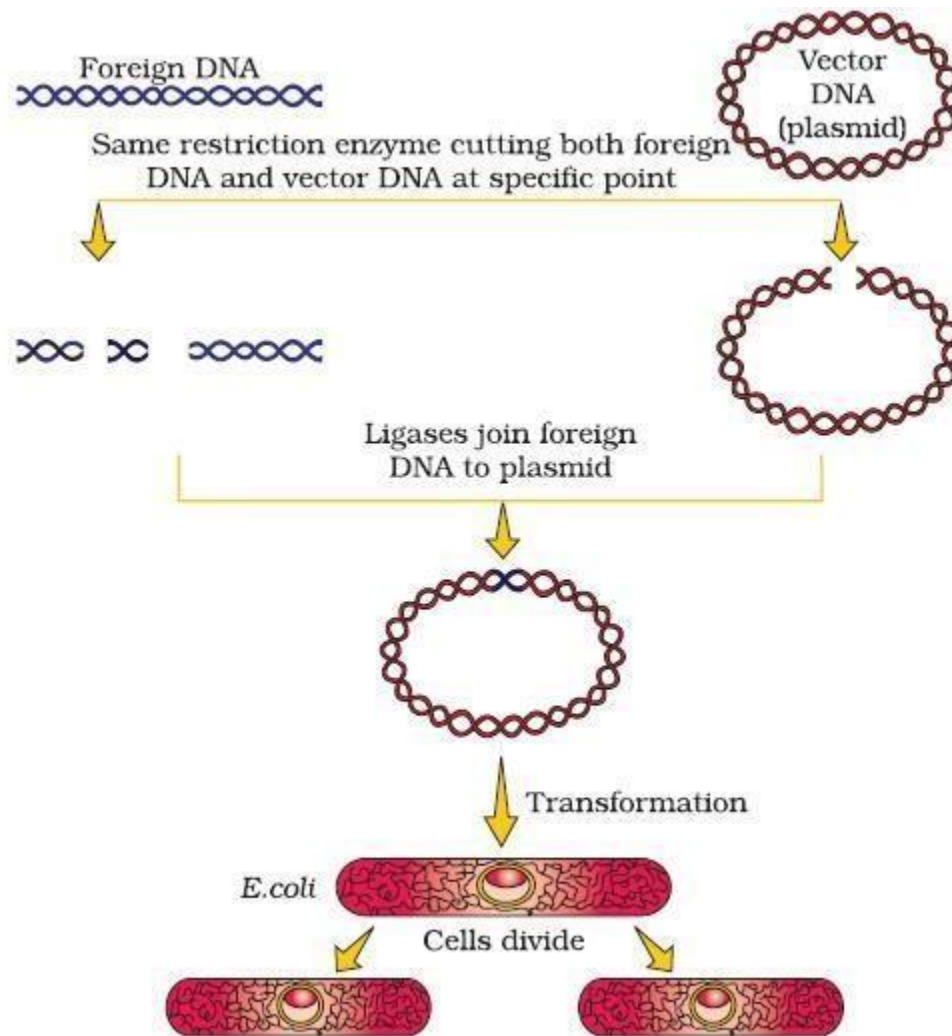
R.E. cut the DNA strand a little away from the centre of the palindrome sites, but between the same

two bases on the opposite strands. This causes the production of two DNA segments with sticky ends.

Restriction enzymes are named in the following manner?

- i) The first letter of the name comes from the name of the genus of the source bacteria.
- ii) The second two letters come from the species of the prokaryotic cell from which they are isolated.
- iii) The letter R is derived from the name of the strain.
- iv) Roman numbers following the names indicate the order in which the enzymes were isolated from that strain of bacteria. **e.g. EcoRI**

Diagrammatic representation of recombinant DNA technology:-



PROCESSES (STEPS) OF RECOMBINANT DNA TECHNOLOGY:-

1. Isolation of DNA
2. Fragmentation of DNA by restriction enzymes.
3. Isolation of the desired DNA fragment.
4. Amplification of the gene of interest.
5. Ligation of the DNA fragment into a vector using DNA ligase.
6. Transfer of recombinant DNA into the host. 80

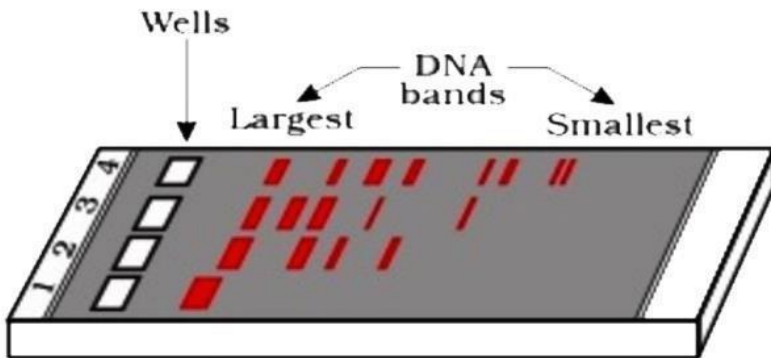
7. Culturing the host cells on a suitable medium on a large scale.
8. Extraction of the desired product.
9. Downstream processing of the product as a finished product ready for marketing.

rDNA Technology

<https://www.youtube.com/embed/xZAD11Sc-a8>

rDNA Technology at a glance

Given diagram showing a typical agarose gel electrophoresis showing migration of DNA fragments . The undigested DNA fragment will be present in the lane



Separation & isolation, Visualization & extraction of DNA fragments:-

DNA has to be isolated in pure form for the action of restriction enzymes.

- i) DNA can be released from cells by digesting the cell envelope by the use of enzymes like lysozyme for bacterial cells, chitinase for fungal cells, and cellulase for plant cells.
- ii) Since DNA is intertwined with histone proteins and RNA, proteins are removed by proteases and RNA are removed by ribonucleases.
- iii) Other impurities are removed by employing suitable treatments.

-
- iv) The purified DNA is precipitated by the addition of chilled ethanol. It is seen as fine threads in suspension.

Gel Electrophoresis is the technique of separating DNA segment, in which the negatively charged DNA segments are forced to move towards anode(+ve electrode) under an electric field through a medium or matrix.(Commonly Agarose gel)

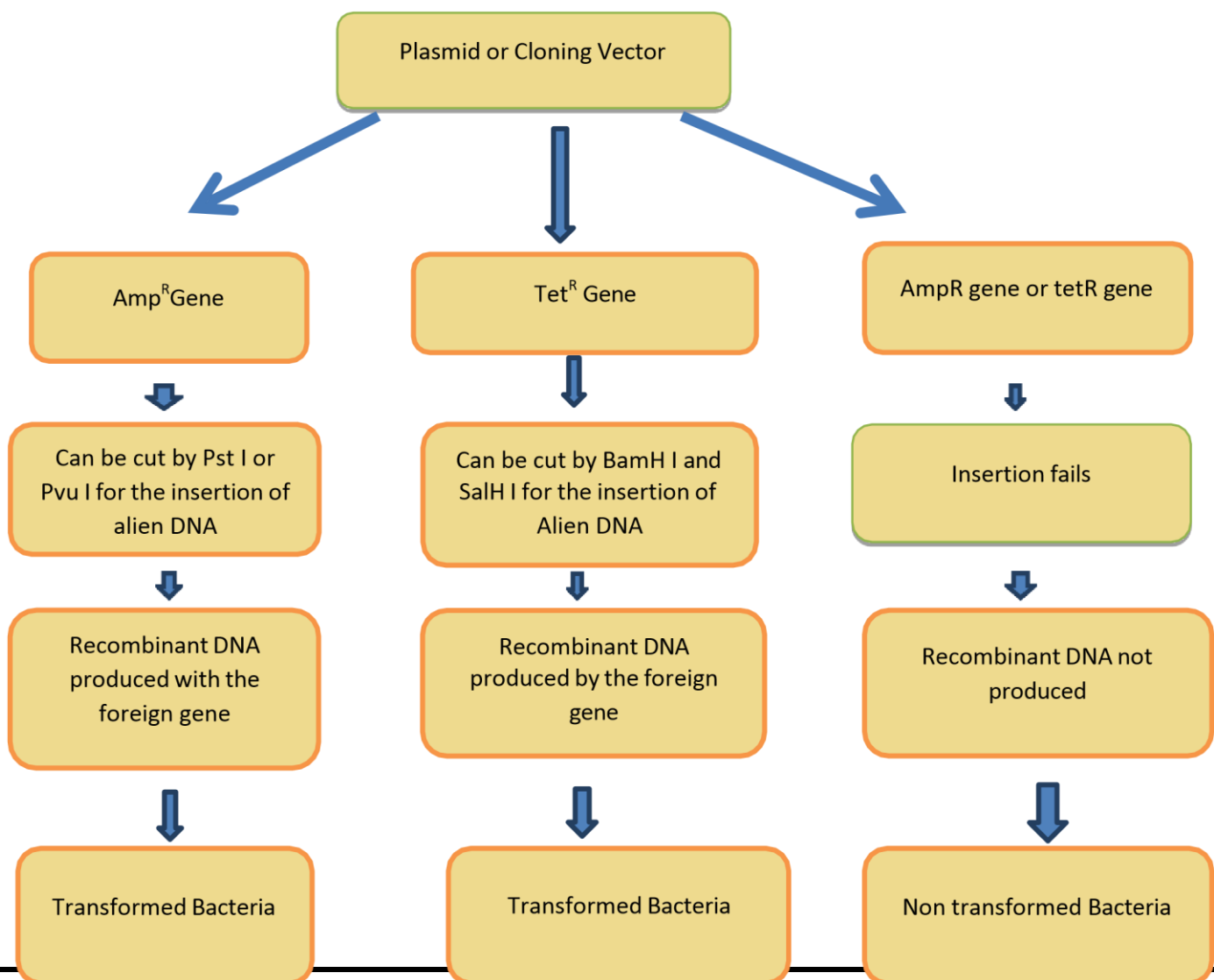
Visualisation :-The separated DNA fragments can be visualised after staining the DNA by ethidium bromide followed by exposure to UV rays. A bright orange coloured bands of DNA is observed.

Extraction:- The separated bands of DNA are cut out from the agarose gel & extracted from the gel piece. This process is called as elution.

CLONING VECTORS :-

- ⦿ PLASMIDS AND BACTERIOPHASES ARE COMMONLY USED CLONING VECTORS.
- ⦿ NOWADAYS , GENETICALLY ENGINEERED /SYNTHETIC VECTORS ARE ALSO USED FOR EASILY LINKING THE FOREIGN DNA AND SELECTION OF RECOMBINANTS FROM NONRECOMBINANTS.

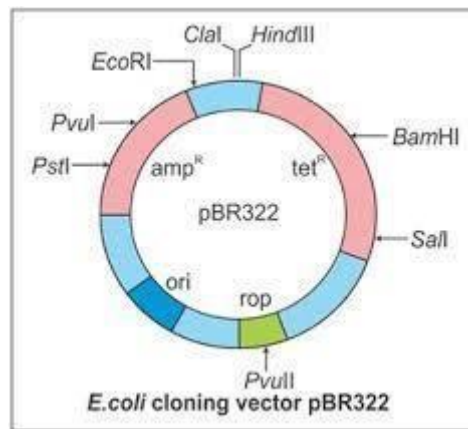
Making of rDNA at a glance:



FOLLOWING FEATURES ARE REQUIRED TO FACILITATE CLONING IN A VECTOR:-

- I) **ORIGIN OF REPLICATION :- (ori)** This is a sequence of base pairs on DNA where replication starts. Any piece of DNA linked to this sequence can be made to replicate with in the host cells. This sequence is also responsible for controlling the copy number of linked DNA.
- II) **SELECTABLE MARKER: -** Marker is a gene which helps in selecting the transformants (those host cells which contain the gene of interest) and eliminating the non transformants.

Common selectable markers for E.coli include the genes encoding resistance to antibiotics such as ampicillin, chloramphenicol, tetracycline and canamycin or gene for b-galactosidase which can be identified by colour reaction



- III) **CLONING / RECOGNITION SITE: -** In order to link the alien DNA, the vector needs to have very few, preferably single recognition site for the commonly used restriction enzymes.

The ligation of alien DNA is carried out at a restriction site present in one of the two antibiotic resistant genes. Eg. A foreign DNA is inserted at BamHI site of tetracycline resistant gene in the vector PBR322 (A plasmid).

Some cloning vectors:-

- a) **Agrobacterium tumefaciens:** - It is the bacterium that infects a number of dicot plants and transfers a piece of its DNA known as T-DNA, which transforms the normal plant cells into tumor cells. Ti plasmid (Tumor inducing plasmid) of this bacterium has been modified (Disarmed) and used as a cloning vector.
- b) **Retro Viruses:**-They infect normal cells and transform them into cancerous cells. Such retroviruses have been modified (Disarmed) and used as vectors for transferring DNA into animal cells.

- IV) **SMALL SIZE OF THE VECTOR :-**

Methods of introducing a recombinant DNA into a competent host:-

Since DNA is hydrophilic molecule, it cannot pass through cell membranes. Four methods to introduce the gene of interest into a host.

1. For Bacterial Cell :- (a prokaryotic cell)

- a) In order to force bacteria to take up the plasmid, the bacterial cells must first be made 'competent' to take up DNA. This is done by treating them with a specific divalent Cation, eg. Calcium ion, which increases the efficiency with which DNA enters the bacterium through pores in its cell wall.
- b) Recombinant DNA can then be forced into such cells by incubating the cells with recombinant DNA on ice, followed by placing them briefly at 42⁰C (heat Shock), and then putting them back on ice. This enables the bacteria to take up the recombinant DNA.

2. **MICROINJECTION:-** (Suitable for animal cells) In this method , recombinant DNA is directly injected into the nucleus of an animal cell.

3. **BIOLISTICS or GENE GUN :-** (Suitable for plants) In this method plant cells are bombarded with high velocity microparticles of gold or tungsten coated with DNA.

4. **DISARMED PATHOGEN VECTORS :-** Such vectors when allowed to infect the cell, transfer the recombinant DNA into the host.

PCR: - polymerase chain reaction (Discovered by K Mullis)

It is a technique by which any piece of DNA can be quickly amplified (copied many times) without using cells. Each cycle of PCR consists of three steps:-

1. Denaturation of DNA: - Double stranded DNA is denatured by using high temperature.
2. Primer Annealing:- Primers are chemically synthesised oligonucleotides that are complementary to the regions of DNA segments of interest.
3. Extension of Primers: - Thermostable DNA polymerase enzyme (Taq Polymerase obtained from *Thermus aquaticus*) extends the primers using the nucleotides provided in the medium and the genomic DNA as template.

PCR - Link for the video: <https://www.youtube.com/embed/09whdt6PPs0>

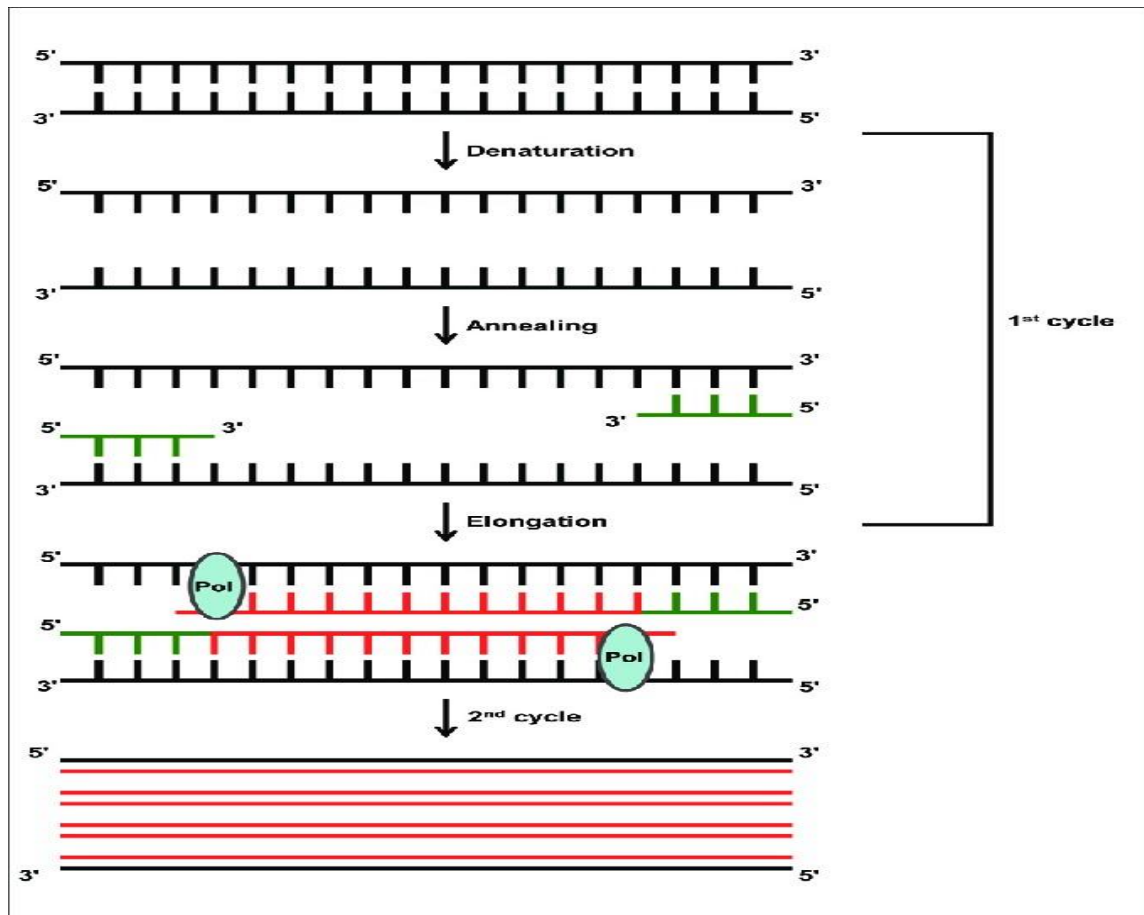
PCR

Polymerase Chain Reaction

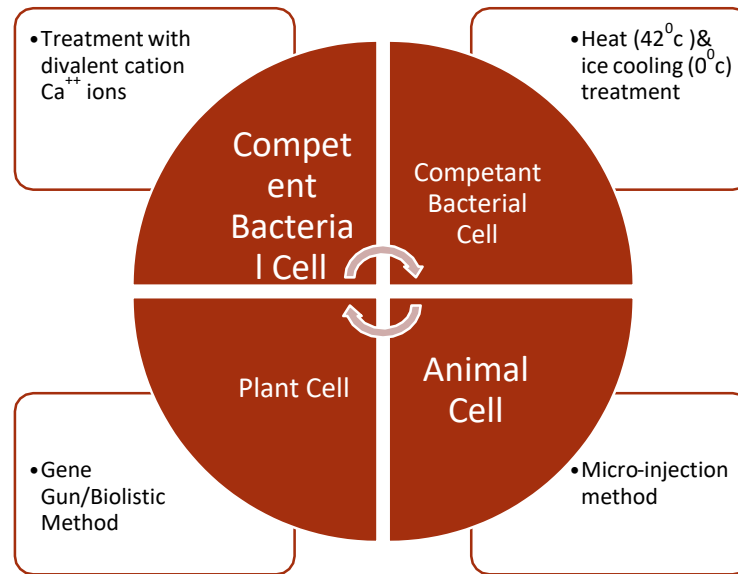
Denaturation 94⁰c
Separation of DNA Strands

Annealing Use of Primers

Extension Use of Taq Polymerase → Polymerisation



Introduction of Alien DNA in the competent host at a glance:



BIOREACTORS:-

The bioreactors can be thought of as vessels in which raw materials are biologically converted into specific products by microbes, plants and animal cells and/or their enzymes.

A bioreactor has the following components:-

- i) An agitator system.
- ii) An oxygen delivery system.
- iii) A foam control system. iv) A temperature control system.
- v) pH control system. vi) Sampling ports.

Downstream processing:-

The products obtained from the genetically modified microorganisms in a bioreactor is subjected to a series of processes (collectively called downstream processing) before it is made into a finished product ready for marketing.

The two main processes are:-

- a) Separation and b) Purification.

The product is then formulated with suitable preservatives. Such formulations have to undergo clinical trials, in case of drugs.

Chapter 10 - BIOTECHNOLOGY AND ITS

APPLICATIONS

Critical areas of Biotechnology:

- Providing the best catalyst in the form of improved organism usually a microbe or pure enzyme.
- Creating optimal condition through engineering for a catalyst to act.
- Downstream processing technologies to purify the protein/organic compound.

BIOTECHNOLOGICAL APPLICATIONS IN AGRICULTURE:

The focus have been made to increase the food production through Biotechnology in the following areas. □ Agrochemical based agriculture

- Organic Agriculture
- Genetically engineered crop- based agriculture

Plants, bacteria, fungi and animals whose genes have been altered by manipulation are called **Genetically Modified Organisms (GMO)**.

Advantages of Genetic Modification in plants.

- Made crops more tolerant to abiotic stresses (cold, drought, salt, heat)
- Reduce reliance on chemical pesticides (pest resistant crop)
- Helped to reduce post-harvest losses.
- Increased efficiency of mineral usage by plants.
- Enhanced nutritional values of food e.g. vitamin A enriched rice. **Bt Cotton:**

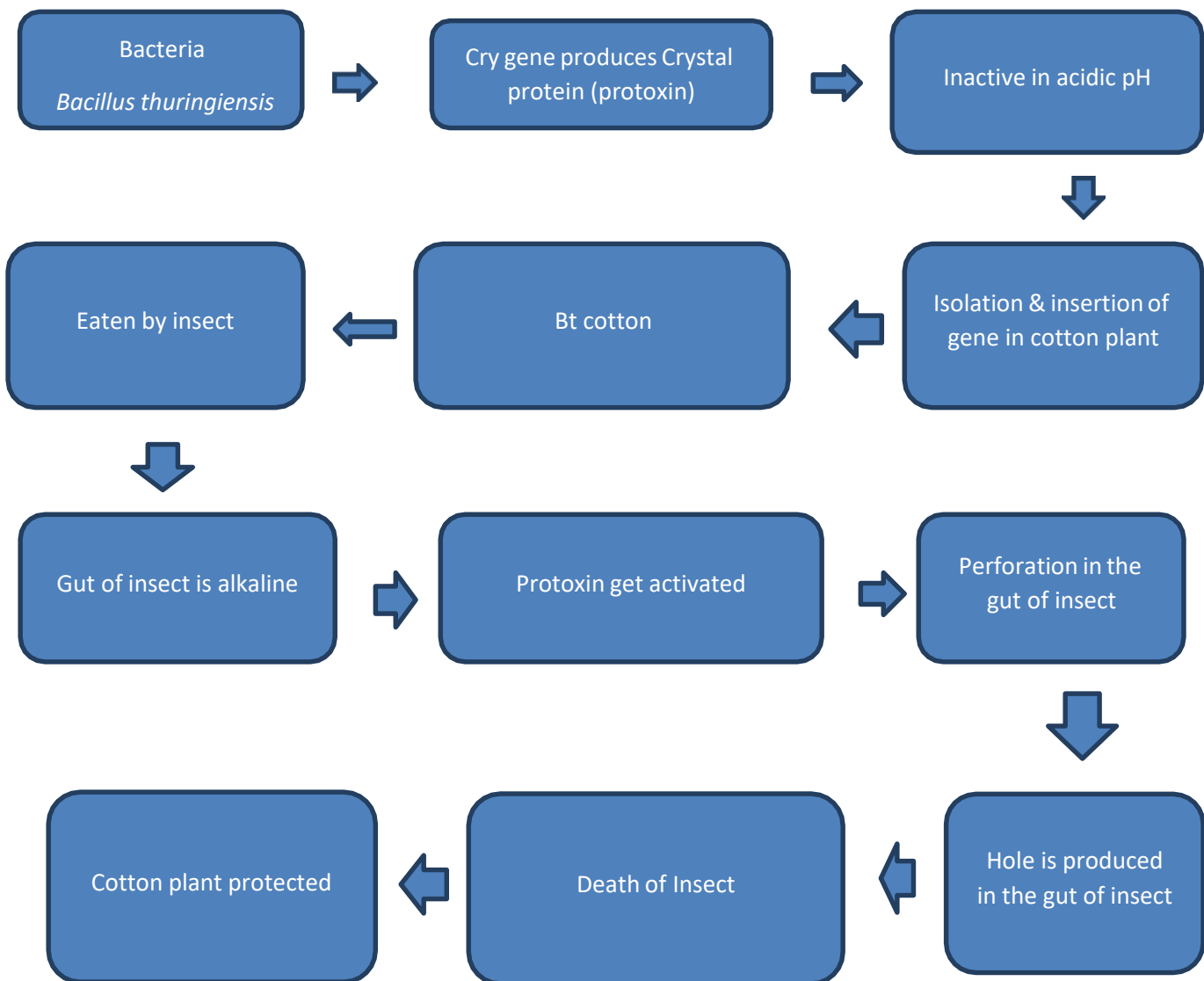
APPLICATIONS OF BIOTECHNOLOGY

PRODUCTION OF PEST RESISTANT PLANTS:-

(A) Bt Cotton:-

- i) The soil bacterium *Bacillus thuringiensis* produces crystal proteins called Cry proteins that are toxic to larvae of insects like tobacco budworm, armyworm, beetles and mosquitoes.
- ii) The cry proteins exist as inactive protoxins and get converted into active toxin when ingested by the insect, as the alkaline pH of the gut solubilises the crystals. iii) The activated toxin binds to the surface of the epithelial cells of midgut and create pores.
- iv) This causes swelling and lysis of cells leading to the death of the insect (larva).
- v) The cry genes encoding this protein isolated from the bacterium and incorporated into several crop plants like cotton, tomato,, corn, rice, soyabean etc.
- vi) The proteins encoded by the following cry genes control the pest given against them :-
- vii) Cry I Ac and Cry II Ab control cotton boll worms viii) Cry I Ab controls corn borer.

Action of cry gene at a glance:



(B) PROTECTION AGAINST NEMATODES

A nematode *Meloidegyne incognita* infects tobacco plants and reduces their yield. This nematode is controlled by a method called RNA interference:-

- i) The specific genes (in the form of cDNA) from the parasite are introduced into the plant using *Agrobacterium* as the vector.
- ii) The genes are introduced in such a way that both sense/coding RNA and antisense RNA (complementary to the sense / coding RNA) are produced.
- iii) Since these two RNAs are complementary, they form a Double stranded RNA (dsRNA)
- iv) This neutralises the specific RNA of the nematode by a process called RNA – interference.

As a result the parasite cannot live in the transgenic host and the transgenic plant is protected from the pest.

APPLICATIONS OF BIOTECHNOLOGY IN MEDICINE

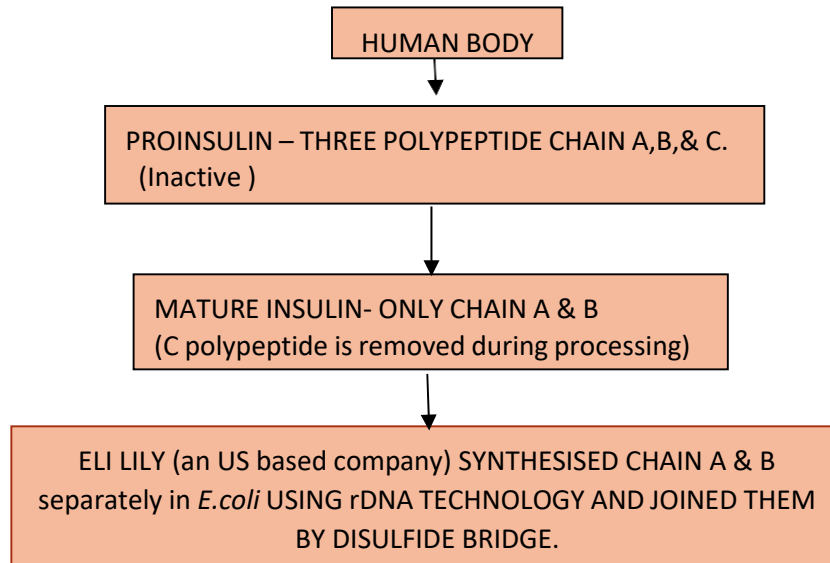
1. The rDNA technology has been used in the production of safe and more effective therapeutic drugs.
2. The recombinant therapeutics do not induce unwanted immunological responses that are commonly observed with similar products isolated from non – human sources.
3. At present about thirty recombinant therapeutics have been approved for human use, of which twelve are being marketed in India.

GENETICALLY ENGINEERED INSULIN (HUMULIN)

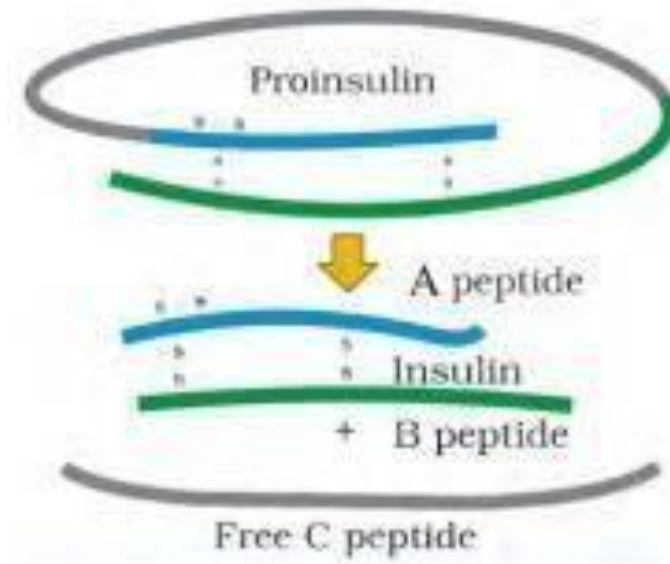
- a) Human insulin consists of two short polypeptide chains: - Chain A and Chain B, linked by disulphide bridges.
- b) Insulin is secreted as prohormone which has to be processed before it becomes a mature and functional hormone.
- c) The prohormone contains another polypeptide called C – peptide., which is removed during maturation.
- d) In 1983, Eli Lilly, an American company, prepared two DNA sequences coding for chains A and B of human insulin and introduced them into the *E.coli* to produce insulin.
- e) The two chains produced were extracted and combined by creating disulphide bridges.

INSULIN PRODUCTION BY r-DNA TECHNOLOGY

Maturation of proinsulin to insulin



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



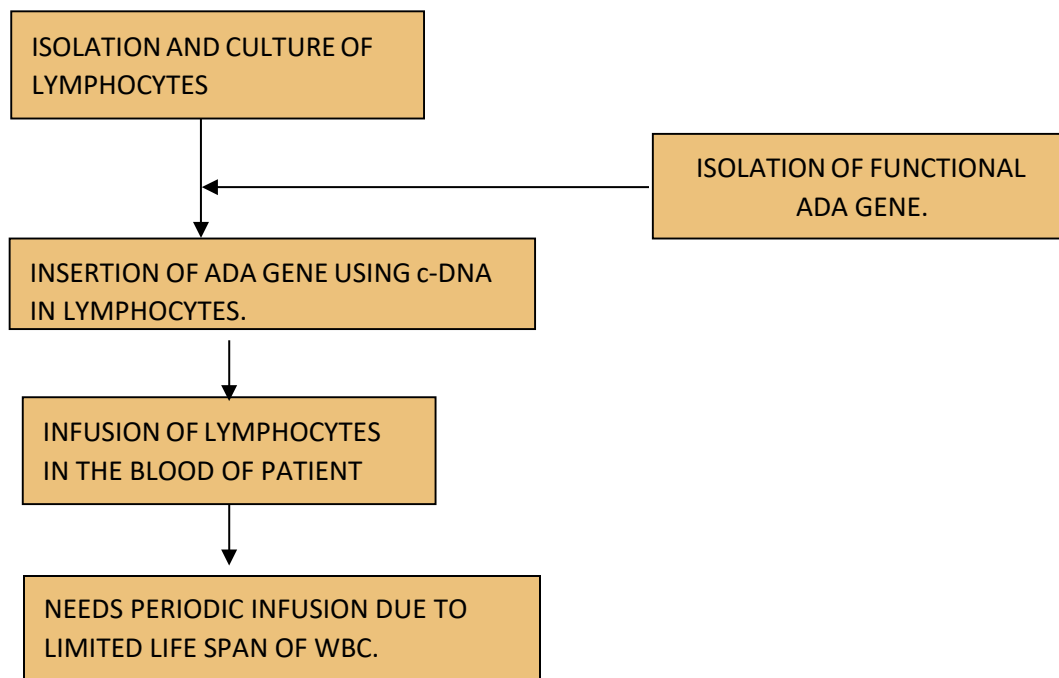
Maturation of Pro insulin to insulin:

<https://www.youtube.com/embed/uST-u8flcow>

GENE THERAPY:

Gene Therapy is a collection of methods that allows correction of gene defect.

- i) In this method, genes are inserted into the cells and tissues of an individual to correct certain hereditary diseases.
- ii) It involves the delivery of a normal gene into the individual or embryo to replace the defective mutant allele of the gene.
- iii) Viruses which attack the host and introduce their genetic material into the host are all used as vectors.
- iv) The first clinical gene therapy was given in 1990 to a four year old girl with adenosine deaminase (ADA) deficiency.



TREATMENT OF ADA DEFICIENCY

Traditional Method: - ADA deficiency can be cured by bone marrow transplantation in some children, but it is not completely curable.

Modern Method:-

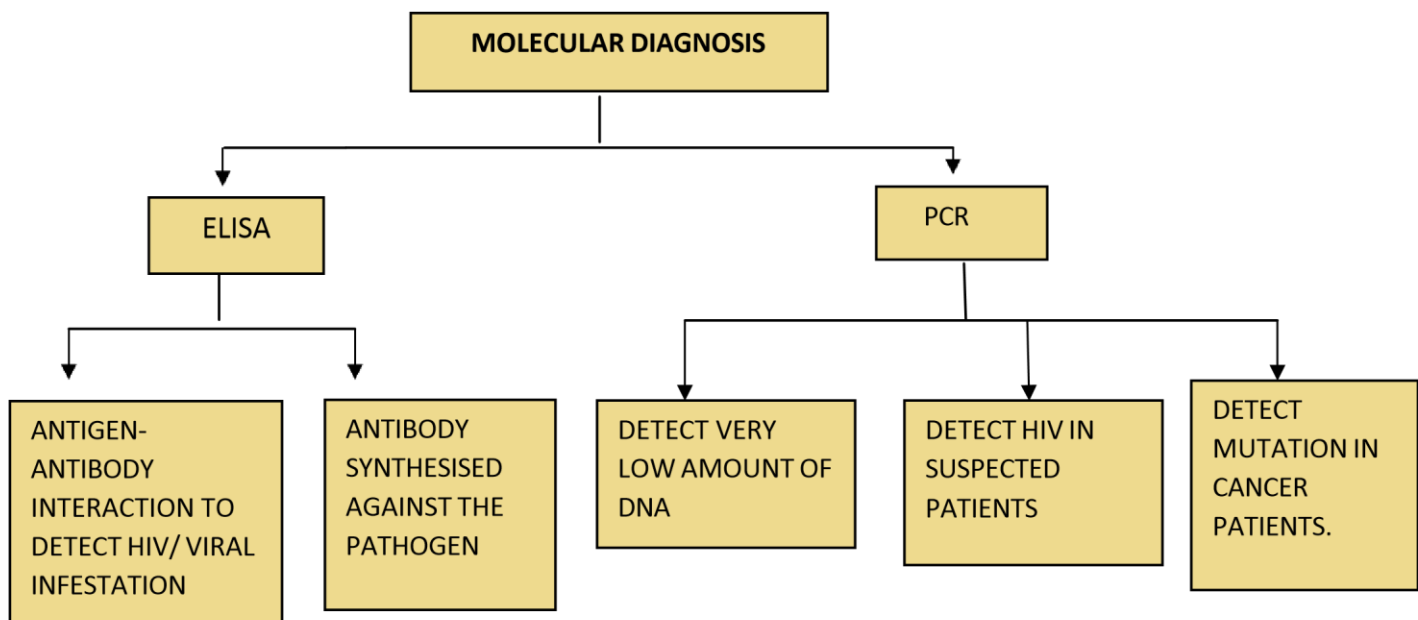
- a) For gene therapy, lymphocytes were grown in a culture and functional ADA, c DNA is then introduced into these lymphocytes using retroviral vectors. These lymphocytes are then transferred into the body of the patient. The patient requires periodic infusion of such genetically engineered lymphocytes.
- b) If a functional gene is introduced into the bone marrow cells at early embryonic stage, it would be a permanent cure.

- i) Recombinant DNA molecule and techniques like PCR are used for early diagnosis of disorders.
- ii) Cloned genes when expressed to produce recombinant proteins , help in developing sensitive diagnosis of techniques like ELISA.
- iii) The cloned genes are also used as probes to detect the presence of complementary DNA strand.

A probe is a piece of a single stranded DNA that is tagged with a radioactive molecule and it is used to find its complementary DNA by hybridisation. It is followed by detection of radioactivity by autoradiography.

- iv) Presence of normal or mutant gene can also be detected using such a method.

MOLECULAR DIAGNOSIS



TRANSGENIC ANIMALS

Transgenic animals are those animals that have had their DNA manipulated to possess and express a foreign gene.

Importance of Transgenic Animals :-

- i) Transgenic animals can be specifically designed to allow the study of how genes are regulated and how they affect the normal functions of the body and its developments. Eg. Information is obtained about the biological role of insulin like growth factors.

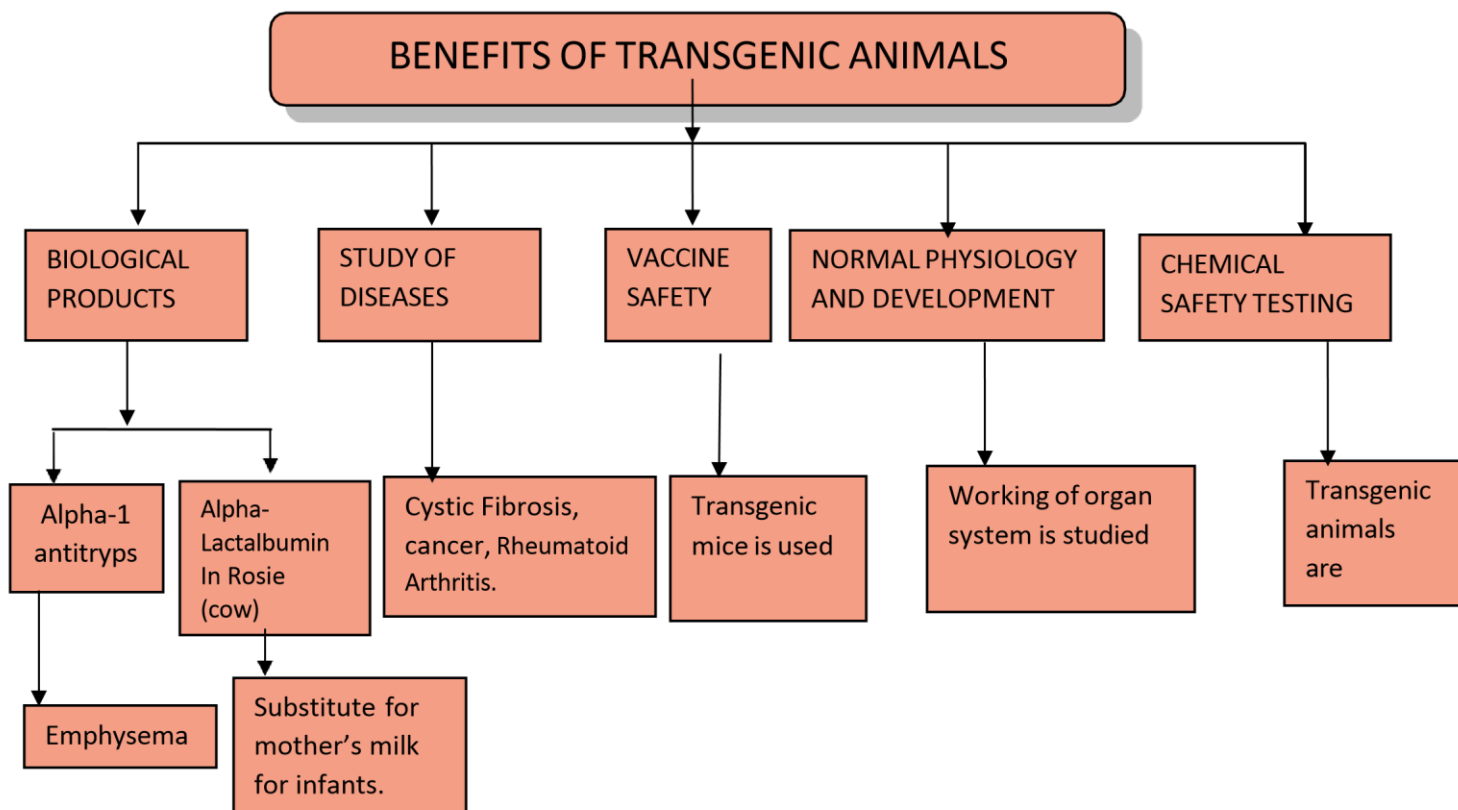
Transgenic animals are designed to increase our understanding of how genes contribute to the development of diseases. They are made to serve as models for human diseases.

- iii) Transgenic animals that produce useful biological compounds can be created by introducing a human protein used to treat emphysema.

eg. The first transgenic cow , Rosie ,produced the human protein enriched milk (2.4g/l).It also contained human alpha lactalbumin, a more nutritionally balanced product for human babies.

- iv) Transgenic are being developed for use in testing the safety of vaccines (e.g. polio vaccine)
- v) Transgenic animals with more sensitivity , to toxic substances are being developed to test the toxicity of drugs.

BENEFITS OF TRANSGENIC ANIMALS:



STEM CELL TECHNOLOGY

- * Definition :- Stem cells are the undifferentiated cells, which can divide (by mitosis) and differentiate into specialised cells.
- * Location :-
 - a) Embryonic stem cells are found in the inner cell mass of blastocyst and adult stem cells are found in the bone marrow , blood , adipose tissue etc.
 - b) Stems cells are also obtained from umbilical cord blood just after birth.
- Properties of Stem Cells :-
 - a) Self – renewal or ability to multiply.
 - b) Potential to differentiate into specialised cells.
- Example :- Bone marrow transplantation is an example of stem cell therapy.

ETHICAL ISSUES

- * Genetic modification of organisms can have unpredictable / undesirable effects, when such organisms are introduced into the ecosystem.
- * The modification and use of such organism for public service has also resulted in problems with the granting of patents.

GEAC (Genetic Engineering Approval Committee) :-

The Indian Govt. has set up GEAC which is authorised:-

- i) To make decisions regarding the validity of genetic modifications and
- ii) The safety of introducing genetically modified organisms for public services.

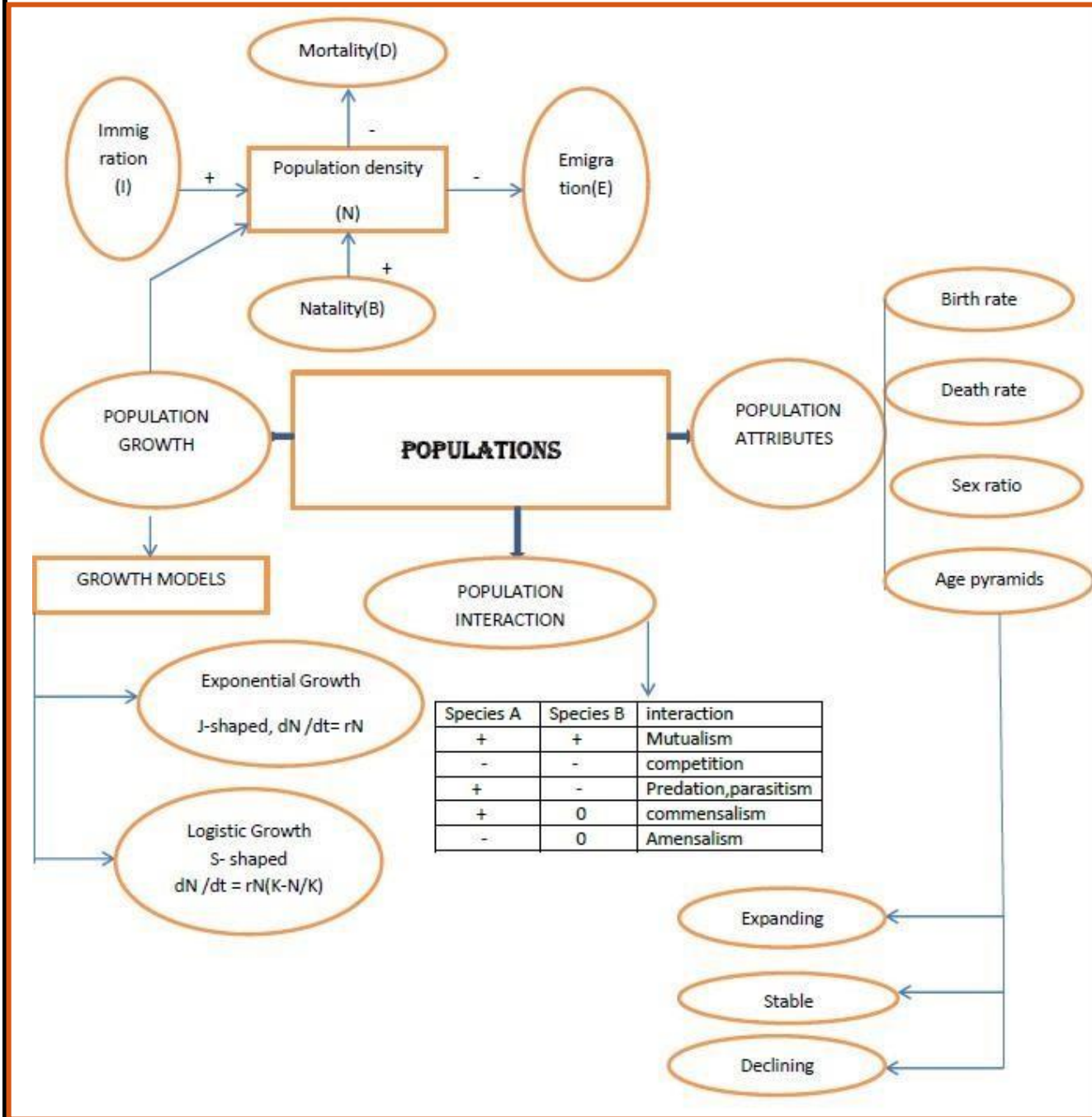
BIOPIRACY

Biopiracy refers to the use of bioresources by multinational companies and other organisations without proper authorisation from the countries and people concerned or without giving compensation to the people / countries concerned.

The industrialised / developed nations are rich financially, but poor in biodiversity and traditional knowledge, while the developing and underdeveloped countries are rich in bioresources and traditional knowledge. Such developed countries often indulge in Biopiracy.

Example :- The genome of Basmati Rice, Neem and Haldi was illegally patented by multinational companies illegally, however, these crops are of Indian Origin.

Unit 10 - ECOLOGY Chapter 11 - ORGANISMS



AND POPULATIONS

Ecology: Study of interactions among organisms between organisms and their physical environment.

Ecosystem: Biological community of interacting organisms and their physical environment. **Populations:** A group of individual living in a well-defined geographical area, share or compete for similar resources, potentially interbreed.

POPULATION:

Population growth: Depends on the following factors.

Population size fluctuated due to changes in four basic processes, two of which (Natality and immigration) contribute an increase in population density and two (mortality and emigration) to a decrease.

Representation of age pyramids for human populations:

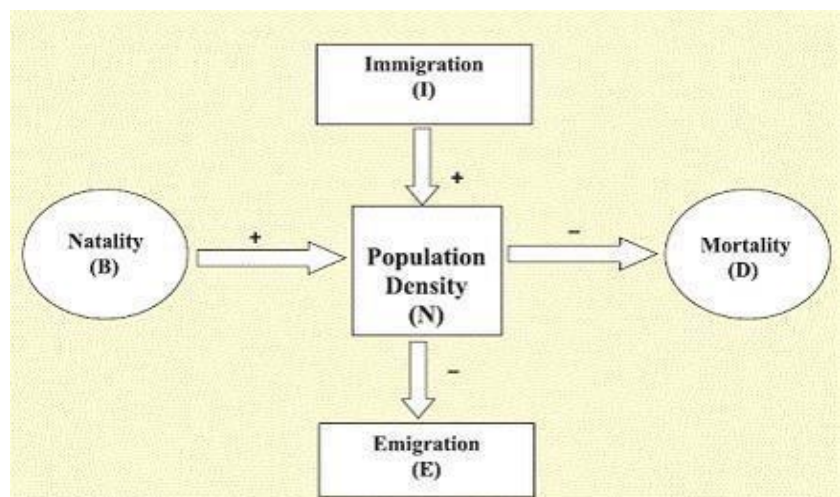
The geometrical diagrammatic representation of different age groups in a population of any organism is called Age of pyramids. These are of three types:-

- i) Expanding pyramid:- It is a broad base, triangular pyramid which represents a population containing large number of young people. It is rapidly expanding population with high birth rate.
- ii) Stable pyramid:- It represents a moderate proportion of young to old. As the rate of growth becomes slow & stable i.e.- pre-reproductive & reproductive age groups becomes more or less equal in size
- iii) Declining Pyramid:- The type of pyramid of population decreasing in size is



characterised by a narrow base because there are fewer pre-reproductive individuals than in the other two age categories.

Natality: number of birth in given period in the population.



Mortality: number of deaths in the population in a given period of time.

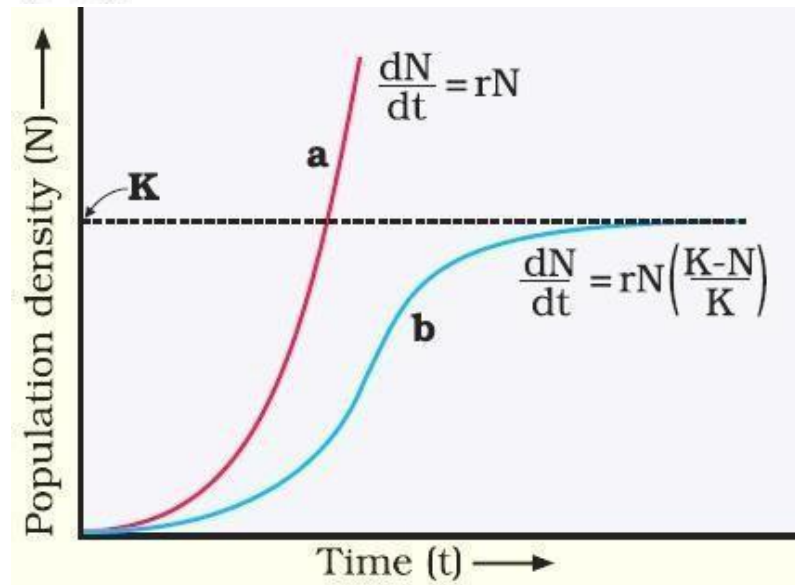
Immigration: is the number of individuals of same species that have come into the habitat from elsewhere during a given period of time.

Emigration: number of individuals of the population who left the habitat and gone elsewhere during a given time period.

Population Density:

If 'N' is the population density at time 't', then its density at time t + 1 is :

$$N_{t+1} = N_t + [(B + I) - (D + E)]$$



Where B = the number of births

I = the number of immigrants
D = the number of deaths
E = the number of Emigrants.

N = Population Density
r = Intrinsic rate of natural increase
t = Time period

K= Carrying capacity (maximum population size that an environment can sustain) **Exponential growth:**

- * The Exponential growth equation is $N_t = N_0 e^{rt}$
- * N_t = Population density after time t
- * N_0 = Population density at time zero
- * r = intrinsic rate of natural increase
- * e = the base of natural logarithms (2.71828) **Exponential growth ('J' shape curve is obtained).**
- * When resources are not limiting the growth.
- * Any species growth exponentially under unlimited resources conditions can reach enormous population densities in a short time.
- * Growth is not so realistic.

Logistic growth model

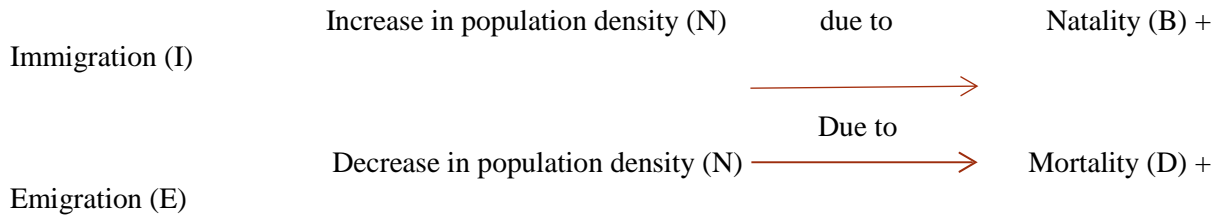
- * Verhulst-Pearl Logistic Growth is described by the following equations

- * $dN/dt = rN (K-N / N)$
- * Where N = Population density at time t
- * r = Intrinsic rate of natural increase
- * K = Carrying capacity

Logistic Growth (Sigmoid curve is obtained)

- * When responses are limiting the Growth.
- * Resources for growth for most animal populations are finite and become limiting.
- * The logistic growth model is a more realistic one.

POPULATION DENSITY



POPULATION GROWTH CURVE

INITIAL POPULATION —→ In presence of unlimited resources —→

Increases infinitely —→ Exponential growth.

Initial population —→ in presence of limited resources (carrying capacity) —→
 increases till a limit and then stabilizes > Logistic growth

Species A	Species B	Name of Interaction
+	+	<i>Mutualism</i>
-	-	<i>Competition</i>
+	-	<i>Predation</i>
+	-	<i>Parasitism</i>
+	0	<i>Commensalism</i>
-	0	<i>Amensalism</i>

Population Interactions:

Predation is an interaction in which one organism, the predator, eats all or part of the body of another organism, the prey. For plants Herbivores are predators. is a form of predation in which the prey organism is a plant. Example American Pacific Coast the starfish *Pisaster* is a predator. **Competition**

A process in which the fitness of one species (measured in terms of its 'r' the intrinsic rate of increase) is significantly lower in the presence of another species.

Eg. Abingdon tortoise in Galapagos Islands became extinct after goats were introduced on the island due to the greater browsing efficiency of the goats

Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one will be eliminated eventually true if resources are limiting

Parasitism

Close relationship between species where one organism, the parasite, lives on or inside another organism, the host causing it some harm, and adapted structurally to this way of life. Eg. The human liver fluke (a trematode parasite) depends on two intermediate hosts (a snail and a fish) to complete its life cycle

Parasites that feed on the external surface of the host organism are called ectoparasites.

Example *Cuscuta*

Endoparasites are those that live inside the host body at different sites

Brood parasitism in which the parasitic bird (cuckoo) lays its eggs in the nest of its host (crow) and lets the host incubate them

Commensalism:

Type of interaction in which one species benefit and the other is neither harmed nor benefited Example

- * An orchid growing as an epiphyte on a mango branch
- * Barnacles growing on the back of a whale
- * The cattle egret and grazing cattle
- * sea anemone that has stinging tentacles and the clown fish that lives among them

Mutualism

Interaction that benefits both the interacting species.

- * Lichens: relationship between a fungus and photosynthesising algae or cyanobacteria. * Mycorrhizae are associations between fungi and the roots of higher plants * Animals pollinating flowers and dispersing their seeds. * Fig trees and pollinator species of wasp

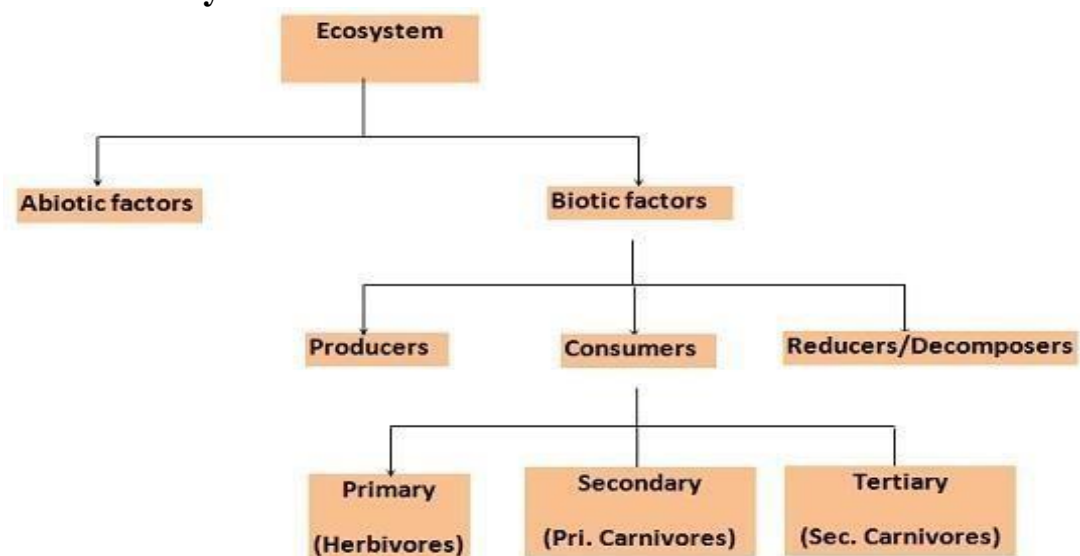
- * female wasp uses the fruit as an oviposition (egg-laying) site and for the developing seeds within the fruit for nourishing its larvae.
- * The Mediterranean orchid *Ophrys* employs 'sexual deceit' to get pollination done by a species of bee.

Link for Population interactions- Video:

<https://www.youtube.com/embed/uBSIz9mms8c>

Chapter 12 - ECOSYSTEMS

The interaction between the living organism and the non-living environment is called **ecosystem**.



ECOSYSTEM – STUCTURE AND FUNCTION:

The following components of the ecosystem functions as a unit: i) Productivity.

- ii) Decomposition.
- iii) Energy flow and
- iii) Nutrient cycle.

Link for Ecosystem Video

<https://www.youtube.com/embed/9MBdtbe5xDQ>

PRODUCTIVITY:

Primary productivity:

The amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis. The rate of biomass production is called **productivity**.

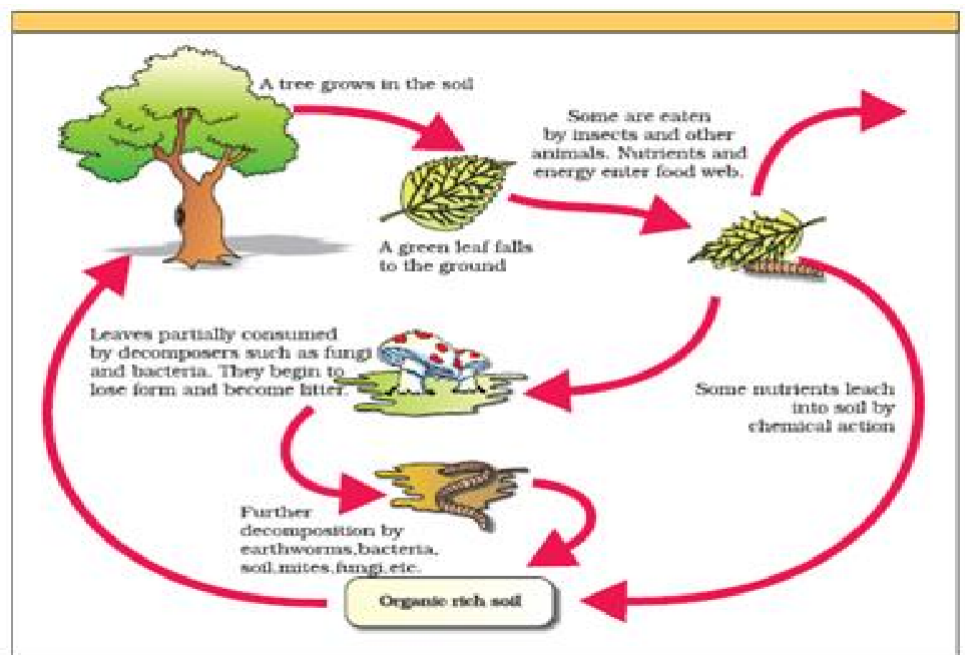
Gross primary productivity (GPP): The rate of production of organic matter during photosynthesis.

Net primary productivity:

A considerable amount of energy is utilized by plants in respiration. Gross primary productivity minus respiration losses (R) is the net primary productivity. $GPP - R = NPP$.

Net primary productivity is the available biomass for the consumption to heterotrophs (herbivore and decomposers).

Secondary productivity: The rate of formation of new organic matter by the consumer.



DECOMPOSITION:

The important steps in the process of decomposition:

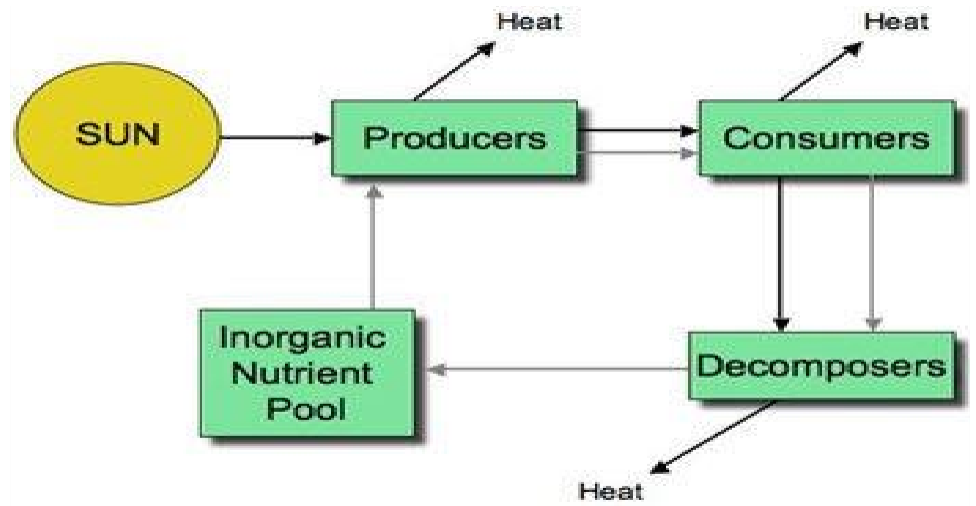
- i) **Fragmentation:** Detritivores (e.g., earthworm) break down detritus into smaller particles. This process is called fragmentation. ii) **Leaching:** Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts. iii) **Catabolism:** Bacterial and fungal enzymes degrade detritus into simpler inorganic substances. This process is called as catabolism. iv) **Humification:** leads to accumulation of a dark coloured amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate. Being colloidal in nature it serves as a reservoir of nutrients. v) **Mineralisation:** The humus is further degraded by some microbes and release of inorganic nutrients occur by the process known as mineralisation.

Factors affecting Decomposition:

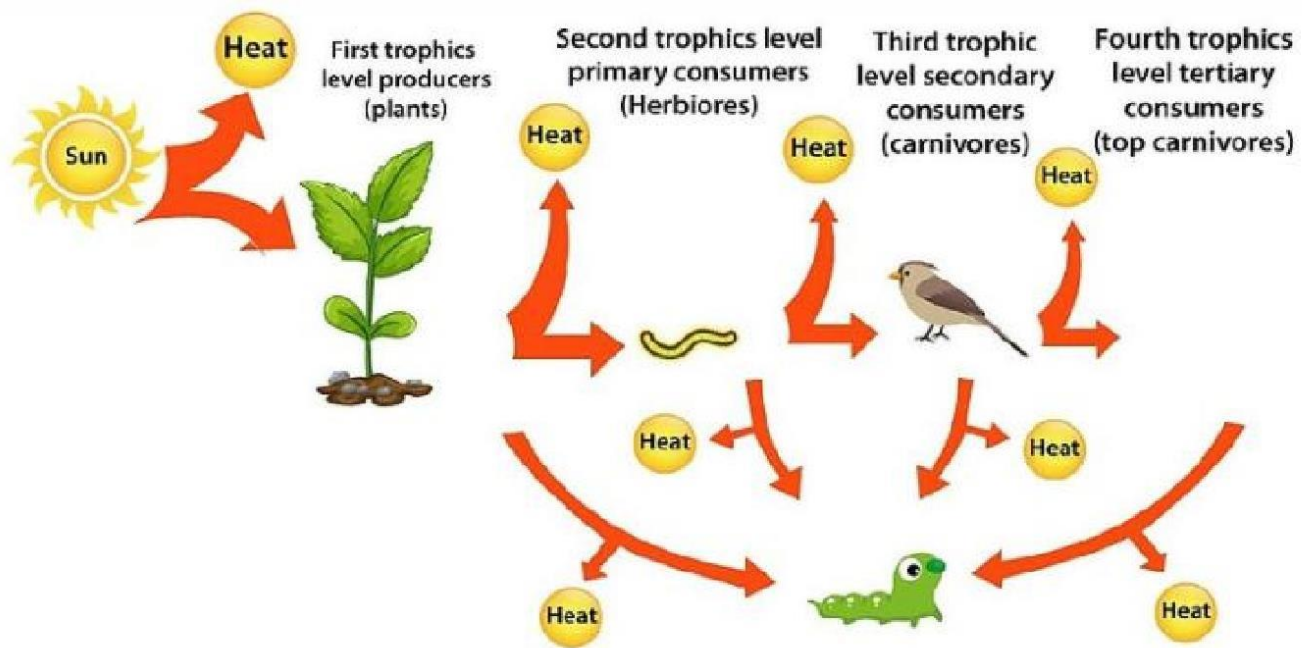
- i) The rate of decomposition is controlled by chemical composition of detritus and climatic factors.
- ii) In a particular climatic condition, decomposition rate is slower if detritus is rich in lignin and chitin, and quicker, if detritus is rich in nitrogen and water-soluble substances like sugars.
- iii) Temperature and soil moisture are the most important climatic factors that regulate decomposition through their effects on the activities of soil microbes.
- iv) Warm and moist environment favour decomposition whereas low temperature and anaerobiosis inhibit decomposition resulting in build-up of organic materials.

ENERGY FLOW

- * Flow of energy is unidirectional from the sun to producers and then to consumers.
- * The green plants in the ecosystem are called producers.
- * All organisms are dependent for their food on producers, either directly or indirectly.
- * In a terrestrial ecosystem, major producers are herbaceous and woody plants and in an aquatic ecosystem major producers are phytoplankton, algae and higher plants.
- * All animals depend on plants (directly or indirectly) for their food needs and they are called consumers.



Energy Flow through different Trophic Levels



Trophic levels in an ecosystem:

	Examples	
Tertiary Consumer	Fourth Trophic level (Top Carnivore)	Man, lion
Secondary Consumer	Third trophic level (Carnivore)	Birds, fishes, wolf
Primary Consumer	Second trophic level (Herbivore)	Zooplankton, grasshopper and cow
Primary Producer	First Trophic level (Plants)	Phytoplankton, grass, trees



Food chain: The sequence of transfers of matter and energy in the form of food from organism to organism forms food chain.

Grazing food chain (starts from producers through herbivore to carnivore)

**Fo
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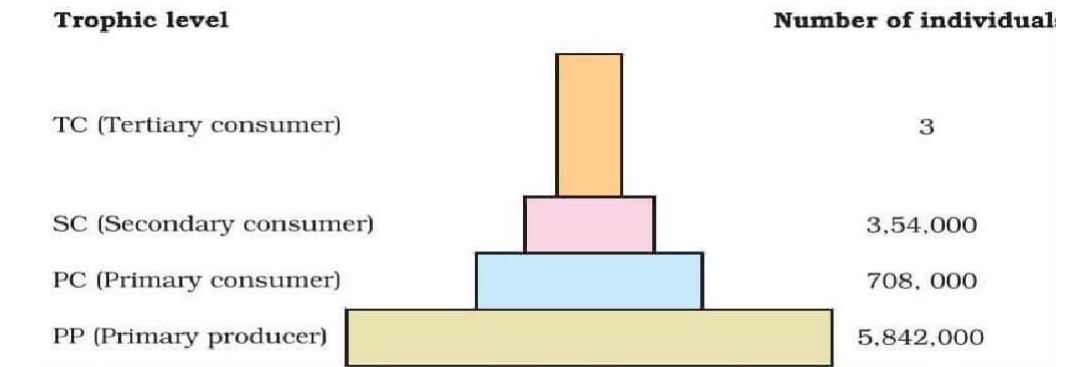
Detritus food chain (starts from dead organic matter (detritus) and pass through detritus feeding organism in soil to organisms feeding on detritus-feeders).

ECOLOGICAL PYRAMID:

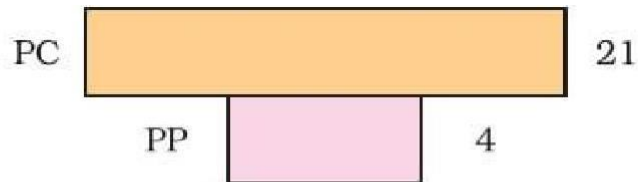
- * The base of the pyramid is broad and it narrows down at the apex. The similar shape is obtained when food or energy relationship between organisms at different trophic level.
- * The relationship can be expressed in terms of number, energy or biomass.
- * The base of the pyramid represented by producer and apex is the top consumer; other trophic levels are in between.
- * In most ecosystems, all the pyramids, of number, of energy and biomass are upright.
- * The pyramid of **number** in a tree ecosystem is **inverted**.
- * The pyramid of **biomass** in sea also **inverted** because the biomass of fishes is far exceeds that of phytoplankton.

Pyramid of **energy** is **always upright**, can never be inverted, because when energy flows from a particular trophic level to the next, some energy is always lost as heat at each step.

Pyramid of numbers in a grass land ecosystem:

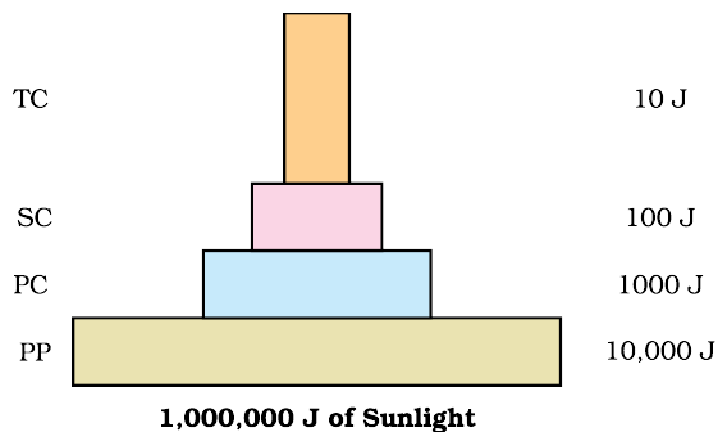


Pyramid of numbers in a grassland ecosystem. Only three top-carnivores are supported in an ecosystem based on production of nearly 6 millions plants



Inverted pyramid of biomass-small standing crop of phytoplankton supports large standing crop of zooplankton

Inverted pyramid



An ideal pyramid of energy

ECOSYSTEM SERVICES:

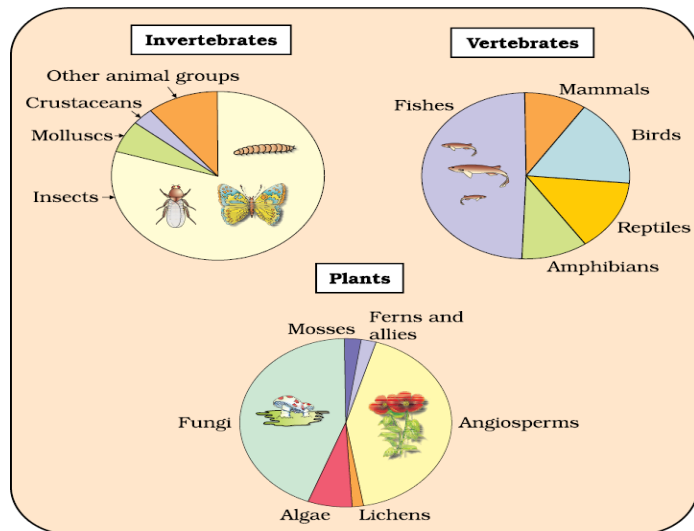
- * The products of ecosystem processes are named as **ecosystem services**.
- * Healthy forest ecosystems purify air and water.
- * Mitigate droughts and flood.
- * Cycle nutrients and generates fertile soil.
- * Provide wildlife habitat, maintain biodiversity and pollinate crops.
- * Provide storage site for carbon
- * Provides aesthetic, cultural and spiritual values

Chapter 13 - BIODIVERSITY AND CONSERVATION

Biodiversity: the term biodiversity refers to the totality of genes, species, and ecosystems of a region.

Genetic diversity	Species diversity	Ecological diversity
<p>A single species might show high diversity at the genetic level over its distributional range.</p> <p>Eg. Medicinal plant <i>Rauwolfia vomitoria</i> of Himalayan range produces active chemical reserpine shows genetic variation.</p> <p>India has more than 50000 different strain of rice.</p> <p>varieties of mango.</p>	<p>The diversity at the species level.</p> <p>Eg. The Western Ghats have a greater amphibian species diversity than Eastern Ghats.</p>	<p>Diversity in the ecological level like desert forest, mangrove forest, reef, wetlands, etc.</p>

Types of biodiversity described by **Edward Wilson:**



Global Biodiversity: Proportionate number of species of major taxa of plants, invertebrates and vertebrates.

Pattern of Biodiversity:

Latitudinal gradients:

- * Species diversity decreases as we move away from the equator towards the pole.
- * Tropic (23.5° N to 23.5° S) harbors more species than temperate and pole
- * The largely tropical Amazonian rain forest in South America has the greatest biodiversity on earth:
- * 40,000 species of plants, .3000 species of fishes, 1300 of birds, 427 amphibians, 378 reptiles and more than 1, 25,000 invertebrates.
- * Unlike temperate regions subjected to frequent glaciations in the past, tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification.
- * Tropical environments. Unlike temperate ones, are less seasonal, relatively more constant and predictable, promotes niche specialization and lead to greater species diversity.
- * There is more solar energy available in the tropics, which contribute to higher productivity.

- * ALEXANDER VON HUMBOLDT observed within a region species richness increased with increasing explored area but only up to a limit.
- * The relation between species richness and area for a wide variety of taxa turns out to be a rectangular hyperbola.
- * On a logarithmic scale the relationship is a straight line describe by the equation **LogS = logC +Z log A**

Where S= species richness, A = Area, Z = slope of the line (regression coefficient), C =Y- intercept.

Species area relationship:

ALEXANDER VON HUMBOLDT observed within a region species richness increased with increasing explored area but only up to a limit.

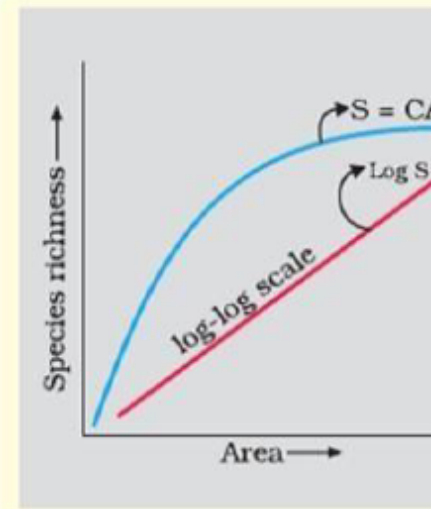
The relation between species richness and area for a wide variety of taxa turns out to be a rectangular hyperbola.

On a logarithmic scale the relationship is a straight line describe by the equation

$$\text{Log}S = \text{log}C + Z \text{ log } A$$

Where S= species richness, A = Area, Z = slope of the line (regression coefficient), C = Y- intercept.

It has been noted that regardless of the taxonomic group or region the slope of the regression line are amazingly similar. However, for a very large area like the entire continent the slope of the line is steeper.



David Tillman's long-term field experiment finds that: Plots with more species showed less year to year variation in biomass * Increased diversity contributed to higher productivity.

The rivet popper hypothesis: In an airplane (ecosystem) all parts are joined together by thousands of rivets (species).

If every passenger starts popping a rivet to take home (species extinct), it may not affect flight safety initially but as more and more rivets are removed the plane becomes dangerously weak.

- * Furthermore which rivet is removed may also be critical.
- * Loss of rivets on the wings (key species) is obviously a more serious threat to flight safety than loss of a few rivets on the seats or windows inside the plane.

Loss of Biodiversity:

- * The IUCN Red List (2004) documents the extinction of 784 species.
- * Recent extinction includes: Dodo (Mauritius), Quake (Africa), Thylacine (Australia), Stiller's cow (Russia), Three subspecies of tiger (Bali, Java, Caspian).

- * Since the origin and diversification of life on earth there were **five episodes of mass extinction** of species.

The sixth mass Extinctions in progress now.

The Sixth Extinction is different from the previous five extinctions because the current extinction rate is 100 to 1000 times faster due to this one is anthropogenic influence.

Effects of biodiversity loss:

- * Decline in plant production.
- * Lowered resistance to environmental perturbations such as drought.
- * Increased variability in certain ecosystem processes such as plant productivity, water use, and pest and disease cycle.

Causes of biodiversity loss:

The present loss is all due to human activity (anthropogenic)

There are four major causes known as “**The Evil Quartet**” are as follows:

- * **Habitat loss and fragmentation:**
- * **Over-exploitation:**
- * **Alien species invasion:**

Eg. i) Nile perch introduced into Lake Victoria in east Africa led to extinction of 200 species of **cichlid fish** in the lake. **ii) *Parthenium***, (carrot grass), ***Lantana***, and water hyacinth (***Eichornia***) posed a threat to indigenous species. **iii) African cat fish *Clarias gariepinus*** for aquaculture purposed is posing a threat to indigenous catfishes in our rivers.

Co-extinction:

When a species becomes extinct, the plant and animal species associated with it an obligatory way also become extinct. Extinction of **Host species** leads to extinction of the **parasite** also. Co-evolved **plant- pollinator** mutualism where extinction of one invariably lead to the extinction of the other.

Conservation of Biodiversity:

Reason for conservation biodiversity is grouped into three categories. **i) Narrowly utilitarian. ii) Broadly utilitarian**

iii) Ethical

Narrowly utilitarian:

- * Human derive countless direct economic benefits from nature-
- * Food (cereals, pulses, fruits), firewood, fiber, construction material. *
- Industrial products (tannins, lubricants, dyes, resins, perfumes) * Products of medicinal importance.
- * **Bioprospecting:** exploring molecular genetic and species-level diversity for products of economic importance.

Broadly Utilitarian

- * Amazonian forest along produce 20% of oxygen during photosynthesis.
- * **Pollinator layer:** bees, bumblebees, birds and bat that pollinate the plant without which seed cannot be produced by plants.
- * Aesthetic pleasure we get from the biodiversity.

Two types of conservation of biodiversity: In situ and Ex situ conservation.

In situ conservation:

- * When we conserve and protect the whole ecosystem, its biodiversity at all level is protected – we save the entire forest to save the tiger. This approach is called **in situ** (on site) conservation.
- * **Biodiversity hot spot:** regions with very high levels of species richness and high degree of **endemism**. (species confined to that region and not found anywhere else) * Hot spot in biodiversity is also regions of accelerated habitat loss.
- * Out of 34 hot spot in the world, three hot spot located in India:
 - Western Ghats and Srilanka.
 - Indo-Burma.
 - Himalaya.
- * Other protected area under in situ conservations are: ○ 14 biosphere reserve ○ 90 national park ○ 448 wild life sanctuary
- * **Sacred groves:** tract of forest were set aside, and all the trees and wildlife within were venerated and given total protection.

Ex situ conservation: threatened animals and plants are taken out from their natural habitat and placed in special setting where they can be protected and given special care. * Zoological Park. * Botanical garden * Wildlife safari.

- * Conservation of gamete by **cryopreservation**.
- * Genetic strains are preserved in **seed bank**.
- * **Convention on Biodiversity:**
- * **“The earth Summit”** held in Rio de Janeiro in 1992 called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilization of its benefits.
- * **World Summit** on Sustainable development held in 2002 in Johannesburg, South Africa, 190 countries pledged their commitment to achieve by 2010 a significant reduction in the current rate of biodiversity loss at global, regional and local level.

CHAPTER :- 1

SEXUAL REPRODUCTION IN FLOWERING PLANTS

VERY SHORT ANSWER TYPE QUESTIONS. (one mark)

- The function of coleoptile is
A It protect radicle of monocot.
B It protect root tip
C. It protects the plumule of the monocot embryo.
D. None of these
- The function of scutellum.is
A It protect and provide nourishment to the developing embryo.
B. It protects plumule
C. It protects radicle
D. It provides only protection
- The type of pollination in maize is.
A Anemophily or wind pollination. B. Hydrophily
C. Entomophily D. none of these
- Identify the type of flower which favours cross pollination.
A. Cleistogamy B. Geitonogamy C. Chasmogamy D. none of these
- The type of pollination in self-incompatible plants is
A. Xenogamy B. cleistogamy C. geitonogamy D Chasmogamy.
- How many nuclei are present in fully developed male gametophyte of flowering plants?
A. One B. Two C. Three D. Four
- Which nuclei fuse to give rise to endosperm?
A. Polar nuclei of central cell which belong to the female gametophyte and the one male gametophyte.
B. only polar nuclei
C. only generative nuclei
D. only vegetative nuclei.
- What is the site of microsporogenesis ?
A. Nucellus B. megasporangium C. Microsprangium or pollen sac of anther
D. both A&B
- What is the site of megasporogenesis ?
A. Microsprangium . B. Nucellus tissue (megasporangium) present in ovule.
C. Tapetum D. none of these
- What is nucellus ?
A. It is mass of parenchymatous cell rich in reserve food material.
B. It is mass of sclerenchymatous cell rich in reserve food material.
C. It is mass of collenchymatous cell rich in reserve food material. D.
None

11. The substance of which the intine and exine is made up of.
- A. Only cellulose
- B. only pectose
- C. Sporopollenin
- D. cellulose & pectin and sporopollenin.
12. How many germ pore are there in pollen grains of monocot and dicot ?
- A. Both have same
- B. In monocot two and dicot has two
- C. In monocot one and dicot has three germ pore.
- D. both A&B
13. The function of filiform apparatus is.
- A. The filiform apparatus guides the egg apparatus into the synergid.
- B. The filiform apparatus guides the pollar nuclei into the central cell.
- C. The filiform apparatus guides the pollen tube into the synergid.
- D. none
14. Which of the following is/are example/s of non - albuminous seed?
- A. Pea B, groundnut C. both D. none
15. How many meiotic divisions are required to produce 76 seeds in guava fruit ?
- A. 90 B. 93 C. 94. D. 95
- *. 76 functional pollen will be formed by $76/4 = 19$ meiotic divisions and 76 egg cells are produced by 76 meiotic divisions So total meiotic division required to produce 76 seeds $76+19 = 95$.

Assertion and reasoning type questions.

In each of the following questions two statements are given, one is Assertion (A) and other is Reason (R) statements, mark the correct answer as-

- (A) If both A and R are true and R is the correct explanation of A.
- (B) If both A and R are true and R is not the correct explanation of A.
- (C) If A is true but R is false. (D) If both A and R are false.

16..Assertion . Insect visit flower to gather honey.

Reason . Attraction to flowers prevents the insects from damaging other part of the plant.

17. Assertion . In some species of Asteraceae and poaceae seeds are formed without fertilization.

Reason . Formation of fruit without fertilization is called parthenocarp.

Answers MCQ

Q No	1	2	3	4	5	6	7	8	9
Ans	C	A	A	C	A	C	A	C	B
Q.No	10	11	12	13	14	15	16	17	
Ans	A	D	C	C	C	D*	C	B	

(Two marks questions)

Q.1. What are the component cells of the egg apparatus in an embryo sac?

A. An egg apparatus consists of:

- One egg cell
- Two synergids

Q.2. Which part of gynoecium determines the compatible nature of pollen grain?

A. Stigma

Q.3. What is common in the function performed by nucellus and cotyledons?

A. The cotyledons and nucellus both store reserve food material and does the work of providing nourishment- nucellus (embryo sac), cotyledons (embryo).

Q.4. Fill in the missing words:

Pollen mother cell → Pollen tetrad → Pollen grain → Vegetative cell, ___? ___

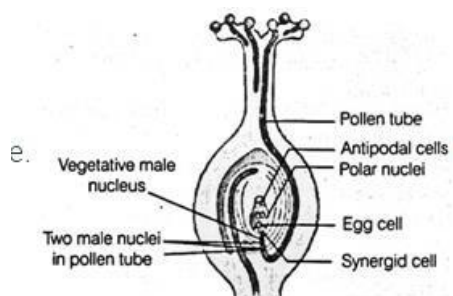
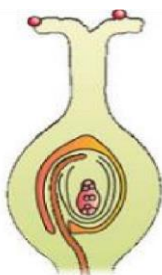
A. Generative cell

Q.5. In the following events, indicate the stages where mitosis and meiosis occur (1,2,3).

Megaspore mother cell →(1)→Megaspores→(2)→Embryo sacs→(3)→Egg

A. 1- Meiosis 2- Mitosis 3- Meiosis

Q.6. Show the direction of the pollen tube from the pollen on the stigma to the embryo sac in the given diagram.



A.

Q.7. Which regions of pistil form fruits and seeds?

A. The ovary develops into a fruit. The ovule develops into the seed.

Q.8. During polyembryony, if one embryo is formed from synergids and the other from nucellus, state the one that is haploid and the one that is diploid.

A. Embryo developed from the synergid- haploid and Embryo developed from the nucellus- diploid.

Q.9. Is it possible that an unfertilized apomictic embryo sac gives rise to a diploid embryo? Give a reason in support of your answer.

A. Yes, an unfertilized apomictic embryo sac can give rise to a diploid embryo. If the megaspore mother cell develops into an embryo sac without mitotic division, it will give rise to a diploid embryo.

Q.10. When a pollen grain is shed at the 3-celled stage, which three cells are found?

A. The following three cells are found at the three-celled stage:

- One vegetative cell
- Two male gametes

Q.11. Define self-incompatibility. How do self-incompatible plants pollinate?

A. Self-incompatibility is a genetic mechanism in which the growth of the pollen tube in the pistil is inhibited which prevents self pollens from fertilizing the ovules. The self incompatible plants pollinate by cross-pollination.

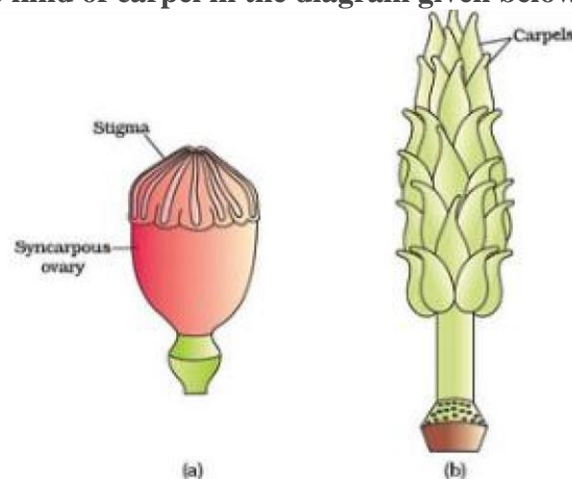
Q.12. Which is a triploid tissue? How is the condition achieved in a fertilized ovule?

A. The **endosperm** is a triploid tissue in a fertilized ovule. Triple fusion, leading to the fusion of one male gamete and two haploid polar nuclei form the triploid tissue.

Q.13. Does apomixis require fertilization and pollination? Give reasons in support of your answer.

A. No, apomixis does not require pollination and fertilization. This is because apomixis is a form of asexual reproduction in which the female reproductive apparatus is used. The embryos can develop directly from the nucellus or synergids.

Q.14. Mention the kind of carpel in the diagram given below.



A.14.

- (a) Multicarpellary, the syncarpous pistil of *Papaver*
- (b) Multicarpellary, apocarpous gynoecium of *Michelia*

Q.15. How do aquatic plants undergo pollination?

A. A few aquatic plants have their flowers growing in the air. They are pollinated by the insects. Other plants that have their flowers submerged in water release their pollen in the water that drifts in the water and are caught by the feathery stigma of female flowers.

Q.16. “Each pollen grain in the flowering plants produces male gametes.” State the function of the male gametes.

A. One male gamete fuses with the nucleus of the egg cell, while the other male gamete moves towards the two polar nuclei present in the central cell and fuses with it to form a triploid primary endosperm nucleus.

Q.17. List out the agents of pollination.

A. The pollinating agents are involved in transferring pollen grains from the male to the female part of the flower. Animals, birds, insects, wind and other biotic and abiotic agents are all examples of pollinating agents.

Q.18. What is pollination?

A. Pollination is a process of transferring pollen grains from the male anther of a flower to the flower's female part called the stigma. Pollination is the sexual mode of reproduction, which is carried out by all flowering plants of a plant kingdom.

Q.19. What are the stages of post-fertilization in plants?

A. In all flowering plants, the post-fertilization is a critical stage which occurs after the double fertilization and includes the series of steps:

1. Endosperm development.
2. Embryo improvement.
3. Development of ovule into a seed.
4. Development of ovary into a fruit.

Q.20. What are the male and female reproductive parts of a flower?

A. A flower plays a vital role in the reproduction process of a plant. Therefore, it is called the reproductive organ of plants.

The male reproductive parts of the flower include the stamen the filament and the anther, which are collectively termed the androecium.

The female reproductive parts of the flower include carpels, pistils, stigma, style and an ovary, which are collectively termed the gynoecium.

Q.21. What is cross-pollination?

A. Cross-Pollination is the complex type of pollination during which the pollen grains are transferred from the anther of one flower into the stigma of another flower. This type of pollination makes use of both biotic and abiotic agents like wind, water, insects, birds, animals, and other agents as pollinators.

Q.22. What are the main layers of a flower?

A. There are different types of flowers in a plant kingdom. A few among them vary in colour, structure, shape, etc. However, all flowers have unique layers. The four main layers of a flower:

1. Calyx
2. Corolla
3. Androecium
4. Gynoecium

Q.23. Define Morphogenesis.

A. Morphogenesis is defined as a biological process which controls the growth, development in size, shape and structure and distribution of cells during the embryonic development of an organism.

Q.24. State the role of endothecium.

A. The endothecium protects the microsporangium and helps in the dehiscence of anther for the release of pollen grains.

Short Answer Type Questions (3 marks)

Q.1. How does a chasmogamous bisexual flower prevent self-pollination?

A. A chasmogamous bisexual flower prevents self-pollination in the following ways:

1. **Dichogamy:** In this strategy, the release of pollens and the receptivity of stigma are not synchronized. i.e in sunflower, the stigma becomes receptive long after the pollen release.
2. **Herkogamy:** In this, the male and female flowers are present at different locations. In this, the pollen of the flower cannot come in contact with the stigma of the same flower. For eg., *Hibiscus gloriosa*
3. **Self-sterility:** It is a mechanism in which the growth of the pollen tube in the pistil or the germination of pollen grains is inhibited. This prevents the fertilization of the ovules from the pollen of the same flower. For eg., Abolition.

Q.2. Arrange them sequentially according to how they appear in the artificial hybridization programme.

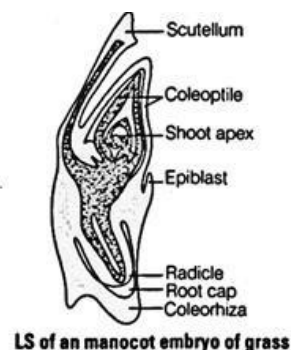
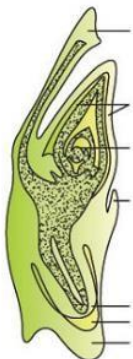
1. Rebagging
2. Selection of parents
3. Bagging
4. Dusting the pollen on the stigma
5. Emasculation
6. Collection of pollen

A. a) Selection of parents b) Emasculation c) Bagging d) Collection of pollen e) Dusting of pollen on the stigma f) Rebagging

Q.3. How do self-incompatibility restrict autogamy? How does pollination occur in such plants?

A. Self-incompatibility restricts autogamy by a mechanism known as self-sterility. This is a genetic mechanism in which the germination of pollen grains or the pollen tube growth in the pistil is inhibited which prevents the pollen from fertilizing the ovules. Such plants pollinate by the process of cross-pollination.

Q.4. Label the following diagram.



Q.5. Explain the term polyembryony. How is it exploited commercially?

A. When more than one embryo occurs in a seed, it is referred to as polyembryony. This can be seen in a few citrus fruits and mango varieties. Polyembryony plays a significant part in plant breeding and horticulture. These embryos give rise to virus-free plantlets and are

healthy. Hybrid varieties of such plants and vegetables are being grown extensively. These varieties thus obtained are highly productive.

Q.6. Is there any difference between apomixis and parthenocarpy? Explain the benefits of each.

A. Yes, **parthenocarpy** is different from apomixis. In parthenocarpy, the fruit is produced without the fertilization of the female gamete. It is used for the production of fruits without seeds such as banana and grapes for commercial purposes. Apomixis is the process in which the seeds are produced without fertilization but the process occurs in the female reproductive tract of the plant. In this, the megaspore mother cell does not undergo meiosis. It is used for the commercial production of hybrid varieties and in the production of virus-free varieties.

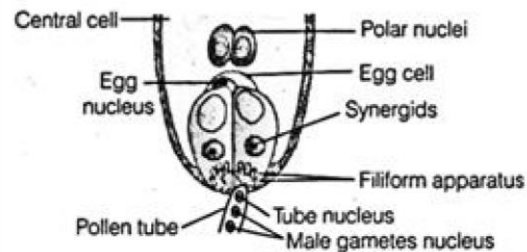
Q.7. The zygote divides only after the division of the primary endosperm cell. Give reasons in support of the statement.

A. Zygote requires nourishment for its growth and division. This nourishment is provided by the primary endosperm cell. That is why the zygote divides only after the growth, food storage and division of the primary endosperm cell.

Q.8. Why is it that the generative cell of 2-celled pollen divides in a pollen tube and not of 3-celled pollen?

A. The generative cell divides to form two male gametes. In three-celled pollen, the generative cell divides into two gametes, therefore, no further division takes place in the pollen tube. However, in two-celled pollen, the generative cell moves down the pollen tube and divides to form two male gametes.

**Q.9. Label the following parts in the diagram given below:
Male gametes, egg cell, polar nuclei, synergid, pollen tube.**



A.

Q.10. Explain the events which occur after the process of fertilization in plants.

A. Fertilization is a vital process, which takes place in all sexually reproducing organisms. In all flowering plants, fertilization occurs after pollination and germination. After the process of fertilization, the following events occur:

1. The ovary becomes the fruit
2. The ovules become the seeds.
3. The other structures including the corolla, calyx, and other remaining parts of the androecium and gynoecium degenerate or fall off.

Long Answer Type Questions (5 marks)

Q.1. Explain the pollination occurring in the chasmogamous flowers.

A. The chasmogamous flowers are open with their anther and stigma exposed for pollination. In these flowers two types of pollinations take place:

Self-Pollination: Self-pollination occurs when both the anther and the stigma mature simultaneously and come in contact with each other.

Cross-Pollination: This type of pollination occurs in self-incompatible plants. In this, the anther and the stigma mature at different times so cannot come in contact with each other.

Cross-pollination is of two types:

- **Geitonogamy**– When the pollen grains from the anther transfer to the stigma of a different flower in the same plant, it is known as geitonogamy.
- **Xenogamy**– When the pollen grains from the anther of a flower get transferred to the stigma of a flower in some other plant, it is known as xenogamy. This process carries genetically different pollen to the stigma.

Q.2. Describe the structure of the embryo sac of a mature angiosperm. Explain the role of synergids in it.

The cell walls of the 8 nucleate stage are organized in the form of a female gametophyte or embryo sac.

- Six out of the eight nuclei are surrounded by cell walls.
- The egg apparatus comprises two synergids and one egg cell.
- Three cells called the antipodals are present at the chalazal end.
- The central cell is formed by the fusion of two polar nuclei.
- On maturity, the embryo sac of the angiosperms consists of 8 nuclei and 7 cells.
- A single megaspore gives rise to the embryo sac, hence called monosporic embryo sac.

Role of Synergids

The synergids are responsible for the reproduction in an angiosperm. During fertilization, a pollen tube grows into one of the synergids. The tube ceases growth, ruptures and releases two sperm cells.

Q.3. How is it that the embryo sacs of some apomictic species look normal but contain diploid cells?

A. The offsprings produced by apomixis are genetically identical to the parent. In flowering plants apomixis is used to reproduce asexually through seeds. In a few species, the diploid egg cell does not undergo reduction division and forms an embryo without fertilization. In a few citrus species, the nucellar cells surrounding the embryo sac divide and give rise to an embryo. This takes place in the megaspore mother cell. It only undergoes mitosis and hence produces diploid cells in the embryo sac.

Q.4. What are the characteristics of wind, water and insect-pollinated flowers?

A. Characteristics of wind-pollinated flowers:

- These flowers are not brightly coloured.
- They possess no special odours or nectar.
- They are small and have no petals.
- Their stigma and stamens are exposed to air currents.
- The pollen is smooth, light can be blown easily by wind and are in large numbers.
- The stigma is feathery and can catch pollen from the wind.

Characteristics of water-pollinated flowers:

- They possess small male flowers that are not clearly visible.
- A large number of pollens are released in water that is caught by large, feathery stigma of female flowers.
- This pollen keeps floating on the water surface until they are caught by female flowers.

Characteristics of insect-pollinated flowers:

- They are large with bright-coloured petals to attract insects.
- The flowers have nectar and a pleasant fragrance.
- The pollen grains are sticky and can easily stick to the insect's body.

Q.5. Explain the structure of the pollen.

A. Pollen grains are microscopic structures that carry the male reproductive cells of a plant. It is a double-walled structure with a thin inner wall known as endospore composed of cellulose& pectin and a thick outer wall known as exospore, composed of sporopollenin.

The exospore protects the male genetic material during transportation from an anther to stigma. The waxes and proteins present on the pollen surface repel moisture and interact with the stigma.

Q6 .Write down difference between microsporogenesis and megasporogenesis.

Ans.

It occurs inside microsporangia	It occurs inside the nucellus of ovule
There are many microspores mother cell in microsporangium.	There are is generally a single megaspore mother cell in a megasporangium.
The four microspores formed from single microspore mother cell are generally arrange in tetrahedral structure.	The four megaspores formed from a megaspore mother cell are arrange in the form of linear tetrad.
Four microspores are functional	One is functional while three are
	degenerated.
The microspores give rise to male gametophyte	The functional megaspore gives rise to female gametophyte.

1.CASE BASED QUESTION;-

Read the following and answer any Four questions I to v.

The pollen grains or microspores of male reproductive bodies of a flower and are contained in the pollen sac or microsporangia. Each pollen grain consist of a single microscopic cell, possessing two coat ; the exine and intine. The exine of a pollen grain is made of chemically stable material. Because of this ,pollen grains are often very well preserved for thousand of year in soil and sediment.

- One of the most resistant biological material present in the exine of pollen grain is
A .Pectocellulose B. Sporopollenin C. Suberin D . Cellulose.
- The exine possesses one or more thin place known as
A Raphe B. Germ pore C. Hilum D. Endothecium

iii. What is the function of germ pore ?

- A . Emergence of radicle B . Absorption of water for seed C. Initiation of pollen tube. D. All of these

iv . What is the key advantages to the plant for having such strong pollen grain wall?

- A. It protect the vital genetic material in the pollen grain.
B. It allow pollen to serve as a valuable Fossil record for the study of ancient plant.
C. It prevents the pollen tube from growing out before the pollen grain reaches the stigma. D. All of the above.

v .The number of germ pore indicot and monocot respectively are

- A . one &three B. three &two C. two& three D. three & one

Q No.	i	ii	iii	iv	v
Ans	B	B	C	D	D

-

CHAPTER :- 2 HUMAN REPRODUCTION

MCQ:

1. Testes descent into scrotum in human for :
 - A. Fertilisation
 - B. Spermatogenesis
 - C. Development of sex organs
 - D. Formation of sex hormones
2. Acrosome produces an enzymatic substance for dissolving egg coverings. It is called
 - A. Hyaluronic acid
 - B. Androgen
 - C. Hyaluronidase
 - D. Diastase
3. Antrum is a fluid filled cavity of
 - A. Ovary
 - B. Secondary follicle
 - C. Graafian follicle
 - D. Blastula
4. Seminal plasma of humans is rich in
 - A. Galactose, certain enzymes and calcium
 - B. Fructose, certain enzymes and calcium
 - C. Fructose, certain enzymes but poor Calcium
 - D. Fructose, certain enzymes but no calcium
5. The number of sperms produced from 100 primary spermatocytes are:
 - A. 100 sperms
 - B. 200 sperms
 - C. 300 sperms
 - D. 400 sperms
6. The number of eggs produced from 100 primary Oocytes are
 - A. 100 eggs
 - B. 200 eggs
 - C. 300 eggs
 - D. 400 eggs
7. Leydig's cell secretes hormone
 - A. Gonadotropin
 - B. Relaxin
 - C. Inhibin
 - D. Androgen
8. Spermatids are changed to spermatozoa through
 - A. Spermatosis
 - B. Spermogenesis
 - C. Spermiogenesis
 - D. Spermiation
9. Embryo at 8 to 16 celled stage called
 - A. Blastomere
 - B. Morula
 - C. Blastula
 - D. Gastrula
10. Leydig's cells are regulated by pituitary hormone
 - A. LH
 - B. FSH
 - C. GnRH
 - D. Prolactin
11. Which one of the following is not a male accessory gland?
 - A. Seminal vesicle
 - B. Mammary gland
 - C. Prostate
 - D. Bulbourethral gland
12. Which of the following hormone is not secreted by human placenta?
 - A. hCG
 - B. Estrogens
 - C. hPL
 - D. FSH
13. During parturition, the foetal ejection reflex triggers the release of
 - A. GnRH from foetal hypothalamus
 - B. Oxytocin from maternal pituitary.
 - C. An increasing amount of estrogen from placenta.
 - D. An increasing amount of progesterone from placenta

14. What does a doctor inject to induce delivery of baby?
 A. Progesteron C. Inhibin
 B. Estrogen D. Oxytocin
15. The first movement of the foetus and appearance of hair on the head are usually observed during the month of
 A. 3th month of pregnancy C. 5th month of pregnancy
 B. 4th month of pregnancy D. 7th month of pregnancy
16. Layers of an ovum from outside to inside is
 A. corona radiata, zonapellucida and membrane C. vitelline membrane, zonapellucida vitelline and corona radiate
 B. zonapellucida, corona rodiata and membrane D. zonapellucida, vitelline membrane vitelline and corona radiata
17. In spermatogenesis, reduction division of chromosome occurs during conversion of
 A. spermatogonia to primary spermatocytes
 B. primary spermatocytes to secondary spermatocytes
 C. secondary spermatocytes to spermatids
 D. spermatids to sperms
18. Select the correct sequence of stages in spermatogenesis are:
 A. spermatogonia → spermatid → spermatocyte → sperm
 B. spermatocyte → spermatogonia → spermatid → sperm
 C. spermatogonia → spermatocyte → spermatid → sperm
 D. spermatid → spermatocyte → spermatogonia → sperm

ANSWER:

Q. Nos.	1	2	3	4	5	6	7	8	9	10
Answer	B	C	C	B	D	A	D	C	B	A
Qnos.	11	12	13	14	15	16	17	18		
Answer	B	D	B	D	C	A	B	C		

ASSERTION AND REASONING TYPE OF QUESTIONS WITH ANSWERS

- A.** If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.
B. If both Assertion and Reason are true but the Reason is not a correct explanation of the Assertion
C. If Assertion is true but the Reason is false.
D. If both Assertion and Reason are false

Q.No.1.

Assertion(A): In a Graafian follicle, the primary oocyte and the follicle cells may be regarded sibling cells.

Reason (R): Both arise from the same parent cell, the oogonium, by mitotic divisions

Q.No.2.

Assertion (A): Ovum retains most of the contents of the primary oocyte and is much larger than a spermatozoan.

Reason (R): Ovum needs energy to go about in search of a spermatozoon for fertilization. **Q.NO.3.**

Assertion: In the testes, spermatogenesis occurs in the seminiferous tubules and testosterone secretion takes place in the interstitial cells.

Reason(R): Testosterone brings about growth and maturation of secondary sex organs and also development of accessory sex characters. **Q. No 4.**

Assertion (A):A sperm sticks to an egg for fertilization.

Reason(R): Interaction of surface receptors, fertilizin on the egg and antifertilizin on the sperm head, makes them adhere together.

Q. No 5.

Assertion(A):At puberty only 60000 to 80000 primary follicles are left in both the ovaries **Reason(R):** Large numbers of these follicles degenerate during the phase from birth to puberty.

Q No.6.

Assertion (A): Sperm formation continues even in old man but formation of ovum ceases in women around the age of 50 years.

Reason(R): The stoppage of menstrual cycle in female is termed as menopause. **Q. No 7.**

Assertion(A):The primary follicles get surrounded by more layer of granulosa cells and a new theca called secondary follicles

Reason(R): These are characterized by the presence of fluid filled cavity called antrum. **Q. No 8.**

Assertion (A): The regions outside the seminiferous tubules contain Sertoli cells.

Reason (R) :Sertoli cells synthesize and secrete androgens.

Q.NO.9

Assertion(A): .Infundibulum of fallopian tube is with finger –like fimbriae

Reason(R):Graafian follicle of ovary is with secondary Oocyte hanging in cavity called antrum

Q.No.10

Assertion (A):At puberty, human male does not develop secondary sexual characters.

Reason(R):At puberty, there is a decrease secretion of testosterone in male.

Q No. 11.

Assertion (A):The endometrium undergoes cyclical changes during the Menstrual cycle. **Reason (R):**Myometrium contracts strongly during delivery of the baby.

Q No. 12.

Assertion (A):Only one sperm can fertilise an ovum.

Reason (R):The changes in the membrane of zonapellucida prevents polyspermy **Q NO.13.**

Assertion (A):After implantation, finger like projections appears on the trophoblast called chorionic villi.

Reason (R) :Chorionic villi are surrounded by the uterine tissue and the maternal blood.

Q NO.14.

Assertion (A): Placenta is an endocrine tissue .

Reason (R): It produces several hormones like hCG ,hPL , estrogens progesterone etc.

Q NO.15.

Assertion (A): The signals of parturition originate from fully developed foetus and placenta. **Reason (R):** Oxytocin causes stronger uterine contractions which stimulates further secretion of oxytocin.

Q NO.16.

Assertion (A): The first movement of the foetus is usually observed during 5th month of pregnancy.

Reason (R): By the end of first trimester the body is covered with fine eyelids and eyelashes are formed **Q NO.17.**

Assertion(A): The bulbourethral gland is a male accessory gland.

Reason: Its secretion helps in the lubrication of the penis, thereby facilitating reproduction.

Q NO.18.

Assertion (A): Spermatogenesis starts at the age of puberty.

Reason (R): There is a significant increase in level of gonadotropin releasing hormone at puberty.

Q NO.19.

Assertion (A): Each seminiferous tubule is lined on its inside by three type of cells.

Reason(R): These cells are male germ cells, Sertoli cells and Leydig's cells.

Q NO.20.

Assertion (A): The female external genitalia include mons pubis, labia majora and labia minora.

Reason(R): The glandular tissue of each breast is divided into 5-10 mammary lobes.

Q. nos.	1	2	3	4	5	6	7	8	9	10
Answer	A	C	B	A	A	B	D	D	B	D
Q. nos.	11	12	13	14	15	16	17	18	19	20
Answer	B	A	B	A	A	C	A	A	D	C

2. SHORT ANSWER TYPE-1 (2MARKS)

Q.No.1. Differentiate between gametogenesis in human males and females on the basis of

- Time of initiation of the process.
- Products formed at the end of the process.

Answer: (a) In male, initiation of Spermatogenesis takes place during puberty whereas in female, Oogenesis takes place at foetal life.

(b) In male, four spermatozoa are produced from one spermatogonium whereas in female, one ovum and two polar bodies are produced from one Oogonium.

Q.No.2. Why testes are located outside the abdominal cavity within a pouch? Also name that pouch.

Answer:

The process of spermatogenesis requires lower temperature (2 - 2.0°C) than the body and hence testes (site of spermatogenesis) are present outside the abdominal cavity. The pouch is known as the scrotum or scrotal sac.

Q.No.3.

- (a) What is the total no of testicular lobule in human male reproductive system?
- (b) Write the total number of seminiferous tubules in human male reproductive system.

Answer: (a) The total no of testicular lobule in human male reproductive system are 500 as one testis contain 250 in number.

(b) The total number of seminiferous tubules 500 to 1500 in number as one lobule contain 01 to 03 tubules.

Q.No.4. Write location and function of each

- (a) Leydig's cells (b) Sertoli cells

Answer: (a) Leydig cells located in Interstitial space and function : Leydig's cells can synthesise and secrete the male testicular hormones called androgen.

- (b) Sertoli cells located in seminiferous tubules and function is to provide nutrition to the germ cells.

Q.No.5. Write function of

- (a) Endometrium (b) Myometrium

Ans: (a) Myometrium: The highly muscular middle layer. This is what expands during pregnancy and contracts to push your baby out.

- (b) Endometrium: The inner layer or lining of your uterus (uterine lining). This layer of your uterus is shed during your menstrual cycle.

Q.No.6. (a) How is the tertiary follicles characterised? (b) What is LH surge?

Answer: (a) The secondary follicle soon transforms into a tertiary follicle, which is characterised by a fluid filled cavity, called as antrum. The theca layer is fibrous and is organised into an inner theca interna and an outer theca externa.

- (b) An LH surge is a rapid increase in luteinizing hormone levels during mid-cycle which induces rupture of Graafian follicle and there by the release of ovum.

Q.No.7. Why all copulations do not lead to fertilisation and pregnancy?

Answer: Fertilisation can only occur if the ovum and sperms are transported simultaneously to the ampullary-isthmic junction and ovum is released only once a month. This is the reason why all copulations do not lead to fertilisation and pregnancy.

Q.No.8. What are the events taking place in the ovary and uterus during follicular phase of the menstrual cycle?

Ans: Ovarian events: Follicle stimulating hormone (FSH) secreted by the anterior pituitary stimulates the maturation of one ovarian follicles to release ovum during ovulation. Remnants of Ovarian follicles in turn secrete estrogen.

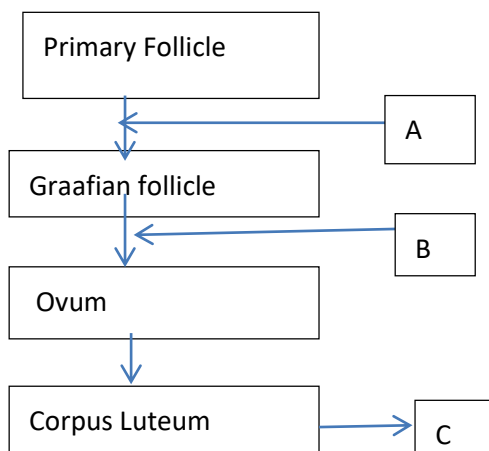
Uterine Events: Uterine changes during follicular phase involves the following:
Estrogen stimulates the proliferation of endometrium of the uterine wall includes extensive vascularization and more secretory.

Q.No.9. Write any two differences between oogenesis and spermatogenesis?

Spermatogenesis	Oogenesis
The production of sperms from Spermatogonia is known as spermatogenesis	The production of eggs from Oogonia is known as oogenesis
Occurs inside the seminiferous tubules of testes .	Occurs inside the ovary
All stages are completed in testes .	The major part of oogenesis occurs inside the ovary. The last few stages occur in the oviduct.
At the end of the process one spermatogonium produces four spermatozoa	At the end of the process one Oogonium produces one ovum.

Q.No.10. Study the flow chart and answer the following:

- (a) Identify the hormones 'A', 'B' and 'C'.
 (b) What is the role of 'C'?

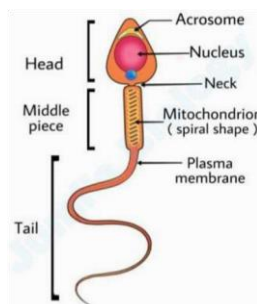


Answer:

- (a) The hormones 'A' is FSH , 'B' is LH and 'C' is Progesterone.
 (b) The role of Progesterone is to maintain pregnancy throughout the gestation period.

SHORT ANSWER TYPE-II (3marks)

- Q. No.1.** (a) Draw a labelled diagram of a human sperm.
 (b) Which part of the sperm provides energy for its movement?



Answer: (a)

- (b) Middle piece as more number of mitochondria are present. **Q. No.2.** (a) What is the function of acrosome?

(b) What is the function of mitochondria of human sperm ?

Answer: (a) Acrosome contains hydrolytic enzymes helps to break down outer layers of ovum. (b) Mitochondria helps sperm mobility in the female reproductive tract.

Q. No.3.

- (a) Where do the signals for parturition originate in humans?
(b) Placenta acts as an endocrine gland. Justify.

Answer: (a) The signals for parturition originate from a fully developed foetus and placenta which induce mild uterine contraction. This triggers the release of oxytocin (birth hormone) from the maternal pituitary gland.

(b) The placenta can also act as an endocrine gland but only during pregnancy and produces some hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogen, progesterone, etc.

Q.No.4 (a) Explain the role of ovarian hormones in inducing changes in the uterus during menstrual cycle. (b) What triggers release of oxytocin at the time of parturition?

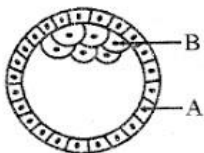
Answer:

(a) In the uterus, estrogen helps proliferate endometrial cells in the follicular phase of the menstrual cycle, thickening the endometrial lining in preparation for pregnancy.

Progesterone is essential for maintenance of the endometrium. Such an endometrium is necessary for implantation of the fertilised ovum and other events of pregnancy.

(b) The signals for parturition, originates from the developed in foetus and placenta

Q.No.5. Study the diagram given below and answer the following questions.

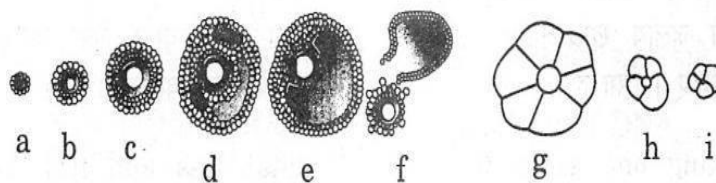


- (a) Name the stage of human embryo in the figure represents.
(b) Identify 'A' and 'B' in the figure and mention their functions.
(c) Where are the stem cells located in the embryo?

Answer: (a) The name of the stage is Blastocyst (b) 'A' is trophoblast layer and 'B' is inner cell mass. (c) The trophoblast layer gets attached to endometrium to form placenta and inner cell mass to form embryo proper. (d) Inner cell mass.

CASE BASED QUESTIONS:

1. Study the diagram below and answer the following questions:

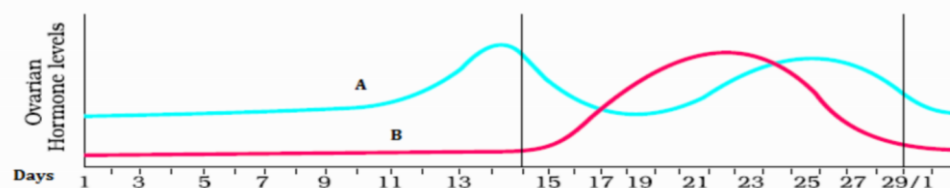


- (i) Identify 'c' and 'e'
- (ii) Name and state the function of 'g'
- (iii) Write one difference between 'c' and 'd'.
- (iv) Name the pituitary hormones that cause the above mentioned events.

ANSWER:

- (i) 'c' is secondary follicle and 'e' is Graafian follicle.
- (ii) 'g' is Corpus luteum. It produces progesterone and maintains pregnancy if the egg is not fertilised.
- (iii) One difference:
In a secondary follicle, a fluid-filled antrum is absent, but in a tertiary follicle, a fluid-filled antrum is present.
- (iv) Pituitary hormones are FSH and LH. FSH induces follicular development and LH induces ovulation.

CASE BASED : 2



Read the graph given above and correlate the uterine events that take place according to the hormonal levels on (i) Identify 'A' and 'B'.

- (ii) Specify the source of the hormone marked in the diagram.
- (iii) Give reason why A peaks before B.
- (iv) Compare the role of A and B.
- (v) Under which condition will the level of B continue to remain high on the 28th day?

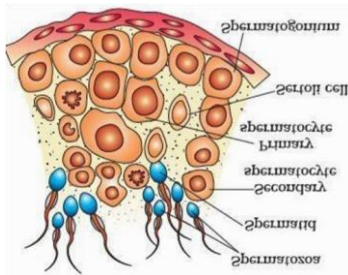
Answer:

- (i) A is Estrogen and B is Progesterone
- (ii) Estrogen is secreted from ovarian follicles and Progesterone is secreted from the corpus luteum.
- (iii) As the follicular phase takes place before the luteal phase.
During the follicular phase of the cycle, the secretion of estrogen peaks due to the developing follicles which release the hormone. Progesterone is produced during the later stages of the cycle from the corpus luteum.
- (iv) Estrogen enhances and maintains the mucous membrane that lines the uterus. Whereas Progesterone prepares the endometrium for potential pregnancy after ovulation. It also triggers the lining to thicken to accept a fertilized egg.

- (v) If an egg is fertilized by sperm and conception occurs then secretion of progesterone remain continues as it is needed for thickening of endometrium lining.

CASE BASED:3

Observe the given diagram and answer the following questions.



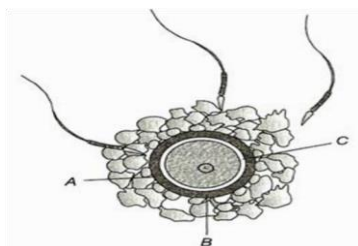
- (i) Which cell among them is known as nurse cell?
 (a) Primary spermatocyte (c) Spermatid
 (b) Spermatogonium (d) Sertoli cell
- (ii) Which hormone of pituitary gland regulates Sertoli cells?
 (a) LH (c) GH
 (b) FSH (d) Prolactin
- (iii) The process of spermatogenesis is induced by
 (a) TSH (b) ACTH (c) MSH (d) Androgens
- (iv) The correct sequence of cell stage in spermatogenesis is
 (a) spermatocyte → spermatids → spermatogonia → spermatozoa
 (b) spermatogonia → spermatids → spermatocyte → spermatozoa
 (c) spermatocytes → spermatogonia → spermatid → spermatozoa (d) spermatogonia → spermatocytes → spermatids → spermatozoa
- (v) The number of sperm produced from 100 Secondary spermatocytes are:
 (a) 100 sperms (c) 300 sperms
 (b) 200 sperms (d) 400 sperms

ANSWER:

- (i) (d) Sertoli cell
 (ii) (b) FSH
 (iii) (d) Androgens
 (iv) (d) spermatogonia → spermatocytes → spermatids → spermatozoa
 (v) (a) 100 sperms

CASE BASED:4

Study the illustration given and answer the questions that follow:



- (i) Identify 'a'.
 (ii) Name and state the function of 'c'.

(iii) Identify 'b'.

(iv). Explain the role of hormones in the formation and release of 'a'.

ANSWER

(i). Ovum (ii) Zona pellucida .It prevents polyspermy (iii). Perivitelline space

(iv).FSH,estrogen helps in development of ovarian follicles which in turn formation of oogonium into secondary oocyte (Ovum) and LH surge releases ovum during ovulation.

LONG ANSWER TYPE QUESTIONS: (5MARKS)

Q No.1. (a) Write the specific location and functions of the following cells in human males.

(i) Leydig's cells (ii)Sertoli cells (iii) Primary spermatocyte

(b) Explain the role of two accessory glands in human male reproductive system.

ANSWER: (a)

(i) Leydig's cells located in interstitial space and produce androgens.

(ii) Sertoli cells located inside the seminiferous tubules and it nurture the sperms.

(iii) Primary spermatocyte located inside the seminiferous tubules and it undergoes meiotic division to formed sperm.

(a) Male accessory glands are seminal vesicles, prostate glands, and bulbourethral glands.

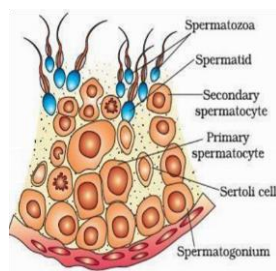
These glands secrete fluids called seminal plasma. The sperms get dispersed in the fluid which makes their transportation into the female body easier.

Q No.2.

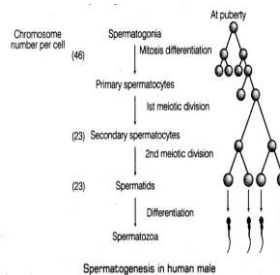
(a) Draw a diagrammatic labelled sectional view of a seminiferous tubule of a human testis.

(b) Digramatically show the sequence the process of spermatogenesis in humans.

ANSWER: (a)



(b)



Q No.3.

(a) When and how does placenta develop in human female?

(b) How is placenta connected to the embryo?

(c) Write the functions of placenta other than endocrine gland. .

ANSWER:

(a) The placenta begins to form after a fertilized egg implants in your uterus around seven to 10 days after conception. Chorionic villi are surrounded by the uterine tissue and the maternal blood. The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between the developing embryo and maternal body called the placenta.

(b) Through umbilical cord

(c) The placenta is an organ that develops in the uterus during pregnancy. This structure provides oxygen and nutrients to a growing baby. It also removes waste products from the baby's blood. The placenta attaches to the wall of the uterus, and the baby's umbilical cord arises from it.

Q No.4.

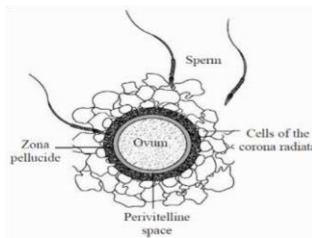
(a) Draw a labelled diagram of ovum surrounded by few sperms.

(b) Differentiate between gametogenesis in human males and females on the basis of:

(i) Time of initiation of the process.

(ii) Products formed at the end of the process.

Answer; (a)



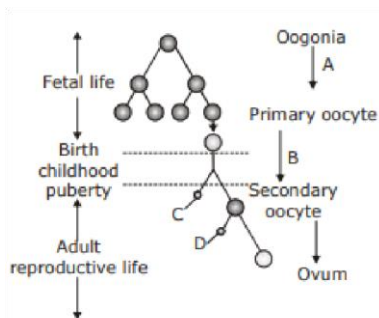
(b)

Spermatogenesis	Oogenesis
Initiated at puberty	Initiated at foetal life
At the end of the process one spermatogonium produced four spermatozoa	At the end of the process one ovum. produced from one oogonium

Q. No.5.. (a) Give a schematic representation of oogenesis in human female indicating the chromosomal number at each step. Mention at what stage of female life each phase occurs.

(b) Explain the role of ovarian hormones in inducing changes in the uterus during menstrual cycle.

Answer: (a)



Oogonia (2n) , Primary oocyte (2n), Secondary oocyte (n) ,Ovum

(n) N = 23 chromosome.

(b) In the uterus, estrogen helps proliferate endometrial cells in the follicular phase of the menstrual cycle, thickening the endometrial lining in preparation for pregnancy.

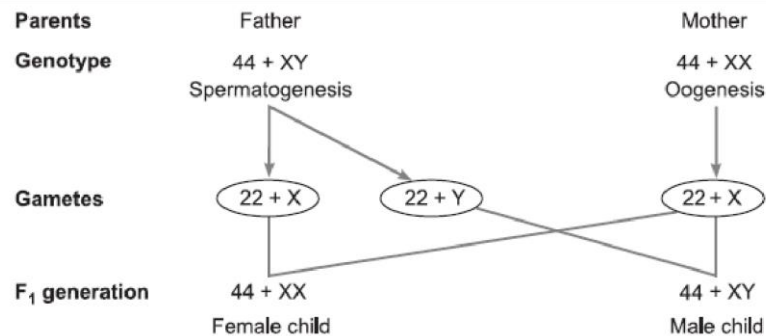
Progesterone is essential for maintenance of the endometrium. Such an endometrium is necessary for implantation of the fertilised ovum and other events of pregnancy.

Q. No.6. (a) Explain sex determination in humans.

(b) How do human males with 'XXY' abnormality suffer?

Answer:

(a) By the process of spermatogenesis, males produce two types of sperms—50% carrying X-chromosome and 50% carrying Y-chromosome. However, females produce only one type of ovum carrying X-chromosome. If the sperm carrying X-chromosome fertilises the ovum, the zygote will develop into a female (XX) and if the sperm carrying Y-chromosome fertilises the ovum, the zygote develops into a male (XY).



(b) The XXY individual suffers from Klinefelter's syndrome

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CHAPTER 3. REPRODUCTIVE HEALTH

MULTIPLE CHOICE QUESTIONS

- 1). Increased IMR and decreased MMR in a population will
 - a) cause rapid increase in growth rate
 - b) result in decline in growth rate
 - c) not cause significant change in growth rate
 - d) result in an explosive population
- 2) Which of the following is a barrier method of contraception?
 - a) diaphragms b) periodic abstinence c) Lactational amenorrhoea d) Withdrawal method
- 3) In Vasectomy the part that is tied up is :
 - (a) Vasa deferens (b) Vasa efferentia (c) Epididymis (d) Fallopian tube
- 4) A doctor advises an infertile male to undergo Artificial insemination to correct his infertility-
 - (a) The male has low sperm count (b) Syphilis (c) Gonorrhoea (d) None of these
- 5) Which of the following have been found to be very effective as emergency contraceptive as they could be used to avoid possible pregnancy due to rape if given within 72 hours?
 - A. Administration of progestogens B. Progestogen-estrogen combination
 - C. IUDs inserted within 72 hours of coitus

(a) A only (b) B

only

(c) A & B only (d) A, B
& C

6) Population explosion in recent years is due to?

(a) Decline in Maternal mortality rate (b) Decline in Infant mortality rate
(c) Increased number of people in reproductive age (d) All of the above

7) Which is the correct surgical procedure as a contraceptive method is (a)
Ovariectomy (b) Hysterectomy (c) Vasectomy (d) Castration.

8) Choose the odd one out

a) Multiload 375 b) CuT c) Tubectomy d) Cu7

9) GIFT is recommended for those female-

a) Who cannot retain the foetus inside uterus
(b) Whose cervical canal is too narrow to allow passage for the sperms
(c) Who cannot provide suitable environment for fertilisation
(d) Who cannot produce an ovum but can provide suitable environment for development

10) Lactational Amenorrhea is related to-

a) Temporary method of contraception
(b) Permanent method of contraception
(c) Absence of menstruation
(d) Onset of menstruation

11) Choose the correct statement for given figure



(a) Hormone containing device inserted in uterus for providing long term conception
(b) These contain non-steroidal preparation and are effective for 3 years
(c) These are one of the devices having levonorgestrel and are effective for 5 years
(d) Chemical contraceptives which kill the sperms by disrupting their membrane in vagina

12) Cu ions released from copper-releasing IUD's.

- (a) Suppress sperm motility (b) Prevent ovulation
(c) Make uterus unsuitable for implantation (d) Kills sperms.

13) Which days are considered as most fertile period in the menstrual cycle?

- (a) 5 to 10 days (b) 10 to 17 days (c) 17 to 23 days (d) 23 to 28 days

14) An ideal contraceptive should be

- (a) user friendly (b) Reversible (c) Both (a) and (b) (d) Decreased sexual drive

15) Which of the following STDs are not curable?

- (a) Genital herpes, hepatitis-B, HIV infection (b) Chlamydia, syphilis, genital warts
(c) HIV, gonorrhoea, trichomoniasis (d) Gonorrhoea, trichomoniasis, hepatitis-B

QUESTION NO	CORRECT OPTION	QUESTION NO	CORRECT OPTION	QUESTION NO	CORRECT OPTION
1	B	6	d	11	c
2	A	7	c	12	a
3	A	8	c	13	b
4	A	9	d	14	c
5	D	10	a	15	a

ASSERTION AND REASONING QUESTIONS

In the following questions a statement of Assertion(A) is followed by a statement of Reason.

(R)

If both Assertion and Reason are true and Reason is the correct explanation of the Assertion, then mark (a)

If both Assertion and Reason are true and the Reason is not the correct explanation, then mark (b)

If Assertion is true and Reason is False, then mark (c)

If Assertion is false and Reason is true, then mark (d)

- 1) Assertion: Lactational amenorrhoea is a natural method of contraception.
Reason: Ovulation does not take place during the period of intense lactation following child birth.
- 2) Assertion(A): Infertility can occur in both males and females.

Reason(R): Infertile couples can have children with the help of ARTS.

- 3) Assertion: Hormone releasing IUD's make the uterus unsuitable for implantation and the cervix hostile to sperms.

Reason: IUD prevent the contact of sperm and ovum.

- 4) Assertion: Reproductive and Child Healthcare Programmes is for reproduction related areas.

Reason: It deals with creating awareness among various reproductions related aspects.

- 5) Assertion: Introduction of sex education in schools should be encouraged.

Reason: This will encourage children to believe in myths about sex related aspects

- 6) Assertion: Vasectomy and tubectomy are reversible methods of birth control.

Reason: MTP is safe during trimester.

- 7) Assertion: Rapid decline in death rate, MMR and IMR have led to a staggering rise in population.

Reason: Such an alarming growth rate has led to an absolute scarcity of even the most basic requirements i.e food and shelter.

- 8) Assertion: Diseases that are transmitted through sexual contact are collectively called STDs

Reason: STDs cannot be prevented by avoiding unknown and multiple partners

- . 9) Assertion: IUDs are an ideal and most widely used contraceptive method for the women in India.

Reason: their male partners are free to take decisions about delaying of pregnancy and or space children for a period of few years.

- 10) Assertion: Artificial Insemination is the technique in which semen is collected from the male partner and artificially introduced either into the vagina or into the uterus.

Reason: It is effectively used in infertility cases where male partner is unable to inseminate the female partner or have very low sperm counts in ejaculations.

- 11) Assertion: Sex education has been included in the school curriculum.

Reason: Sex education in schools may help in eliminating many queries that arise in young students.

- 12) Assertion: Hepatitis-B is also considered a sexually transmitted disease. Reason: It can be spread by sexual contact.

- 13) Assertion(A): A surgical method of contraception is sterilisation.

Reason(R): Sterilisation blocks gamete transport and thereby prevents conception.

- 14) Assertion: IUT is the transfer of embryo with more than 8 blastomeres into the uterus.

Reason: IUT is a very popular method of forming embryos in vitro.

- 15) Assertion: Syphilis, Gonorrhoea and AIDS are some common STDs.

Reason: STDs are transmitted through sexual intercourse.

QUESTIO N NO	CORRECT OPTION	QUESTIO N NO	CORRECT OPTION	QUESTIO N NO	CORRECT OPTION
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1	A	6	d	11	a
2	C	7	a	12	a
3	B	8	c	13	a
4	A	9	c	14	b
5	C	10	a	15	a

VERY SHORT ANSWER QUESTIONS (1 mark)

- 1) Give the full form of ICSI?
- 2) Suggest the name of 2 STDs caused by bacterial infection.
- 3) Name any 2 natural methods of birth control that you are aware of.
- 4) Mention any 2 common causes of infertility in males.
- 5) Suggest any two methods of ARTs which can be used for males with low sperm count.
- 6) Government of India has raised the marriageable age of female to 18 years and of males to 21 years. Suggest any two more measures adopted by Government for the purpose.
- 7) Give one reason to justify statutory ban on amniocentesis.
- 8) A doctor has observed the chromosomal disorders in developing foetus and advised the couple to undergo abortion. Suggest the technique by which doctor observed the chromosomal disorders.
- 9) Reproductive health refers only to healthy reproductive functions. Comment.
- 10) The present population growth rate in India is alarming. Suggest ways to check it.
- 11) Indiscriminate diagnostic practices, using X-rays, etc., should be avoided. Give one reason.
- 12) Why is tubectomy considered a contraceptive method?
- 13) In case of an infertile couple, the male partner can inseminate normally but the mobility of sperms is below 40 percent. Which kind of ART is suitable in this situation to form an embryo in the laboratory conditions, without involving a donor?
- 14) A woman's husband is infertile. So, the lady has decided to have baby by taking sperms from sperm bank. Which technique will you suggest for her pregnancy?
- 15) What technique would you suggest for correcting infertility caused due to very low sperm counts of a male partner?

ANSWERS

- 1) Intra cytoplasmic sperm injection.
- 2) Syphilis and gonorrhoea.
- 3) Periodic Abstinence, Lactational amenorrhea
- 4) Smoking and Alcoholism can be attributed to low sperm count.

- 5) Artificial Insemination and ICSI and be done in cases of Infertility with low sperm count.
- 6) (i) Incentives given to couples with small families. (ii) Media publicity through posters of happy couples with two children (Hum Do Humare Do).
- 7) Statutory ban on amniocentesis prevents female foeticide.
- 8) Amniocentesis.
- 9) Reproductive health refers to the total well-being in all aspects of reproduction, i.e., physical, behavioural, psychological and social.
- 10) (i) By increasing marriageable age. (ii) By promoting use of birth control measures.
- 11) These practices act as carcinogens which convert normal cells to neoplastic cells by harmful mutations or chromosomal aberration.
- 12) Tubectomy involves cutting a piece of the fallopian tube and tying its ends. This way, the sperms are not able to reach the egg so fertilisation cannot take place. Thus, it acts as a contraceptive method.
- 13) Intra Cytoplasmic Sperm Injection 14) Intra cytoplasmic sperm injection (ICSI) 15) Artificial insemination.

SHORT ANSWER TYPE (2marks)

- 1) Comment on the RCH programme of the government to improve the reproductive health of the people.
- 2) What is amniocentesis? Why has the government imposed a statutory ban in spite of its importance in the medical field?
- 3) Describe the lactational amenorrhea method of birth control.
- 4) Name an oral pill used as a contraceptive by human females. Explain how it prevents pregnancy.
- 5) Why is medical termination of pregnancy (MTP) carried out?
- 6) At the time of Independence, the population of India was 350 million, which exploded to over 1 billion by May 2000. List any two reasons for this rise in population and any two steps taken by the government to check this population explosion.
- 7) The alarming population growth is leading to scarcity of basic requirements. Suggest with reasons, any two population control measures other than contraception to address the situation.
- 8) A couple is eager to know the sex of their unborn child. What diagnostic technique will you suggest? What social abuse is associated with the application of this technique?
- 9) Why is _Saheli considered to be an improved form of oral contraceptive for human female?
- 10) How do copper and hormone releasing IUDs act as contraceptives? Explain.
- 11) All reproductive tract infections (RTIs) are STDs but all STDs are not RTIs. Justify with example.

- 12) A couple where both husband and wife are producing functional gametes, but the wife is still unable to conceive, is seeking medical aid. Describe any one method that you can suggest to this couple to become happy parents.
- 13) An infertile couple is advised to adopt test-tube baby programme. Describe two principle procedures adopted for such technologies.
- 14) The process of GIFT involves the transfer of female gamete to the fallopian tube. Can gametes be transferred to the uterus to achieve the same result? Explain.
- 15) How can childless couples be helped by the following assisted reproductive technologies:
 - (a) GIFT? (b) Intracytoplasmic Sperm Injection.

ANSWERS

- 1) The basic aims of the RCH programmes are creating public awareness regarding reproduction related aspects population growth and providing facilities to build up a healthy society with added emphasis on the health of mother and child.
- 2) Amniocentesis is a procedure to test for the presence of certain genetic disorders like Down syndrome, haemophilia etc. Now a days people are using it for foetal sex determination test based on the chromosomal pattern in cells extracted from the amniotic fluid, surrounding the developing embryo. Amniocentesis is used for sex determination, which most people go for, to kill female foetus. Therefore, it has been banned.
- 3) Lactational amenorrhoea is based on the principle that during the period of intense lactation after parturition, menstrual cycle or ovulation does not occur.
- 4) Saheli is an oral pill used as a contraceptive by females. Oral pills inhibit ovulation and implantation, as well as, alter the quality of cervical mucus to prevent or retard entry of sperms. Thus, fertilisation and further pregnancy is prevented.
- 5) MTP is carried out to get rid of unwanted pregnancies. It is also essential when the foetus is suffering from an incurable disease or when continuation of the pregnancy could be harmful or even fatal to the mother and/or foetus or terminate pregnancy in rape cases
 - 6) Two reasons for increase in population are:
 - (i) A rapid decline in death rate, maternal mortality rate and infant mortality rate.
 - (ii) Increase in number of people in reproductive age.
 Two steps for checking population explosion:
 - (i) Statutory raising of marriageable age of the females to 18 years and males to 21 years.
 - (ii) Incentives given to couples with small families.
 - 7) Following are the population control measures other than contraception:
 - (a) Advertisements in the media to generate awareness about advantages of small families.
 - (b) Statutory raising of marriageable age of the female to 18 years and that of males to 21 years, to delay the number of births.
 - (c) Incentives given to couples with small families, to motivate others to comply. (Any two)

- 8) Amniocentesis is the suggested diagnostic technique which when applied helps in sex determination of the foetus and may lead to social abuse like female foeticides.
- 9) Saheli contains a non-steroidal preparation and is a once-a-week pill, with high contraceptive value and very less side-effects. Therefore, it is considered an improved form of contraceptive pills.
- 10) The copper releasing IUDs release Cu ions, which suppress sperm motility and the fertilising capacity of sperms. The hormone releasing IUDs make the uterus unsuitable for implantation and the cervix hostile to the sperms.
- 11) Among the common STDs, hepatitis-B and AIDS are not infections of the reproductive organs though their mode of transmission could be through sexual contact also. All other diseases like gonorrhoea, syphilis, genital herpes, are transmitted through sexual contact and are also infections of the reproductive tract.
- 12) Methods: IVF/ZIFT/AI. (EXPLAIN)
- 13) (i) IVF/In vitro fertilisation: It is the fertilisation of gametes outside the body in almost similar conditions as that in the body.
(ii) ET/Embryo transfer: Embryos formed by fusion of gametes is transferred into reproductive tract or uterus.
- 14) The uterine environment is not congenial for the survival of the gamete. If directly transferred to the uterus, they will undergo degeneration or could be phagocytosed and hence viable zygote would not be formed.
- 15) (a) GIFT (Gamete Intra Fallopian Transfer): It is the transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce one, but can provide suitable environment for fertilisation and further development.
(b) Intracytoplasmic Sperm Injection (ICSI): It is a process in which an embryo is formed in the laboratory, in which a sperm is directly injected into the ovum.

SA-II (3 marks)

- 1) What are the consequences of population explosion?
- 2) If implementation of better techniques and new strategies are required to provide more efficient care and assistance to people, then why is there a statutory ban on amniocentesis? Write the use of this technique and give reason to justify the ban.
- 3) (a) List any four characteristics of an ideal contraceptive. (b) Name two intrauterine contraceptive devices that affect the motility of sperms.
- 4) A woman has certain queries as listed below, before starting with contraceptive pills. Answer them. (a) What do contraceptive pills contain and how do they act as contraceptives? (b) What schedule should be followed for taking these pills?
- 5) (a) Name and explain the mode of action of any two types of IUDs. (b) List the advantages of using ‘Saheli’ as a contraceptive.
- 6) Name two hormones that are constituents of contraceptive pills. Why do they have high and effective contraceptive value? Name a commonly prescribed non-steroidal oral pill.

- 7) (a) Expand IUD. (b) Why is hormone releasing IUD considered a good contraceptive to space children?
- 8) Name three incurable sexually transmitted diseases and their causative organisms.
- 9) Within what age group sexually transmitted diseases (STDs) are reported to be very high. Mention three practices to avoid them.
- 10) Suggest and explain any three Assisted Reproductive Technologies (ART) to an infertile couple.
- 11) Explain the zygote intra-fallopian transfer technique (ZIFT). How is intra-uterine transfer technique (IUT) different from it?
- 12) How are Assisted Reproductive Technologies helpful to humans? How are ZIFT and GIFT different from intra-uterine transfers? Explain.
- 13) Briefly explain IVF and ET. What are the conditions in which these methods are advised?
- 14) Expand the following and explain any one of them. (a) IVF (b) ZIFT (c) IUI (d) MTP.
- 15) Explain any three contraceptive devices that can be used by women for their family planning.

ANSWERS

- 1) Following are the consequences of population explosion:
 - (i) It is causing an absolute scarcity of the basic requirements, i.e., food, clothing, fuel and shelter.
 - (ii) There is greater demand for fossil fuels (oil, gas and coal).
 - (iii) Eco-degradation.
- 2) There is a statutory ban on amniocentesis to legally check female foeticide. This sex determination technique has been misused to eliminate girl child before birth. This technique is also used to detect the abnormal chromosomes or any genetic disorder. The ban is justified to prevent female foeticide which could lead to change in sex ratio of the population.
- 3) (a) The ideal contraceptive should be (i) user-friendly, (ii) effective and easily available, (iii) not interfering with the sexual drive, (iv) reversible with no or least side effects.
 - (b) CuT, Cu7 and Multiload 375 affect motility of sperms.
- 4) (a) Contraceptive pills contain progestogen or progestogen-estrogen combination. They act by either of the following way:
 - (i) Inhibit ovulation (ii) inhibit implantation (iii) alter quality of cervical mucus to prevent or retard entry of sperms.
 - (b) Contraceptive pills should be taken daily for a period of 21 days starting within first five days of menstrual cycle (to be repeated after a gap of 7 days).
- 5) (a) Any two types of IUD like Copper T and LippesLoop .
 - (b) Advantages of Saheli:

- (i) It is non-steroidal (ii) It is taken only once a week (iii) It has high contraceptive value (iv) It has less side effects.
- 6) Progestogen-estrogen combination, Progestogen or Progesterone are present in contraceptive pills. They inhibit ovulation, implantation and alter quality of cervical mucus to retard entry of sperm. Saheli is a commonly prescribed oral pill.
- 7) (a) IUD—Intra uterine devices. (b) Hormone releasing IUDs are considered a good contraceptive because (i) they make the uterus unsuitable for implantation.
- (ii) they increase the phagocytosis of sperms within uterus and the Cu ions released, suppress sperm motility and the fertilising capacity of sperms.
- 8) Sexually transmitted disease Causal agent
- (i) Hepatitis-B, Hepatitis-B virus (ii) Genital herpes, Herpes simplex virus (iii) AIDS, HIV (Human Immunodeficiency Virus).
- 9) In the age group of 15–24 years, STDs are reported to be very high. Following are the three practices to avoid them:
- (i) Abstain sexual contact with unknown partners or multiple partners.
 - (ii) Always use condoms during coitus.
 - (iii) In case of any doubt, medical help should be taken for early detection.
- 10) Explain any three ART like IVF, ICSI and GIFT .
- 11) Zygote intra fallopian transfer technique (ZIFT) is a technique of in vitro fertilisation wherein the zygote or early embryo having up to 8 blastomeres is transferred into the fallopian tube to complete its further development. Intra uterine transfer (IUT) technique is different from ZIFT as the embryos with more than 8 blastomeres are transferred into the uterus in IUT.
- 12) The infertile couples could be assisted to have children through certain special techniques known as assisted reproductive technologies (ART). ZIFT: The zygote or early embryo with up to 8 blastomeres is transferred into the fallopian tube. This is called zygote intra fallopian transfer (ZIFT). GIFT: It is the transfer of an ovum collected from a donor into the fallopian tube of another female, who cannot produce one but can provide suitable environment for fertilisation and further development of the embryo. Intra-uterine transfer (IUT) refers to the introduction of embryo with more than 8 blastomeres into the uterus of a female to complete its further development.
- 13) IVF refers to in vitro fertilisation and ET refers to embryo transfer. Gametes from the male and female are collected hygienically and induced to fuse in the laboratory set up under simulated conditions. The zygote formed is collected and is introduced into the uterine of a host or surrogate mother at an appropriate time. Early embryos (up to 8 cell) are generally transferred to the fallopian tube whereas embryos with more than 8 cells are transferred to the uterus.
- 14) IVF — In-vitro Fertilisation ZIFT — Zygote Intra Fallopian Transfer IUI — IntraUterine Insemination MTP — Medical Termination of Pregnancy.
- 15) Copper releasing IUDs—suppress sperm motility/ fertilizing capacity of sperms

Hormone releasing IUDs—make uterus unsuitable for implantation/cervix hostile to sperms (Female)

Condoms—provide physical barrier and prevent meeting of sperm and ovum.

Oral pills—inhibit ovulation and implantation/alter quality of cervical mucus and prevent entry of sperms.

LONG ANSWER QUESTIONS (5 marks)

- 1) Name and explain the surgical method advised to human males and females as a means of birth control. Mention its one advantage and one disadvantage.
- 2) A large number of married couples the world over are childless. It is shocking to know that in India the female partner is often blamed for the couple being childless.
 - (a) Why in your opinion the female partner is often blamed for such situations in India?
 - (b) State any two reasons responsible for the cause of infertility.
 - (c) Suggest a technique that can help the couple to have a child where the problem is with the male partner.
- 3) A village health worker was taking a session with women. She tells the women that one has to be very careful while using oral pills as method of birth control. Wrong usage can actually promote conception.
 - (a) Analyse the statement and compare the merits and demerits of using oral pills and surgical methods of birth control.
 - (b) Village women were confused as to how a thin metallic copper loop can provide protection against pregnancy. Justify the use, explaining the mode of action of IUDs.

ANSWERS

1) Explain Vasectomy and Tubectomy in details.

Advantage : It is the permanent and most effective method of preventing conception as it blocks transport of gametes.

Disadvantage: The process of surgical method is irreversible.

2) (a) Female partner is often blamed due to following reasons:

(i) Social mind set (ii) Inequality of sexes (iii) Lack of awareness/male dominated society.

(iv) Awareness is to be created that abnormality can occur in both male and females and infertility issues with suitable examples

(v) Mutual respect towards both the partners in case of the problem and to find the remedy from medical experts

(vi) Educate them to find the reason and not believe in superstitions.

(b) Infertility is caused due to physical abnormality in reproductive system, congenital, immunological or psychological problems.

(c) Artificial Insemination.

3) (a) Contraceptive pills-

Merits-

1. Pills are effective with lesser side effects and well accepted by females.

2. Reversible method.

Demerits-

1. If not taken on right days they can promote conception. 2. Can have side effects if taken for a long time.

Surgical methods-

Merits-

1. Surgical intervention block gamete transport. 2. Highly effective.

Demerits-

1. Not reversible. 2. Can affect health of a person if performed in unhygienic condition.

(b) Mode of action of IUDs

(i) Increased phagocytosis of sperms within the uterus.

(ii) Cu^{++} released suppresses sperm motility.

(iii) Hormone releasing IUDs make uterus unsuitable for implantation

CASE BASED QUESTIONS

(I) The so-called test tube babies are produced by the technique of "in vitro fertilisation". It is a form of assisted reproductive technologies (ART). The steps of ART include:

- (i) Administration of gonadotropins or Clomiphene Citrate to the woman.
- (ii) Aspiration of several ova (sec. oocytes) by laparoscopy.
- (iii) Collection of the sperm from the husband/donor semen.
- (iv) Incubation of ovum and the sperm together in special media and environment



i) What will be the reason behind using the above technique?

ii) From which part, the ovum (sec. oocytes) are aspirated using Laparoscopy?

OR

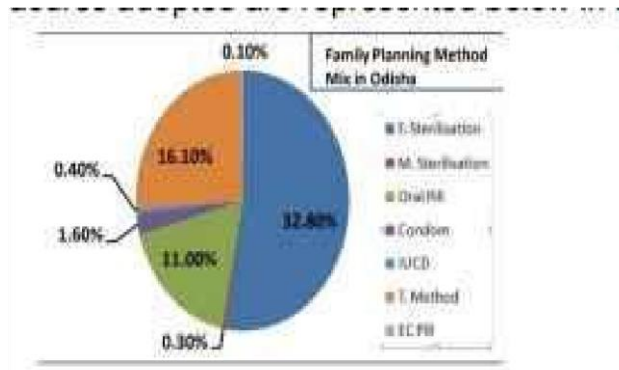
ii) Why Gonadotropins are administered to the woman in above technique?

iii) Why woman is administered with progesterone before the implantation of the embryo?

Answer:

i) The reason behind using this technique is there may be inadequate mobility of spermatozoa or there may be obstruction of the uterine tube. (ii) Graaffian follicle. OR (ii) Growth of corpus Luteum. (iii) To make the endometrium of uterus receptive

II) Population in Odisha is 42 million where youth constitute one fifth of it. The unmet need of family planning is 19%. Modern contraceptive prevalence rate in Odisha is 46.3%. The different contraceptive measures adopted are represented below in a pie chart.



Answer the following question based on your concept on Reproductive health and the above mentioned pie chart.

Q1. From the pie chart write which family planning method is most popular in Odisha?

Q2. How can the use of condoms be advocated?

Q3. Why there is prevalence of female sterilisation over male sterilisation?

Q4. How can as an aware citizen you motivate the young couple to adopt the family planning methods?

Answer: 1.- The female sterilisation method is most popular in Odisha.

2. By creating awareness among the people that, it doesn't have

i) any side effects ii) gives privacy to the user iii) don't need medical assistance

3. i) Still there is a belief in society that female are more responsible for reproduction related problems. ii) Male are not going for sterilisation because of social stigma.

4.- i) By briefing them the benefit of small family.

ii) By creating awareness among them regarding the family planning methods and its benefits.

III) Read the passage given below and answer the following questions.

Assisted Reproductive Technology (ART) refers to treatment and procedures that aim to achieve Pregnancy. These complex procedures may be an option for people who have already gone through various infertility treatment options but who still have not achieved pregnancy. The main type of ART is In Vitro Fertilisation (IVF), IVF involves extracting a woman's egg, fertilising the eggs in the laboratory and then transferring the resulting embryos into the woman's uterus through the cervix. ART success rates vary in the context of patient and treatment characteristics, such as age, infertility diagnosis, number of embryos transferred, type of ART procedure, use of techniques such as ICSI and history of previous births, miscarriages and ART cycles.

5) A woman whose womb is used as a substitute for the biological mother to nurse the embryo is called

(a) Interrogate mother (b) Surrogate mother (c) Both (a) and (b) (d) None of these

6) The stage of cells at which it is transferred into the uterus after induced fertilisation of ova in the laboratory is (a) embryo at 4 blastomeres stage.

(b) Embryo at 2 blastomeres stage. (c) Morula (d) Zygote

7) Artificial reproductive techniques are not always applicable because.

(a) it is an expensive technique, hence only few people can afford it.

(b) it is not possible in women with damaged uterine wall.

(c) it has raised ethical, legal and moral concerns

(d) All of the above

8) Assertion(A): Both ZIFT and IUT are embryo transfer techniques.

Reason(R): In both ZIFT and IUT, the number of cells in zygote is same.

(a) If both A and R are true and R is the correct explanation of A

(b) If both A and R are true, but R is not the correct explanation of A

(c) If A is true, but R is false

(d) If A is false and R is true

CORRECT OPTIONS

QUESTION	CORRECT OPTION	QUESTION	CORRECT OPTION
1	D	5	b
2	D	6	c
3	B	7	a
4	A	8	c

CHAPTER: 4 PRINCIPLES OF INHERITANCE AND VARIATION

MULTIPLE CHOICE QUESTIONS (1 MARKS)

- The degree by which progeny vary from parents is regarded as.....
a)Inheritance b)Mutation c)Recombination d)Variation
- Which is correct about traits chosen by Mendel?
(a) Terminal pod is dominant (b) Constricted pod is dominant
(c) Green coloured pod is dominant (d) Tall plants are recessive
- If the F1 generation produced by a cross between axial and terminal flower-bearing plants produces only axial flowers, the F2 progeny produced by the self-crossing of F1 will also produce only
(a)Axial flowers (b) Terminal flowers
(c)Both Axial and Terminal flowers but in different ratios (d) None of the above
- A cross between F1 hybrid and a recessive parent (Tt X tt) gives a ratio of
(a) 1:1 (b) 2:1 (c) 3:1 (d) 4:1
- A pink snapdragon is crossed to a white snapdragon. What is the probability of getting a red snap dragon?
(a) 1 (b) ½ (c) ¼ (d) None
- Occasionally, a single gene may express more than one effect. The phenomenon is called**
(a) multiple allelism (b) mosaicism (c) pleiotropy (d) polygeny
- In polygenic inheritance
(a) many genes govern a single character (b) heterozygous organisms express only one allele
(c) heterozygous organisms express both alleles (d) a single gene influences many characters
- Select the statements that describe the characteristics of genes.
 - Genes are specific sequences of bases in a DNA molecule
 - A gene does not code for a protein
 - In individuals of a given species, a specific gene is located on a particular chromosome
 - Each chromosome has only one gene.(a) i & ii (b) i & iii (c) i & iv (d) ii & iv
- Percentage of recombination and distance between the genes shows
(a) a direct relationship (b) an inverse relationship
(c) a parallel relationship (d) no relationship
- The map distance between genes A and B is 3 units, between B and C 10 units and between C and A 7units. The order of the genes in a linkage map constructed on the above data would perhaps be:
(a) A, B, C (b)A, C, B (c) B, C, A
(d) B, A, C
- Two genes R

and Y are located very close on the chromosomal linkage map of maize plant.

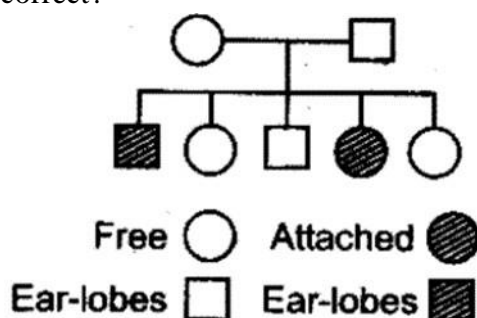
When RRY_Y and rry_y genotypes are hybridized, the F₂ segregation will show:

- A. Higher number of the recombinant types
- B. Segregation in the expected 9: 3: 3: 1 ratio
- C. Segregation in 3: 1 ratio
- D. Higher number of the parental types

12. Which of the following will not result in variations among siblings?

- (a) Independent assortment of genes
- (b) Crossing over
- (c) Linkage
- (d) Mutation

13. Given below is a pedigree chart of a family with five children. It shows the inheritance of attached earlobes as opposed to the free ones. Which one of the following conclusions drawn is correct?



- a) The parents are homozygous recessive
 - b) The trait is Y-linked
 - c) The parents are homozygous dominant
 - d) The parents are heterozygous
14. A disease that shows its transmission from unaffected carrier females to some of its male progeny” Find the nature of the trait.
- (a) Autosomal recessive
 - (b) Autosomal dominant
 - (c) Sex-linked recessive
 - (d) Sex-linked dominant
15. In sickle cell anaemia glutamic acid is replaced by valine. Which one of the following triplets codes for valine?
- D. G G G
 - (b) A A G
 - (c) G A A
 - (d) G U G
16. Conditions of a karyotype $2n + 1$, $2n - 1$ and $2n + 2$, $2n - 2$ are called
- (a) aneuploidy
 - (b) polyploidy
 - (c) allopolyploidy
 - (d) monosomy

Answers : MCQ

1	2	3	4	5	6	7	8	9	10	
d	c	c	a	b	c	a	b	b	d	
11	12	13	14	15	16	17	18			
d	a	a	d	d	a	c	d			

ASSERTION REASON TYPE QUESTIONS

- . (A) Both Assertion and reason are true and the reason is the correct explanation of Assertion
- (B) Both Assertion and Reason are true and Reason is not correct explanation of Assertion.

(C) Assertion is true but Reason is false.

(D) Assertion is false but Reason is true.

1. Assertion: During Mendel's investigations into inheritance patterns it was not for the first time that statistical analysis and mathematical logic were applied to problems in biology.
Reason: His experiments had a large sampling size, which gave greater credibility to the data that he collected
2. Assertion: Mendel's law of Independent assortment does not hold good for the genes that are located closely on the same chromosome.
Reason: Closely located genes assort independently.
3. **Assertion** : In snapdragon, selfing of F1 pink flower plants produces same phenotypic & genotypic ratio.
Reason : Flower colour gene shows incomplete dominance.
4. Assertion : The males have half the number of chromosomes than that of a female, in Honey bee. Reason: An offspring formed from the union of a sperm and an egg develops as a female (queen or worker), and an unfertilized egg develops as a male (drone) by means of parthenogenesis.
5. Assertion: Study of the family history about inheritance of a particular trait provides an alternative. Reason: In the pedigree analysis the inheritance of a particular trait is represented in the family tree over generations.
6. Assertion: Haemophilia is a sex linked recessive disease, which shows its transmission from unaffected carrier female to some of the male progeny has been widely studied. Reason: In this disease, a single protein that is a part of the cascade of proteins involved in the clotting of blood is affected by point mutation.

Answer ASSERTION REASON TYPE QUESTIONS

1	2	3	4	5	6
D	C	A	A	B	A

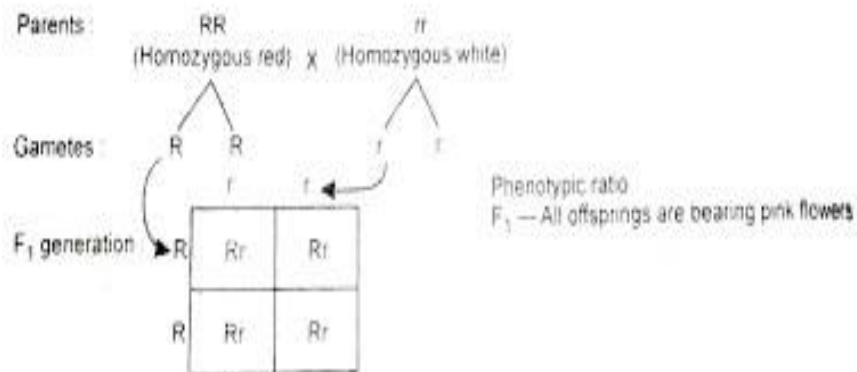
SA-1(2 MARKS)

1 Analyze, why did Mendel self-pollinate the tall F1 plants to get the F2 generation and crossed a pure breeding tall plant with a pure breeding dwarf plant to obtain the F1 generation? **Answer:**

The genotype of 50% of the offspring will resemble one parent and the rest 50% will resemble the other parent. The F1 generation obtained from the cross is heterozygous. So selfing the F1 generation is sufficient to obtain the F2 generation. It would also help to understand the inheritance of selected traits over generations

2 A cross between a red flower bearing plant and a white flower bearing plant of *Antirrhinum* produced all plants having pink flowers. Work out a cross to explain how this is possible.

Answer



3. A woman with blood group 'A' marries a man with blood group 'O'. Discuss the possibilities of the inheritance of the blood groups in the following starting with "Yes" or "No" for each.

Answer:

(b) Yes, if the mother is A (genotype I^AI^A)

OR

I^Ai) and father has O (genotype ii) blood group, then the blood group of some children can be 'O' and some can be with blood group 'A'.

4. In a chromosome, the map distance in certain organism between genes A & B is 6 units, between B & C is 4 units, & between C & D is 10 units which one of these gene pairs will show more recombination frequency? Support your answer with reason.

Answer:

C & D will show maximum gene recombination because genes which are more closely linked, frequency of recombination is least & vice versa

5. Write the types of sex-determination mechanisms the following crosses show. Give an example of each type.

(i) Female XX with Male XO

(ii) Female ZW with Male ZZ

Answer

(i) Female XX with male XO is male heterogamety. For example, grasshopper.

(ii) Female ZW with male ZZ is female heterogamety. For example, birds.

The male Fruitfly and female Fowl are heterogametic while the female Fruitfly and the male Fowl are homogametic. Why are they called so?

Answer: The male fruit fly has XY sex chromosomes and produces two types of gametes hence it is called heterogametic while female fowl has ZW sex chromosomes thereby producing two types of gametes thus they are called heterogametic. Female fruit fly has two X chromosomes i.e. XX and produces similar gametes hence they are homogametic

SA-2(3 MARKS)

1. A teacher wants his/her students to find the genotype of pea plants bearing purple coloured flowers in their school garden. Name and explain the cross that will make it possible.

Answer:

Test cross is a method devised by Mendel to determine the genotype of a plant with dominant phenotype (purple flower in this case). In a test cross, the unknown dominant genotype is

crossed with recessive parent (white, WW in the given case). (i) If the progeny consists of purple and white flowers in ratio of 1:1, the purple flower is a hybrid with Pw genotype.

Cross---

(ii) If the progeny obtained have all purple flowers, both parents are homozygous, i.e. genotype of purple flower is PP.

Cross

2. Compare incomplete dominance and co-dominance with suitable examples?

Answer:

The phenomenon in which two true-breeding parents crossed to produce an intermediate offspring (also known as heterozygous) is called incomplete dominance. Eg. Snapdragon. Co-dominance refers to the dominance in which the two alleles or traits of the genotypes (of both homozygotes) are expressed together in offspring (phenotype). There is neither a dominant nor recessive allele in cross-breeding. Rather the two alleles remain present and formed as a mixture of both of the alleles (each allele has the tendency to add phenotypic expression during the breeding process).eg. AB blood group

3. During his studies on genes in Drosophila that were sex-linked T.H. Morgan found F₂ population phenotypic ratios deviated from expected 9:3:3:1. Explain the conclusion he arrived at.

Answer: The following is an explanation for the divergence from the Mendelian ratio: The genes that are implicated are found on the X chromosome. When two genes are on the same chromosome, parental gene combinations are far more common than non-parental gene combinations. Physical relationship of genes on a chromosome is known as linkage. Non-parental gene combination (recombination).

4. Over the past 20 years in India, 10 million female babies have been aborted. The pressure to have sons is terrifying - mothers who bear daughters are hated and cast aside by husbands and in-laws desperate to escape the financial burden of a girl's dowry. Moreover, Women are often blamed for producing female children and consequently, they are ill-treated and ostracized. Suggest a way how you will address this issue scientifically if you were to conduct an awareness programme to highlight the values involved?

Answer:

It is not appropriate to blame women for producing female children because scientifically it is the father who determines the sex of the baby.

The scientific explanation for the following is:

The chromosome pattern in human females is XX and human males are XY. Males are heterogametic and produce two types of gametes one carrying X and the other carrying Y. The females are homogametic and produce same type of gamete carrying X chromosome.

The sex of the child depends on the sperm that fuses with the ovum. If the fertilizing sperm has an X chromosome, then the baby would be a female and if a sperm with Y chromosome fuses with the ovum, it will develop into a male child. Thus, males are responsible for determination of the sex of a child. So, we should not blame women for the birth of a female child and stop ill-treating them.

CASE STUDY BASED QUESTIONS (4MARKS)

Mendel investigated characters in the garden pea plant that were manifested as two opposing traits, e.g., tall or dwarf plants, yellow or green seeds. This allowed him to set up a basic framework of rules governing inheritance, which was expanded on by later scientists to account for all the diverse natural observations and the complexity

inherent in them. Mendel conducted such artificial pollination/cross pollination experiments using several truebreeding pea lines. A true breeding line shows the stable trait inheritance and expression for several generations.

- a) List the traits studied for the flower in peas along with their allele, and state which one is dominant.
- b) State the number of true breeding pea plant varieties that had been selected by Mendel in Pea Plant.
- c) Explain which individuals will be called as a true breeding line.
- d) Mention any two advantages of selecting pea plant for experiment by Mendel.

Answer:

- a) Flower colour: Violet(dominant) and White (Recessive) Flower position: Axial (dominant) and Terminal (Recessive)
- b) 14

(c) A truebreeding line is one that, having undergone continuous self-pollination, shows the stable trait inheritance and expression for several generations.

d) Short Life span, Easily Cultivable

2. Imagine that there are two alleles, B and b, for a given trait. B is dominant to b. Answer the following questions about this gene:
 - a) List the possible homozygous and heterozygous genotypes?
 - b) In which genotype or genotypes it is expressed that B is dominant?
 - c) State with reason, whether B and b are located on different loci?
 - d) Explain why the two alleles cannot be on the same chromosomes?

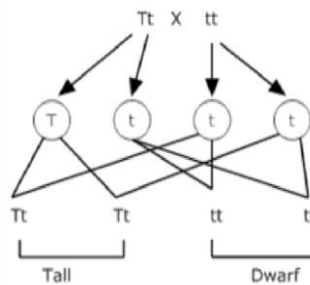
Answers:

a) **BB, bb and Bb**

b) **Bb**

c) **B and b are the two different alleles for the same trait and each trait has a certain loci in a chromosome and both cannot acquire a single position in a chromosome. The chromosomal theory of inheritance proposed by Boveri and Sutton stated that the genes are present on specific locations on a chromosome. Similar or different alleles are located in the same loci of both the homologous chromosomes that they form pair.**

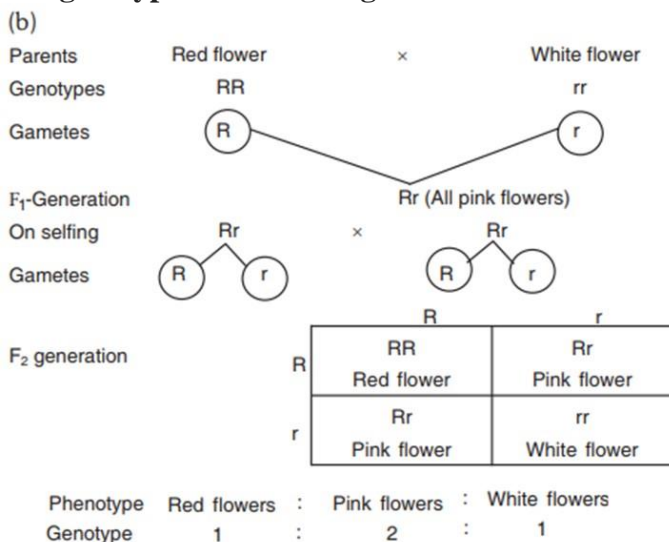
2. By analysing the result of the cross, shown here:
- Identify the name, of this type of cross and express why it is used.
 - Interpret that what will be the genotype of the parental plants if they produce 26 TT: 48Tt: 24tt.
 - If F₂ dwarf plants are self pollinated then the genotype of F₃ and F₄ will be.....
 - TT and tt
 - tt and tt
 - Tt and Tt
 - TT and Tt
 - Compare the Genotypic and Mendel's Monohybrid cross **Answer:**
 - Test cross. It is useful to determine the genotype of a parent plant.**
 - Tt and Tt iii) tt and tt**
 - Genotypic ratio- 1:2:1 and Phenotypic ratio- 3:1**
3. Work out a cross between true breeding red and white flowered dog flower plants (snapdragon) upto F₂ progeny. Explain the results of F₁ and F₂-generation.



phenotypic ratio of

Answer:

In F₁-generation Pink flowered plants obtained. It is due to incomplete dominance. In F₂-generation Alleles of the hybrid (F₁) segregate during gamete formation and the parental characters reappear without any change. So, the phenotypic and genotypic ratios in F₂-generation are same.



3. A 21-year-old female reported to the Outpatient Department of Periodontics, Mamata Dental College and Hospital, Khammam, with the chief complaint of multiple mobile teeth in the mouth since 1 year. On physical examination, it was seen that the patient was of short stature and had webbed neck with a low hair line at the back of the neck and the secondary sexual characters are also not visible. Ultrasound report of the abdomen revealed hypogonadism i.e she has rudimentary ovaries.
- By examining the symptoms, identify the disorder seen in the patient.
 - Discuss the genetic cause of the state she is suffering from.
 - Mention the karyotype of this type of chromosomal aberration. **Answer:**
- a) Turner's Syndrome**

b) Such a disorder is caused due to the absence of one of the X chromosomes, 45 with XO.

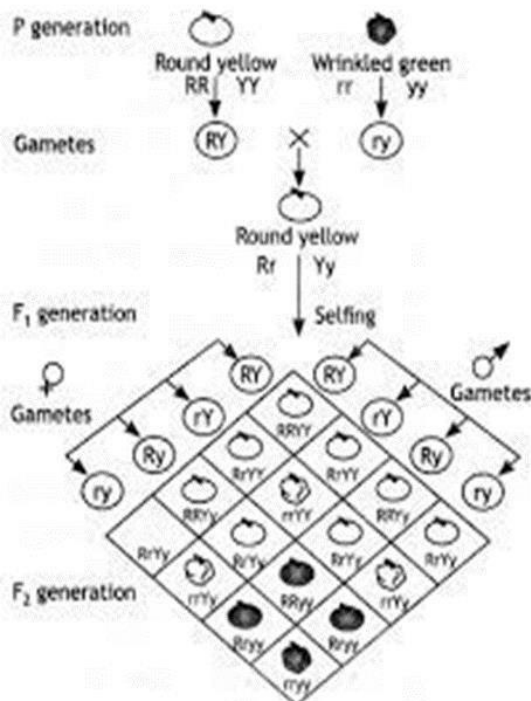
LA (5MARKS)

1. Mendel did a dihybrid cross by observing the inheritance of two genes. In a dihybrid cross plants having 2 sets of contrasting characters are chosen. Based on various dihybrid crosses, Mendel proposed a second set of generalizations in the form of the Law of Independent Assortment. It is the third law of inheritance.

- i) Design a cross for the genes seed colour and seed shape to show the results that obtained in this cross.
- ii) Evaluate the ratio obtained in this dihybrid cross.
- iii) Show the new combination of progeny obtained in the cross.

Answer:

(i) **Punnett square with : RRYY and rryy individuals**



(i) **9:3:3:1**

(ii) **Wrinkled Yellow and Round Green**

2. A smooth seeded & red – flowered pea plant (SsRr) is crossed with smooth seeded & white flowered pea plant (Ssrr). Determine the phenotypic & genotypic ratio in F1 progeny?

Answer: 1. Smooth seed & red flower =3 2. Smooth seed & white flower =3 3. Rough seed & red flower =1 4. Rough seed & white flower =1

3. (a) State the law of independent assortment.

(b) Using Punnett square demonstrate the law of independent assortment in a dihybrid cross involving two heterozygous parents.

Answer:

According to the law of independent assortment, during the inheritance of two different traits, the alleles of both the traits assort and are inherited independently of one another during gamete formation.

4. Inheritance pattern of flower colour in Garden Pea and Snapdragon differs. Compare the difference observed? Explain showing the crosses upto F2 generation.

Answer: The inheritance pattern of flower colour in *Pisum sativum* (garden pea) follows the law of dominance that is out of the two alleles of flower colour (gene) the dominant allele is expressed (phenotypically) and the recessive allele is suppressed when both are present together in heterozygous condition. The recessive trait is expressed only when the recessive allele is present in the homozygous condition. In the case of *Antirrhinum* (snapdragon) the flower colour shows incomplete dominance and all the F1 progeny is of pink colour. It is because the allele for red colour is not completely dominant over its recessive allele. The law of dominance is not exhibited in this case.

Bateson, Saunders, and Punnett decided to cross the F1 plants with each other. After this cross, the researchers expected the F2 generation to have a 9:3:3:1 ratio (nine plants with purple flowers and long pollen grains, to three plants with purple flowers and round pollen grains, to three plants with red flowers and long pollen grains, to one plant with red flowers and round pollen grains). Instead, they observed the results shown in Table 1 (Bateson et al., 1905), and these results were found to be statistically significant

i. From the chart synthesize the fact that what deviation from Mendel's findings were found by the researchers?

ii. This is the reason why Mendel did not recognize linkage phenomenon in his experiments

(a) he studied only pure plants

(b) he did not have a powerful microscope

(c) characters he studied were situated on different chromosomes

(d) many chromosomes to handle iii. Based on these findings, the trio proposed that certain alleles must somehow be coupled with one another. Point out the name of the phenomenon that is called later on? Name the Scientist who discovered it and what was the specimen used in his discovery? Answer:

(i) The researchers realized that there was an excess in the number of parental phenotypes (purple-long and red-round) in the F2 results. Because the parental phenotypes reappeared more frequently than expected, the three researchers hypothesized that there was a coupling, or connection, between the parental alleles for flower color and pollen grain shape, and that this coupling resulted in the observed deviation from Mendel's law of independent assortment.

(ii) (c)

Linkage, T.H. Morgan, *Drosophila melanogaster*

5. In the image given below, a classical example of point mutation is shown. Identify the disorder. State the cause of the problem, its symptoms and the effect.

Answer: Sickle Cell Anaemia, Its cause and effects.

Study the given illustration of an abnormal karyotype of an individual and answer the following questions:

a) Examine the genetic disorder visible in this karyotype.

b) Construct a list of abnormalities seen in the individual suffering from this disorder.

Name the phenomenon which is responsible for this condition.

Answer:

a) Klinefelter's Syndrome

b) Such an individual has overall masculine development, however, the feminine development (development of breast, i.e., Gynaecomastia) is also expressed. Such individuals are sterile.

This genetic disorder is also caused due to the presence of an additional copy of X chromosome resulting into a karyotype of 47, XXY

CHAPTER: 5 MOLECULAR BASIS OF INHERITANCE

MULTIPLE CHOICE QUESTION (MCQ)

1. Sickle cell anaemia is caused
 - a. When valine is replaced by glutamic acid in beta polypeptide chain
 - b. When glutamic acid is replaced by valine in beta polypeptide chain
 - c. When glutamic acid is replaced by valine in alpha polypeptide chain
 - d. When valine is replaced by glutamic acid in alpha polypeptide chain

Ans.b

2. Match the entries in column I with those of column II and choose the correct answer.

Column I

Column II

A) Alkali treatment

M) separation of DNA fragments on gel slab

B) Southern blotting

N) split DNA fragments into single strands

C) Electrophoresis

O) DNA transferred to nitrocellulose sheet

D) PCR

P) X-ray photography

E) Autoradiography

Q) produce fragments of different sizes

F) DNA treated with REN

R) DNA amplification

a) A - N, B - Q, C - P, D - R, E - M, F - O

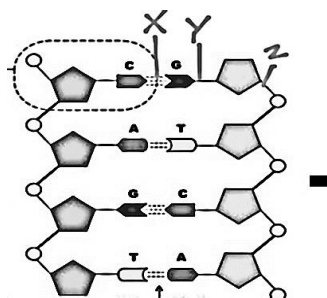
b) A - P, B - R, C - M, D - O, E - N, F - Q

c) A - Q, B - O, C - M, D - R, E - P, F - N

d) A - N, B - O, C - M, D - R, E - P, F - Q

Ans.d

3. Figure A shows the structure of polynucleotide chain, identify the types of bond shown by X, Y, Z and choose correct option from the table below.



	X	Y	Z
A	Hydrogen Bond	Glycosidic linkage	Phosphodiester linkage
B	Hydrogen Bond	Phosphoester linkage	Glycosidic linkage
C	Hydrogen Bond	Glycosidic linkage	Phosphoester linkage
D	Glycosidic linkage	Hydrogen Bond	Phosphoester linkage

Ans - C

4. DNA replication requires various enzymes, table represent enzyme and function, choose the function of respective enzyme.

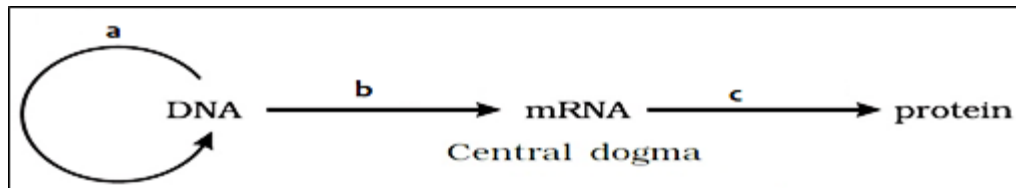
		X	Y	Z	W
(i)	Helicase	Breakdown of H bond	Joining DNA fragments	Formation of RNA primer	Joining DNA fragments
(ii)	DNA polymerase	Polymerization of nucleotides	Polymerization of nucleotides	Polymerization of nucleotides	Polymerization of nucleotides
(iii)	Ligase	Joining DNA fragments	Formation of RNA primer	Joining DNA fragments	Breakdown of H bond

(iv)	Primase	Formation of RNA primer	Breakdown of H bond	Breakdown of H bond	Formation of RNA primer
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- a) X
- b) Y
- c) Z
- d) W

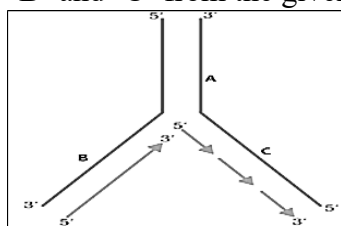
Ans-A

5. Identify 'a', 'b' and 'c' from the given figure.



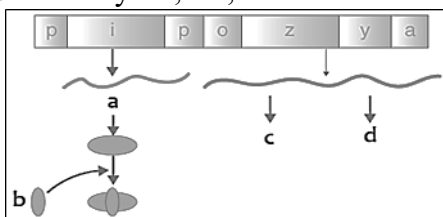
- a) a-Replication, b-Translation, c-Transcription
 - b) a-Reverse Transcription, b-Replication, c-Translation
 - c) a-Replication, b-Transcription, c-Translation
 - d) a-Translation, b-Replication, c-Transcription
- Ans-C

6. Identify 'A', 'B' and 'C' from the given figure.



- a) A-Discontinuous strand, B-Continuous strand, C-Template strand
 - b) A-Template strand, B- Discontinuous strand, C-Lagging strand
 - c) A-Parental strand, B-Leading strand, C-Lagging strand
 - d) All of these.
- Ans-C

7. Identify 'a', 'b', 'c' and 'd' from the given figure.



- a) a-Repressor protein, b-Inducer, c- permease, d- β -galactosidase
- b) a-Repressor mRNA, b-Inducer, c- β -galactosidase, d-permease
- c) a-Repressor mRNA, b- permease, c- Inducer, d- β -galactosidase
- d) a-Repressor mRNA, b-Inducer, c- β -galactosidase, d-transacetylase

Ans-D

ASSERTION REASON

DIRECTION- Choose correct option from given below:

- A) Both assertion and reason are true and reason is a correct explanation of the assertion.
- B) Both assertion and reason are true but the reason is not the correct explanation of assertion.
- C) If the assertion is true but the reason is false.
- D) If both assertion and reason are false.

1. Assertion: HGP is closely associated with the rapid development of a new area in biology called Bioinformatics.

Reason: Bioinformatics uses high speed computational devices for data storage, retrieval and analysis of enormous amount of data generated from HGP.

Answer: B

2. Assertion (A): Replication and transcription occur in the nucleus but translation takes place in the cytoplasm

Reason (R): mRNA is transferred from the nucleus into cytoplasm where ribosomes and amino acids are available for protein synthesis.

Answer: A

CASE BASED QUESTIONS

The Intelligent Design

In September 2013, intelligence agencies raided a house in Zephyr Heights in Mangaluru in search of the alleged bombers of Hyderabad Twin blasts, but found it empty. A forensic team picked up DNA samples from the house, and when the accused were finally caught, the samples matched with theirs. It helped NIA secure convictions for all five accused.

(i) Identify the phenomenon mentioned above:

- A) NIA raid
- B) Escape of suspects
- C) DNA fingerprinting
- D) None of these

(ii) DNA profiling was initially developed by _____.

- A) Alec Jeffreys
- B) James Watson
- C) Francis Crick
- D) Matthew Meselson.

(iii) Select the correct sequence of the process used to identify DNA samples:

- E) DNA isolation > Hybridisation using labelled VNTR probe > Gel electrophoresis > Southern blotting >
 - A) Digestion of DNA > Autoradiography.
 - B) DNA isolation > Digestion of DNA > Southern blotting > Gel electrophoresis > Hybridisation using labelled VNTR probe > Autoradiography.
 - C) DNA isolation > Autoradiography > Digestion of DNA > Gel electrophoresis > Southern blotting > Hybridisation using labelled VNTR probe
 - D) DNA isolation > Digestion of DNA > Gel electrophoresis > Southern blotting > Hybridisation using labelled VNTR probe > Autoradiography.

(iv) Assertion: polymorphism in DNA sequence is the basis of DNA fingerprinting technology.

Reason: If more than one variant (allele) at a locus occurs in human population with a frequency greater than 0.01 is called DNA polymorphism.

- A) Both assertion and reason are true and reason is correct explanation of assertion.
- B) Assertion and reason both are true but reason is not the correct explanation of assertion.
- C) Assertion is true, reason is false.
- D) Assertion is false, reason is true.

Answer: (i) C (ii) A (iii) B (iv) B

SHORT ANSWER TYPE QUESTIONS (2 MARK)

1. What do you mean by the central dogma? Who proposed it?

Ans. Schematic Diagram 2. Francis Crick

2. Write two chemical differences between the DNA and RNA.

Ans. Chemical name , number of helix

3. What is the role operator gene in lac operon?

Ans. Contain the code necessary to begin the process of transcription.

4. What do you mean by the satellite DNA? How it is useful in DNA finger printing?

Ans. Highly repetitive DNA consisting of short sequences repeated a large number of times

(a) Forensic Analyses on Animals

(b) Paternity Testing

5. What do you mean by the DNA polymorphism? What is its application?

Ans. Sequence variation if more than one variant (allele) at a locus occurs in human population with a frequency greater than 0.01.

Satellite DNA as probe that shows very high degree of polymorphism(variation) to compare.

6. What are the common functions performed by RNA

Ans. messenger, adaptor, structural component of ribosome, catalyst

7. How do histone acquire positive charge?

Ans. They contain a very high amount of positively charged amino acids such as lysines and arginines.

8. Expand SNPs. What are they?

Ans. SNPs - Single nucleotide polymorphisms.

These are locations on DNA, where single base differences are observed.

9. .If the length of E.Coli DNA is 1.36 mm, Calculate the number of base pairs it contains.

Ans. The distance between two adjacent bp = 0.34×10^{-9} m length = Total no. of bp x distance between two bp.

No. of bp. = $1.36 \times 10^{-3} / 0.34 \times 10^{-9} = 4 \times 10^6$ bp

10. Why is it that transcription & translation could be coupled in prokaryotic cell but not in eukaryotic cell?

Ans. Prokaryotic polycistronic eukaryotes mRNA need processing

11. Why is DNA & not RNA is the genetic material in majority of organisms? **Ans. The -OH group in the nucleotides of RNA is much more reactive & makes RNA labile & easily degradable .**

11. Give two reasons why both the strands are not copied during transcription?

Ans. i) If both the strands codes for RNA, two different RNA molecules & two different proteins are formed hence genetic machinery would be complicated.

ii) Since two RNA molecules produced would be complementary to each other, they would wind together to form ds-RNA.

SHORT ANSWER TYPE QUESTION (3 MARKS)

Q 1. Following are the features of genetic code. What does each one indicate? Stop codon, Unambiguous codon, Degenerate codon and Universal codon.

Ans 1. Stop codon: Codons that cause termination of protein synthesis and do not code for any amino acid; Example: UAA (ochre), UGA (opal) and UAG (amber).

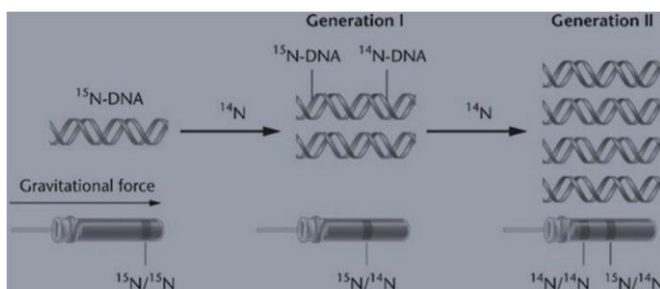
Unambiguous codon: one codon for one amino acid only; Example: GAA codes for glutamine only.

Degenerate codon: multiple codons specify single amino acid; Example: UUU and UUC code for phenylalanine.

Universal codon: a particular codon specifies a particular amino acid in all the organisms. The mRNA codon "ACU" codes for threonine, irrespective of its source.

Question 2. Describe Meselson and Stahl's experiment that was carried in 1958 on E. coli. Write the conclusion they arrived at after the experiment

Ans 2



Observation and conclusion: Since E coli cell takes 20 min to complete one round of cell cycle, the DNA extracted after 20 min had a hybrid density while that extracted after 40 min exhibited equal amounts of hybrid and light density; it was concluded that each new DNA molecule has one parental and one new strand i.e. the semi conservative mode of replication.

3. Write the basic difference between the Replication and Transcription.

Replication	Transcription
1. It is the process of formation of two copies of DNA molecules. Entire genomic DNA is copied.	1. Only a segment of DNA is copied to RNA.
2. It is the synthesis or formation of DNA from DNA.	2. It is the synthesis of RNA from DNA.
3. Both the strands of DNA take part in replication.	3. Only one strand of DNA acts as a template strand and gets transcribed to RNA.
4. Nitrogenous bases found in DNA polynucleotide chains are adenine, thymine, guanine and cytosine.	4. Nitrogenous bases found in RNA polynucleotide chains are adenine, uracil, guanine and cytosine.
5. It is catalysed by DNA dependent DNA polymerase enzymes.	5. It is catalysed by DNA dependent RNA polymerase enzymes.

4. What are the goals of the Human genome project?

Ans . Optimization of the data analysis. Sequencing the entire genome. Identification of the complete human genome. Creating genome sequence databases to store the data. Taking care of the legal, ethical and social issues that the project may pose. 5. What do you mean by the BAC and YAC? How they are useful in Human genome project?

Ans. YAC stands for Yeast Artificial Chromosome and BAC stands for Bacterial artificial chromosome.

YAC and BAC being artificial chromosomes were utilized for cloning large sections of the human

genome within them. This enabled researchers to identify the start and end points for that particular section of the human DNA.

6. The base sequence on one strand of DNA is ATGTCTATA (i) Give the base sequence of its complementary strand.

(ii) If an RNA strand is transcribed from this strand what would be the base sequence of RNA ?

(iii) What holds these base pairs together?

Ans. (i) TACAGATAT. (ii) UACAGAUAU

(iii) Hydrogen bonds hold these base pairs together. Adenine & thymine are bonded by two hydrogen bonds & cytosine & Guanine are bonded by three hydrogen bonds.

7. A tRNA is charged with amino acid methionine.

i) At what site in the ribosome will the tRNA bind?

ii) Give the anticodon of this tRNA? iii) What is the mRNA codon for methionine? iv) Name the enzyme responsible for this binding?

Ans. (i) P- site (ii) UAC (iii) AUG (iv) Amino acyl tRNA Synthetase

8. The DNA packaging in eukaryotes is carried out with the help of lysine and arginine rich basic proteins called histamine. The unit of compaction is nucleosome.

(a) What would happen if histones were to be mutated and made rich in aspartic acid and glutamic acid in place of basic amino acids such as lysine and arginine?

(b) What is the role of non-histone chromosomal proteins in DNA packing?

Ans. (a) If histone proteins were rich in acidic amino acids instead of basic amino acids then they may not have any role in DNA packaging in eukaryotes as DNA is also negatively charged molecule. The packaging of DNA around the nucleosome would not happen. Consequently, the 81 chromatin fibre would not be formed.

(b) The packaging of chromatin at higher level requires non-histone chromosomal proteins (NHC)

LONG ANSWER TYPE QUESTIONS (5 MARKS)

1. Answer the following question regarding Griffith experiment (a) Name the bacteria with which the experiment has done.

(b) What do you mean by the R-Strain and S-Strain?

(c) Did the mice developed the disease when he injected the heat killed S Strain to the mice?

(d) Among the two strains which one is Virulent??

(e) What was the finding of his experiment?

Ans. (a) *Streptococcus pneumonia* (b) Rough & Smooth strain

(c) No Mice Live (d) Smooth

(e) Transforming principle is transferred from heat killed S strain has enabled the R strain to synthesize a smooth polysaccharide coat and become virulent.

2. When did replication takes place in eukaryotic cell? Describe briefly the mechanism of DNA replication.

Ans. Synthetic Phase of Cell division

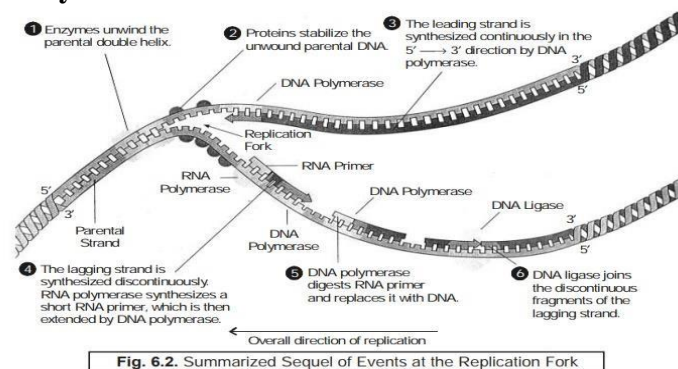
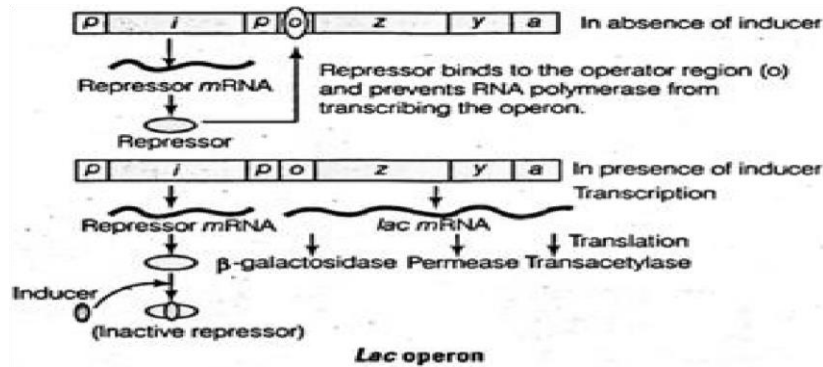


Fig. 6.2. Summarized Sequel of Events at the Replication Fork

3. What are different component of the lac operon? Describe the mechanism of regulation of the lac operon.

Ans. The lac operon consists of 3 structural genes, and a promoter, a terminator, regulator, and an operator.



4. (a) Explain the process of amino acylation of tRNA. Mention its role in translation.
 (b) How do ribosomes in the cells act as factories for protein synthesis?

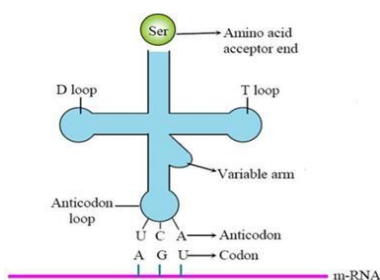
Ans. (a) Amino Acid + ATP + tRNA → Aminoacyl-tRNA + AMP + PP.

This is an essential step as only activated amino acids are carried to the site of protein synthesis by their respective tRNA.

(b) By translating the genetic code transcribed in mRNA into an amino acid sequence. Ribosomes use cellular accessory proteins, soluble transfer RNAs, and metabolic energy to accomplish the initiation, elongation, and termination of peptide synthesis

5. (a) Describe the structure and function of a t-RNA molecule. Why is it referred to as an adapter molecule?
 (b) Explain the process of splicing of hn-RNA in a eukaryotic cell.
 a) t-RNA (transfer RNA) reads the genetic code on one hand & transfers amino acids on the other hand, so it is called as adapter molecule by Francis Crick.

Structure of t-RNA:



Secondary structure of t-RNA is clover leaf like but the 3-D structure is inverted L-shaped.

t-RNA has five arms or loops

- (i) Anticodon loop has bases complementary to the code.**
- (ii) Amino acid has an acceptor end to which amino acid binds.**
- (iii) T-loop help in binding to ribosome.**

(iv) **D-loop help in binding amino acyl synthetase.**

(v) **Variable loop has no known function.**

The function of tRNA is to align the required amino acids according to the nucleotide sequence of mRNA.

tRNA is also called the adapter molecule because on one hand it can read the code and on the other hand it can bind to specific amino acid. It acts as intermediate molecule between triplet code of mRNA and amino acid sequence of polypeptide chain.

6.A DNA segment has a total of 1000 nucleotides, out of which 240 of them are adenine containing nucleotides. How many pyrimidine bases this DNA segment possesses? Or

A DNA segment has a total of 1500 nucleotides, out of which 410 are guanine containing nucleotides. How many pyrimidine bases this segment possesses? Or

A DNA segment has a total of 2000 nucleotides, out of which 520 are adenine containing nucleotides. How many purine bases this DNA segment possesses?

Answer:

According to Chargaff's rule, ratio of purines to pyrimidines is equal, i.e. $A + G = C + T$

The number of adenine (A) is equal to the number of thymine (T). $A = 240$ (given)

Therefore, $T = 240$

Also, the number of guanine (G) is equal to cytosine (C). Thus, $G + C = 1000 - [A + T]$

$G + C = 1000 - 480 = 520$ Hence, $G = 260$, $C = 260$

The number of pyrimidine bases, i.e. $C + T = 240 + 260 = 500$

Or

**(i) Given, $G = 410$ therefore, $C = 410$ $A + T = 1500 - (G + C)$
 $= 1500 - 820 = 680$**

Hence, $A = 340$; $T = 340$

The number of pyrimidine bases, i.e. $C + T = 410 + 340 = 750$

Or

(i) Given, $A = 520$ therefore, $T = 520$

$A + T = 520 + 520 = 1040$

Total number of nucleotides = 2000

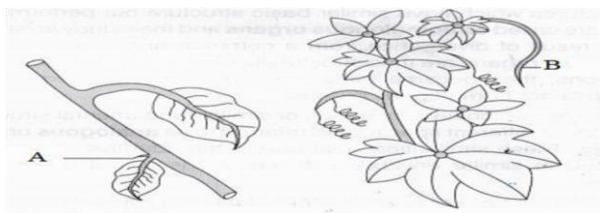
$G + C = 2000 - 1040 = 960$ $G = 960/2 = 480$

Hence, total number of purine bases are

$\Rightarrow A + G = 520 + 480 = 1000$

CHAPTER : 6 EVOLUTION

Sl no	Questions: 1 mark each
1	The theory of spontaneous generation stated that (a) life arose from living forms only. (b) life can arise from both living and non-living. (c) life arose from non-living things only. (d) life arises spontaneously neither from living nor non-living.
2	The fitness according to Darwin refers ultimately and only to: (a) physical fitness (b) reproductive fitness (c) chemical fitness (d) none of the above
3	Paleontological evidences for evolution refer to the (a) development of embryo (b) homologous organs (c) fossils (d) analogous organs
4	Darwin's finches are excellent example of (a) brood parasitism (b) connecting link (c) adaptive radiation (d) seasonal migration



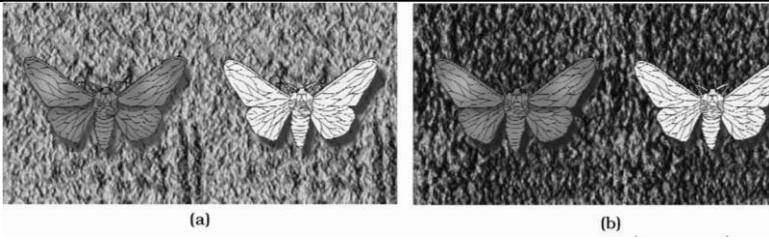
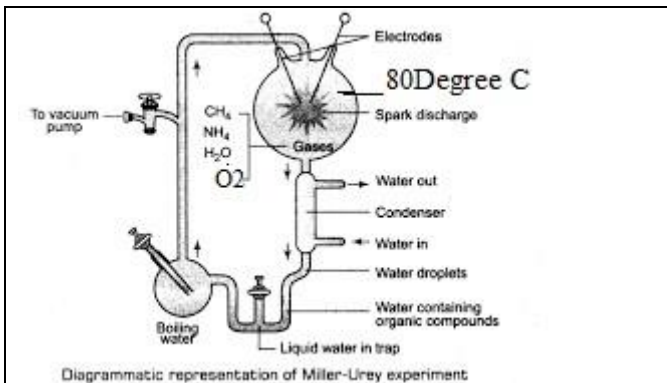
5	Choose the correct answers from the alternatives given. Darwin believed that a giraffe has a long neck because (a) God designed it that way (b) Catastrophes eliminated short-necked forms. (c) Its ancestors stretched their necks to get food. (d) Ancestral giraffes with slightly longer necks got more food than others and left more surviving offspring.
6	Single step large mutation is called (a)speciation (b) saltation (c) mutation (d)genetic drift
7	Which is the correct formula of hardy –Weinberg Principle? (a) $p^2+pq+q^2=0$ (b) $p^2+pq+q^2=1$ (c) $p^2+pq+q^2=\text{infinity}$ (d) $p^2+2pq+q^2=1$
8	Which of the following is an example for link species? (a)Lobefin (b)Dodo bird (c)Sea weed (d)Chimpanzee
9	The Neanderthal man having a brain size around (a)600 cc (b) 700 cc (c)800 cc (d)1400 cc
10	Evolution of life shows that life forms had a trend of moving from (a)Land to water (b)dry land to wet land (c)fresh water to sea water (d)water to land
11	‘Those who are better fit in an environment, leave more progeny than others. They will survive more and hence are selected by nature’. What is it called? (a)natural selection (b) adaptive radiation (c) physical fitness (d)chemical evolution
12	The bones of forelimbs of whale, bat, cheetah and man are similar in structure because (a)One organism has given rise to another (b)they share a common ancestors (c)they perform the same function(d)they have biochemical similarities
13	When more than one adaptive radiation appeared to have occurred in an isolated geographical area (representing different habitats), this is called (a)divergent evolution (b)convergent evolution (c)founder effect (d)mutation
14	The best description of natural selection is (a)the survival of the fittest (b)the struggle for existence (c)the reproductive success of the members of a population (d)a change in the proportion of variation within a population
15	Sometimes the change in allele frequency is so different in the new sample of population that they become a different species. This effect is called (a)stabilizing (b) directional (c) disruptive (d) founder effect
16	Change of frequency of alleles in a population results in evolution. This statement is proposed in (a)Darwin’s theory (b) Lamark’s theory (c)Hardy-Weinberg Principle (d)de Vries theory
17	The biggest dinosaurs was (a) <i>Tyrannosaurus rex</i> (b) <i>Spinosurus sp</i> (c) <i>Allosaurus sp</i> (d) <i>Triceratops sp</i>
18	<i>Ramapithecus</i> was more (a)ape-like (b) man- like (c) gorillas –like (d)chimpanzees like
19	The hypothesis that ‘Life originated from pre-existing non-living organic molecules was proposed by (a)Oparin and Haldane (b)Louis Pasteur (c)S L Miller (d)Hugo de Vries
20	The geological history of earth closely correlates with the (a)biological history of earth (b)paleontological history (c) geological history (d) none of the above
21	Thorn of Bougainvillea and tendril of Cucurbita are example of (a)vestigial organ (b)retrogressive evolution (c) analogous organ (d)homologous organ

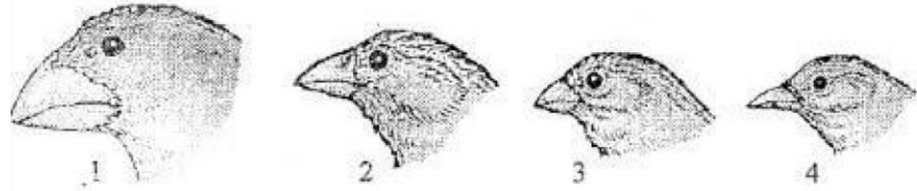
22	The diversity in the type of beak of finches adapted to different feeding habits on the Galapagos Islands as observed by Darwin provides evidences for (a)intraspecific variation (b)interspecific variation (c)interspecific competition (d) origin of species by natural selection										
	Darwin was influenced by (a)Thomas Malthus (b) Lamarck (c) Hugo de Vries (d) Oparin										
	Stabilising selection favours (a)only one extreme form of a trait (b)both the extreme forms of a trait(c) intermediate form of a trait (d)none of these										
	Coelacanths are primitive (a) bony fish (b) cartilaginous fish (c)amphibian (d) reptile										
	Java man was (a) <i>Homo habilis</i> (b) <i>Homo erectus</i> (c) <i>Homo sapiens</i> (d) <i>Ramapithecus</i>										
	Which type of selection explains industrial melanism observed in moth, <i>Biston bitularia</i> ? (a)stabilizing (b)directional (c) disruptive (d)artificial										
	Evolution of different species in a given area starting from a point and spreading to other geographical areas is known as (a) adaptive radiation (b)natural selection (c)migration (d)divergent evolution										
	Variations caused due to mutations are a) random and directionless b) random and directional c) random and small d) random, small and directional										
	A team of archaeologists found a fossilized skeleton of a human-like creature with a brain capacity of more than 700cc. The structure and its associated findings also show evidence that this creature could use tools for hunting. Which stage of human evolution is this creature NOT from? (a) Homo erectus (b) Homo habilis (c) Neanderthal Man (d) Australopithecines										
	Answers of MCQ										
	1	2	3	4	5	6	7	8	9	10	
	C	B	C	C	D	B	D	A	D	D	
	11	12	13	14	15	16	17	18	19	20	
	A	B	B	C	D	C	A	B	A	A	
	21	22	23	24	25	26	27	28	29	30	
	D	D	A	C	A	B	B	A	B	B	
	ASSERTION(A) AND REASON(R)(1 mark each)										
	The following Questions consist of two statements – Assertion(A) and Reason(R) Answer these questions selecting the appropriate option given below: (a)Both A and R are true and R is the correct explanation of A (b)Both A and R are true and R is not the correct explanation of A (c)A is true but R is false (d)A is false but R is true										
	Assertion: Louis Pasteur showed that in flask open to air, new living organisms appeared in the heat killed yeast culture. Reason: Life arises from pre-existing life.										
2	Assertion Any population has built in variation in characteristics. Reason: Those characteristics which enable some to survive better in natural conditions										
3	Assertion The eye of the octopus and of mammals show analogy. Reason: Analogous organs are anatomically different but functionally similar.										

4

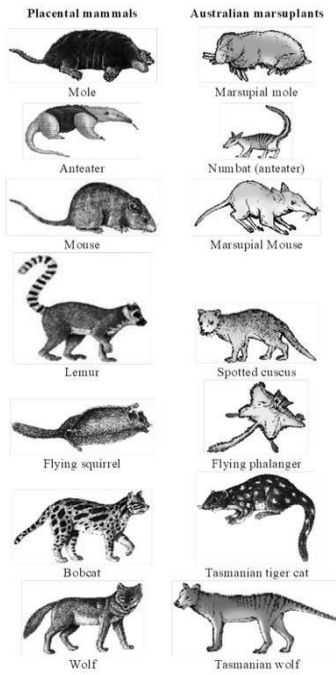
Assertion: Darwin's finches show a variety of beaks suited for eating large seeds, flying insects and cactus seeds.

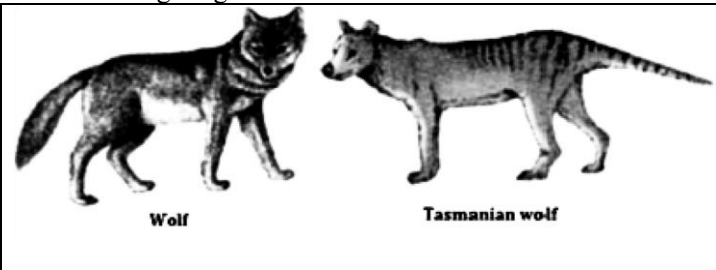
Reason: Ancestral seed-eating stock of Darwin's finches radiated out from South

	(c) mention the advantages he showed over <i>Homo sapiens</i> .
Ans	(a) lived in near east and central Asia between 1,00,000-40,000 years back.(b) brain size of 1400cc (c) They used hides to protect their body and buried their dead.Their brain size of 1400cc whereas Homo erectus had brain around 900cc
7	 <p>(a) (b)</p> <p>What do these pictures (a)and (b) represent? Illustrate with reference to evolution. Explain.</p>
Ans	Industrial melanism- explanation
8	(a)What is adaptive radiation? (b)Explain with the help of an suitable example where adaptive radiation has occurred to represent convergent evolution.
Ans	(a)Definition (b) correct example and explanation
9	a) Darwin's theory of natural selection is widely accepted but some limitations have been identified by modern biologists. Mention the limitations identified. (b) Name and state the most accepted theory of evolution in modern times. (c) Mention any two ways the of evolution are explained in modern biology.
Ans	a) Limitation of Darwin's theory of evolution(i)The theory of evolution could not explain how and where variations have arisen. (ii)It also could not explain how the variations are inherited. (b) The synthetic theory of evolution or Neo-Darwinism, also called the modern concept. According to this theory, the origin of new species is based on the interaction of genetic variations and natural selection. (c) (i) evolution is the change of gene (allele) frequencies in the gene pool of a population over many generations. (ii) species (and their gene pools) are isolated from one another, and (iii) the gene pool of each species is held together by gene flow, an individual.
SECTION – D CASE BASED QUESTIONS (4 marks each)	
Read the following passages and answer the following:	
1	<p>A student was simulating Urey and Miller's experiment to prove the origin of life.</p>  <p>Diagrammatic representation of Miller-Urey experiment</p> <p>(a) Find out the reasons why he could not get desired result? (b)What conclusion was drawn by Urey and Miller through this experiment? Or What was the purpose of this experiment?</p>

	(c) Compare the conclusion drawn with the theory of panspermia generation.
Ans	(b) Life could have come from pre-existing non-living inorganic molecules by chemical evolution Or To confirm abiogenesis (origin of life from organic matter) (c) Urey and Miller proved that life originated abiogenetically whereas theory of spontaneous generation emphasized that units of life called spores were transferred to different planets including earth.
	Darwin found the varieties of finches that in travelled to Galapagos Islands and observed variation in them.
	
	(a) What role does an individual organism play as per Darwin's theory selection? (b) How did Darwin explain the existence of different varieties of finches of Galapagos Islands? Or, How did Darwin's illustrate adaptive radiation? c) What is fitness of individuals according to Darwin?
	a) An individual organism passes on the variations, mutations and adaption from one generation to another. (b) Darwin explained it as the process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) called adaptive radiation. OR, Explanation of Darwin's finches as an example of adaptive radiation. (c) 'Fitness of an individual' is the ability of an organism to survive and pass of its genes to future generations

Study the given diagram below and answer the following questions.

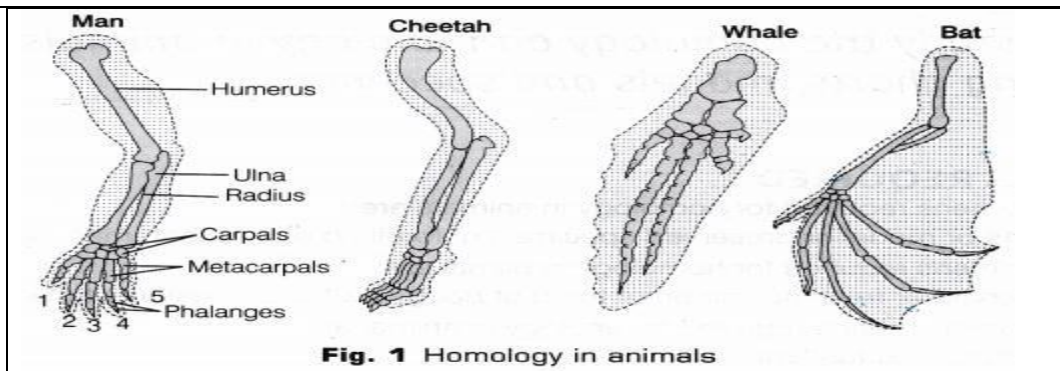


	<p>(b) Name and explain the phenomenon that had resulted in the evolution of such diverse species in the region.</p> <p>(c) Explain giving reasons the existence of Placental wolf and Tasmanian wolf sharing the same habitat. OR</p> <p>Which evolution is responsible for the existence of lemur and spotted cuscus sharing the same habitat.</p>
Ans	<p>(a)Australia</p> <p>(b)Adaptive radiation (convergent evolution) has resulted in this evolution. The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) called adaptive radiation (c)Placental wolf and Tasmanian wolf share similar habitat due to converge Evolution and evolved into unrelated group of organisms OR, Lemur and spotted cuscus share similar habitat due to convergent evolution and evolved into correlated group of organisms</p>
4	<p>Refer to the figure given below and answer that follows:</p> <div style="text-align: center;">  </div> <p>(a)Recognise and explain the process by which Tasmanian wolf evolved.</p> <p>(b)Give one example of an animal that has evolved along with Tasmanian wolf. OR, Name the process that results in evolution of Wolf and Tasmanian wolf.</p> <p>(c)Compare and contrast the two animals shown.</p>
Ans	<p>(a)Tasmanian wolf evolved by adaptive radiation. The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography(habitats) called adaptive radiation</p> <p>(b)tiger cat/banded ant eater/marsupial rat</p> <p style="text-align: center;">OR,</p> <p>Convergent evolution has resulted in evolution of wolf and Tasmanian wolf</p> <p>(c)Wolf is placental mammal whereas Tasmanian wolf is a marsupial mammal</p>
SECTION – E LONG ANSWER QUESTIONS (5marks each)	
1	<p>(a)Name the primates that lived about 15 million years ago. List their characteristic features.</p> <p>(b) (i) Where was the first man like animals found?</p> <p>(ii)Write the order in which Neanderthals, <i>Homo habilis</i> and <i>Homo erectus</i> appeared on the earth. State the brain capacity of each of them</p> <p>(iii)When did modern <i>Homo sapiens</i> appear on this planet?</p>

Ans	<p>(a) Dryopithecus and Ramapithecus</p> <p>Characters: (i) hairy (ii) walked like gorillas and chimpanzees. (iii) Ramapithecus was more man-like while Dryopithecus was more ape-like.</p> <p>(b)(i) East African grassland</p> <p>ii)Homo habilis brain capacities were between 650-800cc.Homo erectus had a large brain around 900cc. Neanderthal man with a brain size of 1400cc.</p> <p>(ii) Homo sapiens arose during ice age between 75,000-10,000 years ago</p>
2	Study the figure and answer the following:

Chapter 8: HUMAN HEALTH AND DISEASE

MCQ P:- (1 MARK EACH)



	<p>(a)Name and define the type of evolution these organisms exhibit. (b) What are such organisms called? What do they indicate about ancestry? (c) Contrary to the above condition organs that are not anatomically similar, but perform similar functions in different groups of organisms are also found. (i)What are such organs called and what type of evolution do they exhibit? (ii)Give two examples (one from plants and one from animals) of such organs.</p>
Ans	<p>a) Divergent evolution-definition (b)(i) Homologous organ-they are called homologous organs (c)(i) Analogous organs exhibit convergent evolution(ii)Example from plants –Tuber of potato and of sweet potato Example from animals(i)Eyes of Octopus and of mammals (ii)Flippers of Penguin and of dolphins (iii)Wings of insects and of birds (any one)</p>
3	<p>(a)State what is disturbance in Hardy –Weinberg equilibrium indicative of. (b)Write any four factors that affect the equilibrium. Explain how?</p>
Ans	<p>a) Explanation of Hardy-Weinberg principle Any deviation from this value ‘one’ is indicative of evolutionary change. (b)Factors affecting genetic equilibrium-gene migration or gene flow, genetic drift, mutation, genetic recombination and natural selection- definition of each (any four)</p>
4	<p>(a)Differentiate `between analogy and homology giving one example each of plant and animal respectively. (b)How are they considered as an evidence in support of evolution?</p>
Ans	<p>(a)Differences (b)Homology-Two examples each from plants and animals Analogy: Two examples each from plants and animals 3+2=5</p>

Q1. Antibodies produced against allergens

- are – a) IgA b) IgE c) IgG
 d) IgM

Q2. Immature lymphocytes become antigen sensitive in -

- a) Spleen b) Thymus c) Lymph node d) Tonsil

Q3. The plant that does not cause hallucination is –

- a) *Atropa belladonna* b) *Erythroxylum coca* c) *Papaver somniferum* d)
Datura sp

Q4. Cellular barrier that provides non-specific innate immunity does not include – a)

- Erythrocyte b) Neutrophil c) Macrophages d) Monocyte

Q5. Fertilization between gametocytes occur in –

- a) Gut of mosquito b) liver of human c) salivary gland of mosquito d) erythrocyte of human

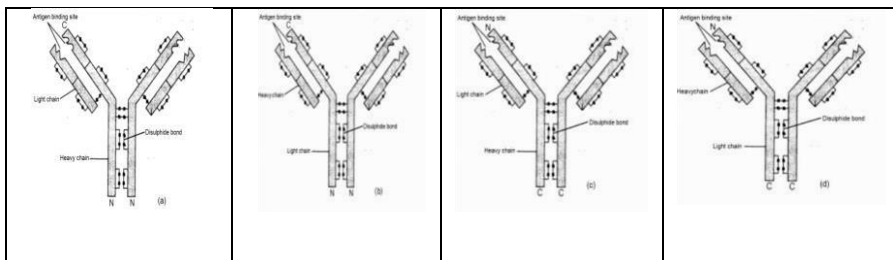
Q6. Ringworm is caused by –

- a) *Ascaris* b) *Wuchereria* c) *Microsporium* d) *Entamoeba*

Q7. The disease that does not spread through contaminated food and water is – a) Ascariasis b) Typhoid c) Amoebiasis d)

Filariasis

Q8. Which one of the following is a correct depiction of antibody molecule?



Q9. The percentage of lymphoid tissue in our body comprising of MALT

- is – a) 5% b) 15% c) 25% d) 50%

Q10. Which one of the following is a physical barrier?

- a) Tear from eyes b) Acid in stomach
c) Mucus coating on respiratory tract epithelium d) Saliva in mouth

Q11. Vaccines have made it possible for us to control various diseases. Which one of the following diseases is an exception to this?

- a) Measles b) Rubella c) Dengue d) Polio

Q12. *Wuchereria bancrofti* is a –

- a) Bacteria b) Nematode c) Fungus d) Protozoa

Q13. Malignant malaria is caused by –

- a) *Plasmodium falciparum* b) *Plasmodium ovale* c) *Plasmodium vivax* d) *Plasmodium malariae*

Q14. Chewing of tobacco increases the risk of-

- a) Lung cancer b) Oral cancer c) Prostate gland cancer d) Cervical cancer

Q15. Marijuana is produced from –

- a) Poppy plant b) cannabis plant c) coca plant d) *Datura* plant

Answer of MCQ

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B	B	C	A	A	C	D	C	D	C	C	B	A	B	B

ASSERTION REASON QUESTIONS :- (1MARK EACH)

The following questions consist of two statements – Assertion (A) and Reason (R).

Answer these questions selecting the appropriate option given below: a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true and R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

Q1. **Assertion** : Thymus is a primary lymphoid organ.

Reason : Immature lymphocyte differentiate into antigen sensitive lymphocyte in thymus.

Q2. Assertion : People become addicted to drugs with repeated use.

Reason : With repeated use of drugs the tolerance level of the receptors in our body increases.

Q3. Assertion : Colostrum provides passive immunity to foetus during gestation.

Reason : colostrum is rich in antibodies like IgA.

Q4. Assertion : cases of allergy is more common in children living in cities than in villages.

Reason : modern lifestyle has lowered immunity in urban children.

Q5. Assertion : Malignant tumour is more dangerous than benign tumour.

Reason : Malignant tumour undergoes metagenesis.

Q6. Assertion : Anamnestic response is less intense than primary response to a pathogen. Reason :

First exposure to pathogen generates memory B and T cell that recognises the same pathogen more quickly on subsequent exposure.

Answer of Assertion and reason questions

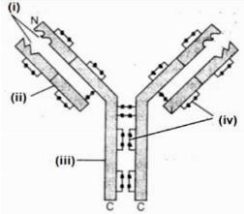
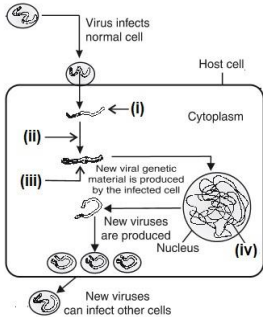
2 MARKS QUESTIONS WITH ANSWERS

2 MARKS QUESTIONS

Q.1	a) What is innate immunity? b) How is it different from acquired immunity? c) List the cells that act as cellular barriers. Ans. a) Non-specific immune response that is present at birth.
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Q3	<p>a) Why macrophages are referred to as HIV factory? b) Name another cell which is also infected by the virus after it enters human body. c) What happens as a result of such infection? Ans. a) Initially HIV infects macrophages and multiply to produce virus b) Helper T lymphocyte. c) Number of T helper cell decrease/patient starts suffering from various infections like fever, diarrhoea etc.</p>
Q4	<p>HPV vaccine protects against cervical cancer caused by Human Papilloma virus. a) Name the gene present in HPV that causes cancer. b) Human cells also have similar cancer causing genes. What are they called? c) If a person possesses these genes, will he definitely suffer from cancer? Give reason. Ans. a) viral oncogene. b) cellular oncogene /Proto oncogene. c) No. when proto oncogenes are activated under certain conditions/it may result in oncogenic transformation of the cell into cancerous neoplastic cells.</p>
Q5	<p>a) What is 'contact inhibition' property of cell? b) What happens when a cell loses this property? Ans. a) contact with other cells stop uncontrolled growth. b) Cells continue to divide giving rise to tumour.</p>
Q6	<p>a) Name a parasitic protozoa and a bacteria that usually infect a person suffering from AIDS. b)What makes AIDS patients more vulnerable to these infections than others? Ans. a) Protozoa – <i>Toxoplasma</i>, Bacteria – <i>Mycobacterium</i> (1/2 + 1/2) b) HIV attacks T – helper cells leading to a progressive decrease in their number, as a result an AIDS patient cannot overcome infections like other people.</p>
Q. 7	<p>a) Write the scientific names of two causal organisms of ringworm. b) Mention the symptoms of this disease. Ans. a) <i>Epidermophyton/Trichophyton/Microsporum</i> b) Dry scaly lesion on skin, nail and scalp/intensely itchy lesion</p>
Q. 8	<p>a) Which disease is detected by Widal test? b) What are the symptoms of this disease? c) How does it spread from infected to a healthy person? Ans. a) Typhoid b) Sustained high fever (39° C to 40° C)/weakness/headache/loss of appetite/intestinal perforation in critical case. c) Contaminated food and water.</p>
Q9	<p>a) Apart from <i>Streptococcus pneumonia</i>, which other bacteria causes pneumonia? b) How does this disease affect the lungs? c)How is it transmitted from one person to another? Ans. a) <i>Haemophilus influenza</i>. b) Alveoli of lungs get filled with fluid leading to respiratory problems. c) Droplet or aerosol released by infected person.</p>
Q. 10	<p>a) Write the scientific name of the plant from which heroin is obtained? b) How is this drug obtained? c)How does this drug affect human body? Ans. a) <i>Papaver somniferum</i> b) By acetylation of morphine extracted from latex of the plant. c) Depressant/slows down body function.</p>

5 MARKS QUESTIONS WITH ANSWERS

Q.1	<p>a) Identify the molecule represented by the diagram given below.</p> <p>b) Label the parts marked (i) to (iv).</p> <p>c) What do 'N' and 'C' signify in the diagram?</p> <p>d) Name the type of cell that produces these molecules.</p> <p>e) When are these produced?</p> <p>Ans. a) Antibody</p> <p>b) i) Antigen binding site, ii) Light chain, iii) Heavy chain, iv) Disulphide bonds</p> <p>c) N terminal end and C terminal end of polypeptide chain.</p> <p>d) B lymphocyte (plasma cell)</p> <p>e) Produced in response to pathogens present in our blood.</p>	
Q.2	<p>The diagram below shows replication of retrovirus inside an animal cell. a) Label (i) to (iv) in the diagram.</p> <p>(b) Why a person infected with HIV becomes immune deficient?</p> <p>(c) Name the steps taken to prevent the spread of HIV infection.</p> <p>Ans. a) i) viral RNA, ii) reverse transcriptase, iii) viral DNA, iv) host DNA</p> <p>b) HIV infects macrophages which play an important role in innate immunity and also eliciting cell mediated immunity. It attacks helper T lymphocyte which are associated with cell mediated immunity and also initiating humoral immunity. The decreased number of T_H lymphocyte results in immunodeficiency.</p> <p>d) Ensuring blood from blood bank is free of HIV, only disposable syringe are used, free distribution of condoms, controlling drug abuse advocating safe sex, regular check-up of vulnerable populations.</p>	
Q.3	<p>Name the infective stage of <i>Plasmodium</i> that is introduced into the human body when a mosquito bites him/her.</p> <p>b) Trace the stages of life cycle of the parasite from the point of entry into human body till the time another mosquito bites this person.</p> <p>Ans. a) Sporozoite.</p> <p>b) Sporozoite injected with bite of infected mosquito.</p> <p style="text-align: center;">↓</p> <p>Sporozoite reach liver through blood.</p> <p style="text-align: center;">↓</p> <p>Parasite reproduce asexually in liver cells and burst out of the cell into blood.</p> <p style="text-align: center;">↓</p> <p>Parasite reproduce asexually in RBC.</p> <p style="text-align: center;">↓</p> <p>Parasite burst out of RBC every 3-4 days releasing haemozoin which causes fever and chill.</p> <p style="text-align: center;">↓</p> <p>Sexual stage Gametocyte develop within RBC</p> <p style="text-align: center;">↓</p> <p>Gametocytes transferred to mosquito when it bites.</p>	

bacterial or viral infection?

Ans. Water borne -Typhoid, Amoebiasis

Clean drinking water, well cooked food, disinfection of water, proper disposal of waste and excreta.

Air borne - Pneumonia, common cold

Avoid contact with infected person and their belongings.

Insect vector born-malaria, filariasis Elimination of vector, spraying of insecticides. b) Through vaccine.

3 MARKS (CASE BASD) QUESTIONS WITH ANSWERS

Q.1 All children between 9 months and 15 years were given a dose of Measles – Rubella (MR) Vaccine in their schools across West Bengal as a part of a campaign to eradicate Measles and control Rubella.

The vaccination campaign were held from 9th January 2023 to 11th February 2023 in all schools across West Bengal.

This was an additional dose of MR vaccine irrespective of previous vaccination. The same MR vaccine administered to children during routine immunisation will be used during the campaign.

One new auto AD (auto disabled) syringe will be used for each child.

More than 32.4 crore children had already been vaccinated with MR vaccine in 24 states of India.

- What is a vaccine?
- Why was this campaign organised?
- Name another disease against which a similar is being carried out in India.
- Why AD syringe were being used?

Ans. A) A preparation of inactive or weakened pathogen or antigen.

b) to eradicate measles and control Rubella

c) Polio

d) to prevent contamination and spread of any other pathogen through it.

Application Of Knowledge, Concepts ASSERTION REASON QUESTIONS

MCQ (1MARK EACH)

Q1. Which of the following is not a reason why youngsters try drugs or alcohol? a) They are curious to try new thing. b) They feel it is progressive
c) They have supportive family d) peer pressure

Q.2 The recurring chill and fever in a malaria patient occurs due to –

- Release of haemozoin from liver
- Release of sporozoites from liver
- Release of sporozoites from erythrocytes
- Release of haemozoin from erythrocytes

Q.3 Which one of the following diseases can be controlled by eradication of *Aedes* mosquito?

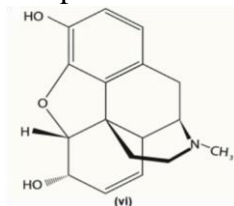
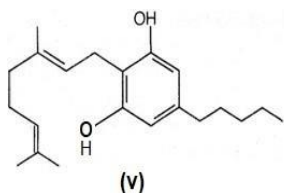
- i) Malaria ii) Dengue iii) Chikungunya iv) Filariasis

- Q.4 a) Name the alkaloid which is primarily associated with the harmful effects of consumption of tobacco.
 b) How does it affect our body?
 c) The risk of which type of cancer is increased by smoking?
 d) Why does smoking cause O₂ deficiency in the body?
- Ans.** a) Nicotine.
 b) Stimulate adrenal gland to release adrenaline and nor-adrenaline into blood/which raise blood pressure and increase heart rate.
 c) Cancer of lungs, urinary bladder and throat.
 d) Smoking increases CO content in blood and reduce the concentration of haemobound O₂.

Q.5 a) Fill in the blanks in the following table.

Type of drug	Plant source	Means of consumption	Effect on body
Opioid	<i>Papaver somniferum</i>	Snorting & injection	(i)
Cannabinoid	(ii)	(iii)	Depressant & stimulant
Coca alkaloid	<i>Erythroxyllum coca</i>	(iv)	Stimulant

b) Which one of the following structures represent cannabinoid molecule?



- c) Which part of the plant is utilised for extracting cannabinoid drug?
 d) Which one the drugs mentioned in the list causes hallucinations? Name another plant with hallucinogenic property.
 e) Give one medicinal use of any one the drugs mentioned in the list.
- Ans.** a) i) Depressant ii) *Cannabis sativa* iii) inhalation, oral ingestion iv) Snorting b)
 (v) is a cannabinoid molecule
 c) Inflorescence
 d) Coca alkaloid, *Atropa belladonna* or *Datura*
 e) Morphine used as sedative and painkiller.

TWO MARKS QUESTIONS WITH ANSWERS

Q.1 An accident victim has been brought to a doctor's clinic. What would the doctor inject him with – Tetanus vaccine or tetanus antisera? Explain with reason.

Ans. Tetanus antisera/because it has ready-made antibody /therefore quick response can be generated against bacteria.

Q.6	<p>a) Why do athletes use drugs like anabolic steroids?</p> <p>b) What are the side effects of these drugs in male and female? (Mention 2 points for each)</p> <p>Ans. a) To enhance their performance.</p> <p>b) Male – Increased aggressiveness, mood swings, depression, reduced testicles, decreased sperm production, breast enlargement, premature baldness, enlargement of prostate gland, potential for kidney and liver dysfunction.</p> <p>Female – Masculinisation, Increased aggressiveness, mood swings, depression, abnormal menstrual cycle, excessive hair growth on face and body, enlargement of clitoris, deepening of voice.</p>
Q.7	<p>Maintenance of personal and public hygiene is important for control of infectious diseases.</p> <p>a) Give examples of water borne, air borne and insect vector borne diseases and suggest specific measures for prevention of these diseases.</p> <p>b) Apart from these measures what is the best way to protect oneself from</p>

Q.2 Differentiate between cell mediated immunity and antibody mediated immunity. Ans.

Cell mediated immunity	Antibody mediated immunity
T lymphocyte mediated	B lymphocyte mediated
Doesn't produce antibodies against specific antigen	Produce antibodies against specific antigen

Q.3 Explain anamnestic response with an example.

Ans. Anamnestic response or secondary immune response is generated when a body encounters the same pathogen the second time/it is due to the production of memory B and T cells/ which is able to neutralise the pathogen more quickly. Eg. A person who has suffered from chicken pox once in his life, is not likely to suffer again from the same infection.

Q.4 Why breastfeeding is important for new born babies?

Ans. Initial days of lactation colostrum is secreted by the mother which has abundant antibodies (IgA) which protects infants from infection and keeps him healthy.

Breast milk is also the only source of nutrition for the baby for the first 6 months.

Q.5 a) Why HIV is called a retrovirus?

b) Why people who need frequent blood transfusion are at a higher risk of getting infected with HIV?

Ans. a) It has RNA genome.

b) HIV spread through body fluid like blood/patient might receive contaminated blood from blood bank.

Q.6 Explain how molecular biology can help in prevention of cancer.

Ans. Techniques of molecular biology can be used to detect genes with inherited susceptibility to cancer/ which predispose an individual to certain cancer/individual may be advised to avoid exposure to a particular carcinogen they are susceptible to.

Q.7 HIV is a retrovirus. How is it able to integrate its genetic material into the host DNA?

Ans. Viral RNA/is converted to Viral DNA/by reverse transcriptase enzyme/this viral DNA is integrated into host DNA.

Q.8 a) Why people who take drugs intravenously are at a greater risk of getting infected with HIV?

b) Apart from HIV which other viral infection can be transmitted in similar way? Ans. a) HIV is transmitted through body fluids/Drug addicts often share syringe to inject drug/if one in a group is HIV+ve others will also get infected through contaminated needle. b) Hepatitis B

Q.9 Recurring chill and high fever is a typical symptom of malaria. a) What gives rise to this symptom?

b) Why does this symptom not appear immediately after bite of an infected mosquito? Ans. a) Every 3 to 4 days Plasmodium multiplying in RBC/rupture of RBC/releases haemozoin which causes chill & fever.

b) Initially Plasmodium attack liver cells and then RBC

Correct option is

- a) i & ii b) ii & iii c) i & iv d) i & iii

Q.4. Which of the following pathogen is not transmitted through a vector?

- a) Alphavirus b) Flavivirus c) Rhinovirus d) *Plasmodium*

Q.5. Drug which will not reduce symptoms of allergy is –

- a) Anti-histamine b) Adrenalin c) Paracetamol d) Steroid

ASSERTION REASON QUESTIONS

The following questions consist of two statements – Assertion (A) and Reason (R).

Answer these questions selecting the appropriate option given below:

- a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true and R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

Q.6. **Assertion:** Smoking causes O₂ deficiency in the body.

Reason: Smoking increases CO₂ concentration blood and reduces concentration of haem bound O₂.

Q.7. **Assertion:** Administration of antivenin is an example of passive immunity. **Reason:** Antivenin quickly neutralises the venom released during snake bite

Q.8 **Assertion:** Tissue matching is essential before organ transplant.

Reason: Cell mediated immunity causes graft rejection.

Q.9 **Assertion:** Ringworm is common in groin area and between toes.

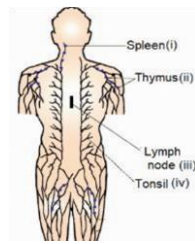
Reason: Heat and moisture help worms to grow.

4 MARKS QUESTIONS WITH ANSWERS

Q.1 a) A student has made mistakes while labelling the lymphoid organs in the following diagram. Label them correctly.

- b) Differentiate between primary and secondary lymphoid organs.
c) Identify the primary lymphoid organ in the diagram.
d) What is the function of spleen?
e) Why doctors are reluctant to remove tonsil?

Ans. a) i) Tonsil, ii) Lymph node s



, iii) Thymus, iv) Spleen b)

Q.10 Assertion: Transmission of HIV from mother to child is considered to be congenital.
Reason: The infection is present at birth.

Answer

1	2	3	4	5	6	7	8	9	10
C	D	B	C	C	C	B	A	D	D

Primary lymphoid organ	Secondary lymphoid organ
------------------------	--------------------------

Immature lymphocyte differentiate into antigen sensitive lymphocyte. Site of interaction of lymphocyte with antigen which then become effector cells.

c) Filter blood by trapping blood borne microorganisms, reservoir of erythrocyte.

d) Tonsil fight infection & stop germs as they enter through mouth or nose. Removal may lead to more instances of respiratory, allergic or infectious diseases later in life.

Q.2 a) Which stage of life cycle of Plasmodium is completed within the body of the female Anopheles mosquito?

b) Show with the help of flow chart the various steps in the life cycle from the time the parasite enter the body of the mosquito up to the point where it bites a healthy person. c) Suggest a few ways to prevent breeding of mosquito in water bodies like pond.

Ans. a) Sexual stage.

b) Female mosquito takes up gametocyte with blood meal.

↓

Fertilization and development occurs in gut of mosquito.

↓

Sporozoites mature infective stage) migrate to salivary gland.

↓

Sporozoites are transferred to a healthy person through mosquito bite. c) Introduce fish like Gambusia that feeds on mosquito larvae. Spraying of insecticide.

Q.3 “Smoking is injurious to health “Smoking causes cancer”

a) Where are these statutory warnings displayed?

b) How does smoking affect our health?

c) Which forms of cancer are commonly associated with tobacco consumption?

d) Suggest two ways in which youth can be dissuaded from smoking?

e) Ans. a) On packets of cigarette, during movies.

b) Causes emphysema/bronchitis/coronary heart disease/gastric ulcer.

c) Smoking increases risk of cancers of lung, urinary bladder, throat and oral

d) cavity.

e) Informing youth about the ill effects of smoking, Teach them ways of healthy management of stress, Showing visuals of people suffering from emphysema/cancer due to smoking.

Q.4 You are living in a hostel room with three other students. One of them develop scaly lesions on the skin which are itchy. a) What is he suffering from?

b) Name two pathogens responsible for this disease. What type of pathogens are they?

c) What type of conditions are suitable for growth of this pathogen?

d) Suggest a few you and your friends should take to prevent the pathogen from infecting you.

Ans. a) Ringworm

b) Epidermophyton /Microsporum /Trichophyton, fungi

c) Warm and humid

d) Keep body clean/ not share towel, comb with others etc

Analyse, evaluate & create

MCQ

Q1. The following are the reasons why climate change may increase the occurrences of mosquito borne diseases all over the world. Which one of the following may not be the reason for this increase?

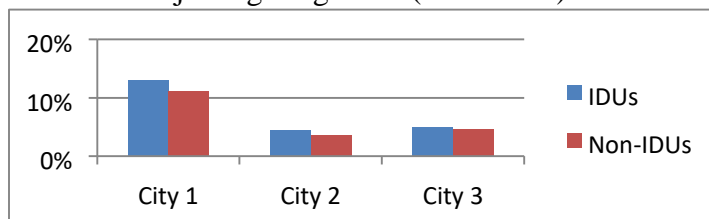
a) Lengthening of breeding season of mosquito b) Expansion of areas where mosquito thrive

c) Droughts becoming longer and more intense

d) Re-emergence of mosquito in areas where their numbers had subsided

Ans. c

Q2. The following graph depicts the prevalence of HIV among injecting drug users (IDUs) and non-injecting drug users (Non-IDUs) in three cities.



The reason for prevalence of HIV among injecting drug users is –

a) HIV spreads through transfusion of contaminated blood

b) HIV spreads through sharing of contaminated syringe and needle

c) HIV spreads through having unprotected sex with infected person

d) HIV spreads from mother to child through placenta

ASSERTION REASON QUESTIONS

3. The following questions consist of two statements – Assertion (A) and Reason (R).

Answer these questions selecting the appropriate option given below:

- a) Both A and R are true and R is the correct explanation of A.
- b) Both A and R are true and R is not the correct explanation of A.
- c) A is true but R is false.
- d) A is false but R is true.

Q1. **Assertion:** Transmission of HIV from mother to child is considered to be congenital.

Reason: The infection is present at birth.

Answer Q. No 1-C	2- B	3- d
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2 MARKS QUESTIONS WITH ANSWERS

Q.1 Abir felt a soft roundish lump just beneath the skin on his neck. The doctor said it is a benign fatty tumour. The word tumour made Abir think of cancer and he was very worried.

- a) What is a benign tumour?
- b) Do you think Abir needs to worry about cancer? Give reason.

Ans. a) Tumour which is confined to its original location and do not spread to other part.

b) No. they do not spread from one location and cause little damage.

Q.2 HPV vaccine protects against cervical cancer caused by Human Papilloma virus.

- a) Name the gene present in HPV that causes cancer.
- b) Human cells also have similar cancer causing genes. What are they called?
- c) If a person possesses these genes, will he definitely suffer from cancer? Give reason.

Ans. a) viral oncogene.

b) cellular oncogene /Proto oncogene.

c) No. when proto oncogenes are activated under certain conditions/it may result in oncogenic transformation of the cell into cancerous neoplastic cells.

3 MARKS QUESTIONS WITH ANSWERS

Q.1. A lot of *Parthenium* was growing in and around a playground where children usually played. A few children started complaining of breathing difficulty, sneezing, watery eyes etc.

- a) What is possible reason for these symptoms?
- b) Which chemicals are responsible for these symptoms?
- c) Which drugs will be effective in treating these symptoms?

Ans. a) Pollen allergy b) Histamine and serotonin released from mast cell c) Anti-histamine, Adrenalin, Steroids

CHAPTER -8 MICROBES IN HUMAN WELFARE

Q1. Rashi was asked by her teacher to list the use of microbes in household products. What couldn't have been her answer from the following list:

- (a) Fermentation of batter to produce dosa -idli
- (b) Use of Rhizobium bacteria

- (c) Conversion of milk to curd.
- (d) Fermentation of dough to produce bread-cake.

Q2 Toddy a drink mostly consumed in some southern parts of India are prepared by fermentation of sap of:

Papaya (b) Palms (d) Grapes (d) Mango

Ans- 1-(b) 2- (b)

Q3. ASSERTION REASONING QUESTIONS

Answer these questions with appropriate options given below:

- a. Both Assertion and Reason are true and Reason is the correct explanation of Assertion
- b. Both Assertion and Reason are true and Reason is not the correct explanation of Assertion
- c. Assertion is true and Reason is false
- d. Assertion is false and Reason is true.

(i) Assertion: For bread making, dough is fermented by yeast only.

Reason: The dough got puffed-up due to the production of carbon dioxide.

Ans- d. Assertion is false and Reason is true.

(ii) Assertion: Meals having curd is good for health.

Reason: LAB present in curd have very beneficial role in checking disease causing microbes and providing Vitamin B12 to human body.

Ans-a. Both Assertion and Reason are true and Reason is the correct explanation of Assertion

Q4. A microbe is deliberately grown over Roquefort cheese to give it a particular flavour.

Identify the microbe.

Ans- It is a fungus, *Penicillium roqueforti* which is grown with Roquefort cheese to give it a particular flavour.

Q5. Suggest any one benefit obtained from these microbes:

- a) LAB
 - b) *Saccharomyces cerevisiae*
 - c) *Propionibacterium sharmanii*
- Ans-**a) Convert milk to curd b) Helps in Bread/ alcoholic drinks c) Produces large holes in Swiss cheese.

Q6. CASE BASED QUESTION

Read the passage and answer any 4 questions out of 5 questions:

Some microbes have an expanding application in Food industry. These microorganisms can ferment carbohydrates to produce chemicals, and are currently widely used in the food fermentation industry. They are used to improve the flavour of fermented foods, increase the nutritive value of foods, reduce harmful substances, increases shelf life, and so on. They can also be used as probiotics to promote health in the body.

(i) State the full form of LAB.

Ans-Lactic Acid Bacteria.

(ii)Lactic acid bacteria can be found in which type of food?

Ans-In curd and yogurt

(iii) Give an outline of curd formation.

Ans-Curd is formed by adding a small amount of curd to warm milk, which acts as a

starter(inoculum). Microbes (LAB) present in the starter multiply at suitable temperature and convert milk into curd.

(iv) What happens to the milk protein during formation of the curd?

Ans- Acids released by LAB during the growth coagulate and partially digest milk protein, casein thus increases the digestibility of milk protein.

(v) State the useful applications of LAB.

Ans- Application of LAB:

(i) Improves nutritional quality of milk by increasing vitamin-B12.

(ii) Check disease-causing microbes in the stomach.

LONG ANSWER QUESTION

Q 1. Some Microbes release a gas during metabolism that is used to make household beneficial products.

a) Name the gas produced due to their metabolic activity .

b) Summarise the role of any four microbes in making house hold beneficial products.

Ans. a) CO₂

(i) Large holes in Swiss cheese-

Propionibacterium sharmanii

ii) Ripening of Roquefort cheese -

A specific fungi

iii) Puffed appearance in Dough and softness in Bread-

Saccharomyces cerevisiae

(iv) Conversion of milk to curd

- LAB

TOPIC-MICROBES IN INDUSTRIES

Q1. Select out of these which one of the following alcoholic drinks is produced without distillation?

mark) a) Wine

b) Rum

c) Whisky

d) Brandy

Ans- a) Wine.

Q. Identify the producer of citric acid:

(a) *Aspergillus*

(b) *Clostridium*

(c) *Saccharomyces*

(d) *Pseudomonas*

Ans- (a) *Aspergillus*.

Q3. ASSERTION REASONING QUESTIONS

Answer these questions with appropriate options given below:

a. Both Assertion and Reason are true and Reason is the correct explanation of Assertion

b. Both Assertion and Reason are true and Reason is not the correct explanation of

Assertion c. Assertion is true and Reason is false

d. Assertion is false and Reason is true.

Assertion: Cyclosporin A is an immunosuppressive medicine.

Reason: It causes activation of T-cells and prevents rejection of new organ in body.

Ans- c. Assertion is true and Reason is false.

Q4. Suggest how the discovery of antibiotics helped mankind in the field of medicine?

Ans- Antibiotics have helped mankind in treating most of the deadly bacterial and fungal diseases of humans.

Q5(i) As a Doctor what would you suggest for a patient who had suffered myocardial infarction and for clots found in his blood vessels? Name the microbe from which it is extracted?

(ii) Children normally prefer fruit juices that are purchased from market rather than prepared at home as they are much clearer. State what is added to make clearer fruit juices?

(3 marks) **Ans-** (i) Streptokinase- Clot buster can be used to dissolve clots. It is obtained from the bacteria *Streptococcus*. (ii) Pectinases

Q6. Case Based Questions:

Read the passage and answer the questions:

Microbes are used for commercial and industrial production of certain chemicals like organic acid, alcohol and enzymes. Examples of organic acids producers are *Aspergillus niger* (a fungus), *Acetobacter aceti* (a bacterium); *Clostridium butylicum* (a bacterium) and *Lactobacillus* (a bacterium). A yeast and a fungus produce other bioactive molecules that have a life saving role in human welfare.

i) Suggest what is to be used in detergent formulations that are helpful in removing oily stains from the dirty clothes?

a) Lipases b) Proteases c) Pectinases d) Statins **ii)** Identify a clot buster used in patients suffering from myocardial infarction. a) Streptokinase b) Cyclosporin A c) Lipases d) Statins

iii) Asha had a kidney transplant. She is kept isolated and administered a bioactive compound for her new kidney to work properly. Identify the molecule being administered to her.

a) Streptokinase b) Cyclosporin A c) *Monascus purpureus* d) Statins **iv)** For industries, *Aspergillus niger* is used for commercial production of which acid? a) acetic acid b) butyric acid c) lactic acid d) citric acid.

v) ----- is used in production of breads & ethanol.

a) Spirogyra b) Bacteria c) Blue green algae d) Yeast

Ans. i) -a ii) -a iii)-b iv) -d v)

d)

LONG ANSWER QUESTION

7. Suggest one usefulness of these microorganisms to mankind:

(i) *Streptococcus* (ii) *Clostridium butylicum* (iii) *Monascus Purpureus*

(iv) *Trichoderma polysporum*. (v) *Penicillium notatum*

Ans-(i) *Streptococcus*- Production of Streptokinase that is used as clot buster in blood vessels.

(ii) *Clostridium butylicum*-Production of butyric acid.

(iii) *Monascus Purpureus*- To produce statins as blood cholesterol lowering agent.

(iv) *Trichoderma polysporum*-Preparation of cyclosporin A having immuno-suppressive properties.

(v) *Penicillium notatum*-Production of antibiotic, Penicillin.

TOPIC-MICROBES IN SEWAGE TREATMENT

Q.1. The greater the BOD of waste water, more is its -----.

- a) cleanliness b) CO₂ potential c) polluting potential d) water level

Q.2. The masses of bacteria held together by fungal filament to form mesh-like structure are called

- a) primary sludge b) flocs c) activated sludge d) anaerobic sludge.

Ans- 1-(c) 2-b

Q.3.ASSERTION REASONING QUESTION

Answer these questions with appropriate options given below:

- a. Both Assertion and Reason are true and Reason is the correct explanation of Assertion
b. Both Assertion and Reason are true and Reason is not the correct explanation of Assertion
c. Assertion is true and Reason is false
d. Assertion is false and Reason is true.

(i) Assertion: The chief component of biogas is CH₄.

(ii) Reason: Biogas plants are prepared on foreign technology
Ans- c. Assertion is true and Reason is false.

(iii) Assertion: Activated sludge is formed during secondary treatment.

Reason: All solids that settle in the settling tank by sedimentation form the primary sludge.

Ans-c. Assertion is true and Reason is false

4. State the relationship between BOD and organic matter in sewage?

Ans- The greater the BOD of wastewater the more is the amount of organic matter in sewage.

5. How Flocs are formed during sewage treatment. State its application in sewage treatment.

Ans- Flocs are mesh-like structures containing aerobic bacteria and fungal mycelium. These are formed in aerobic tanks when organic matter is abundant. They digest the organic matter in sewage and reduce its pollution potential.

Q.6. CASE BASED QUESTIONS

Read the following text and answer any 4 out of 5 of these questions:

Nowadays a large quantity of wastewater is generated every day in metro cities and towns which is treated in sewage treatment plants (STPs) because it contains human excreta, organic matter and microbes. Many of which are pathogenic. So, this cannot be discharged into natural water bodies like rivers and streams directly. Treatment of this sewage in STPs to make it less polluting by heterotrophic microbes through primary & secondary treatments.

1. State what happens during the primary treatment of sewage?

Ans- 1.-Suspended solids, floating debris are removed, grit and soil settle in settling tanks to form Primary sludge.

2. What is sewage? In which way can sewage be harmful to us?

Ans-Sewage is the municipal waste-water collected from city or town, homes, that contains toilet, bathroom and kitchen waste. It contains large amounts of organic matter and many pathogenic bacteria to cause many diseases.

3. Primary effluent is passed into large aeration tanks:

A) To allow bacterial flocs to settle down B) To allow fast growth of aerobic microbes into flocs C) To allow anaerobic sludge digestion D) None of these.

Ans- B) To allow fast growth of aerobic microbes into flocs

4.State the technical term used for sediment formed in sewage treatment: A) Flocs B) Effluent C) Activated sludge D) Anaerobic sludge

Ans.C) Activated sludge.

5. Which step in sewage treatment removes suspended solids:

A) Tertiary treatment B) Secondary treatment C) Primary treatment D) Sludge treatment.

Ans-C) Primary treatment.

LONG ANSWER TYPE QUESTION

Q.7.Describe the primary and secondary treatment of domestic sewage before it is released for Reuse.

Ans- Treatment of domestic sewage. The municipal wastewaters are treated in Sewage Treatment Plant (STP) prior to disposal in water bodies.

It consists of 2 steps: Primary, Secondary.

1. Primary treatment. It includes physical processes, such as sedimentation, floatation, shredding (fragmenting and filtering). These processes remove most of the large debris.

2. Secondary treatment. It is a biological method. Sewage, after primary treatment, is pumped into aeration tanks. Here, it is mixed with air and sludge containing Fungal filaments with bacteria into flocs. Bacteria consume organic matter. During secondary treatment, biological processes are used to remove dissolved and suspended organic matter measured as biochemical oxygen demand (BOD).As BOD decreases pollution level of sewage is also reduced and now it can be passed to water bodies.

TOPIC-MICROBES IN BIOGAS PRODUCTION

Q.1.The spent slurry from biogas plant can be used as

(a) Cooking fuel (b) Manure (c) Biofertiliser (d) Inoculum.

Ans- (b) Manure

Q.2. State the group of microbes that produces Biogas

(a)Aerobic Bacteria (b) Anaerobic bacteria (c) Protozoa (d) Viruses

Ans- (b) Anaerobic bacteria

Q.3.ASSERTION REASONING QUESTION

Answer these questions with appropriate options given below:

- a. Both Assertion and Reason are true and Reason is the correct explanation of Assertion
- b. Both Assertion and reason are true but reason is not the correct explanation of Assertion
- c. Assertion is true and Reason is false
- d. Assertion is false and Reason is true.

Assertion: Biogas can be used as an alternative to fossil fuel.

Reason: Biogas is produced by the microbial fermentation of only cow dung.

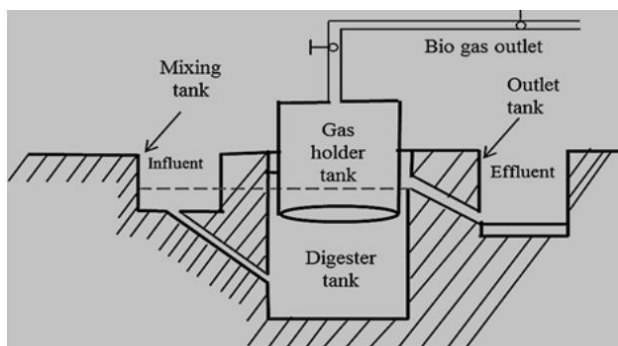
Ans- c. Assertion is true and Reason is false

4. Describe the reason of adding slurry of cattle dung (gobar) in the tank of a bio gas plant for the generation of biogas?

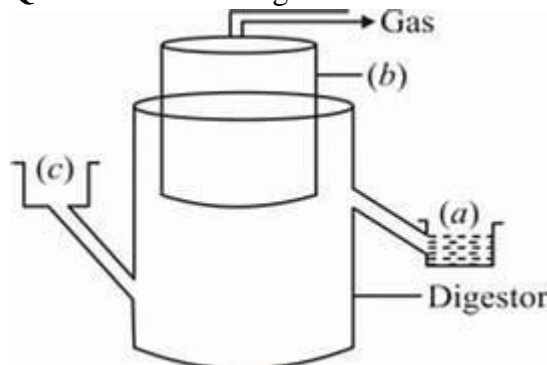
Ans- Slurry consisting of excreta (dung) of cattle commonly called gobar is rich in methanogenic bacteria. It is used for the generation of biogas. These bacteria called methane bacterium grow anaerobically and break down the cellulosic material releasing gases commonly called Biogas.

Q.5. Draw the well labelled diagram of the Biogas plant.

Ans- Any 6 correct labels



Q.6. Observe the diagram and answer the following questions:



(i) Identify a, b and c. (ii) State the significance of the product a.

(iii) Explain the sequence of events occurring in a biogas plant.

Ans-(i) a-Spent slurry, b-Gas holder, C-Sludge tank

(ii) a - is the spent slurry which is removed through another outlet and may be used as fertilizer.

The biogas plant tank is fed with slurry of dung. A floating cover is placed over the slurry which keeps on rising as the gas is produced in the tank due to the microbial activity of methanogens like methano bacterium. Methanogens grow anaerobically on cellulosic

material in cow dung to produce large amounts of methane, CO₂ and H₂. The biogas plant has an outlet, which is connected to a pipe to supply biogas. The spent slurry is removed through another outlet.

CHAPTER: 9 BIOTECHNOLOGY: PRINCIPLES AND PROCESSES

MULTIPLE CHOICE QUESTIONS

- 1 The role of DNA ligase in the construction of a recombinant DNA molecule is a Formation of phosphodiester bond between two DNA fragments b Formation of hydrogen bonds between sticky ends of DNA fragments c Ligation of all purine and pyrimidine bases d None of the above
- 2 While isolating DNA from bacteria, which of the following enzymes is not required? a Lysozyme b Ribonuclease c Deoxyribonuclease d Protease
- 3 In agarose gel electrophoresis, DNA molecules are separated on the basis of their: a Charge only b Size only c Charge to size ratio d All of the above
- 4 Which of the following steps are catalysed by *Taq* DNA polymerase in a PCR reaction? a Denaturation of template DNA b Annealing of primers to template DNA c Extension of primer end on the template DNA d All of the above
- 5 Molecular scissor which cut DNA at specific site is a Polymerase b Ligase c Exonuclease d Restriction endonuclease
6. Which of the given statement is correct in the context of observing DNA separated by agarose gel electrophoresis? a DNA can be seen in visible light b DNA can be seen without staining in visible light c Ethidium bromide stained DNA can be seen in visible light d Ethidium bromide stained DNA can be seen under exposure to UV light.
7. The first restriction endonuclease enzyme discovered that cut ds DNA at specific site was a Bam HI b Eco RI c Hind II d Sal I

1	2	3	4	5	6	7
a	c	b	c	d	d	c

ASSERTION AND REASONING-

- A) Both Assertion and reason are true and the reason is the correct explanation of Assertion
 B) Both Assertion and Reason are true and Reason is not correct explanation of Assertion.
 C) Assertion is true but Reason is false.
 D) Assertion is false but Reason is true.

1 **Assertion:** Plasmids are double stranded extra-chromosomal DNA

Reason: Plasmids are usually present in eukaryotic cells.

2 **Assertion:** Heat shock enables bacteria to take up recombinant DNA.

Reason: DNA is hydrophilic.

3 **Assertion:** In gel electrophoresis, DNA fragments are separated.

Reason: DNA is negatively charged, so it moves towards anode under electric field.

4 **Assertion:** A gene from *Bacillus thuringiensis* is incorporated in plant genome to increase yield.

Reason: It is Bt toxin producing gene which kills larvae of insects

5 **Assertion:** Restriction enzymes Eco RI cut the strand of DNA to produce sticky ends.

Reason: Stickiness of the ends facilitates the action of the enzyme DNA polymerase

6. **Assertion:** In recombinant DNA technology, human genes are often transferred into bacteria (prokaryotes) or yeast (eukaryotes).

Reason: Both bacteria and yeast multiply very fast to form a huge population which express the desired gene.

7. **Assertion:** Restriction digestion is a process of cutting DNA by restriction enzyme.

Reason: DNA ligase joins two DNAs

8. **Assertion:** Genetic engineering requires both nucleases and ligases.

Reason: Ligases produce the nick in the recombinant DNA molecule.

1	2	3	4	5	6	7	8
c	b	a	a	c	a	b	c

2 MARKS QUESTIONS-

Q1 What is a palindrome sequence? How is this helpful in genetic engineering?

ANS Palindrome sequence: A palindromic sequence is a nucleic acid sequence in a double stranded DNA or RNA molecule whereby reading in a certain direction (5' to 3') on one strand is identical to the sequence in the same direction (5' to 3') on the complementary strand. It is recognized by restriction endonucleases as their cutting site in DNA

Q2 State how was *Agrobacterium tumifaciens* been made as a useful cloning vector to transfer DNA to plant cells.

ANS *Agrobacterium* infects plants by transferring its plasmid T-DNA to the plant genome. T-DNA is modified as vector to transfer desired gene into plant host.

Q3 How does one visualise DNA on an agarose gel?

ANS Ethidium bromide stains DNA, which on exposure with ultra-violet, (UV) radiation gives orange light band of DNA. Hence, DNA fragments appear as orange band in the presence of ethidium bromide and UV light

Q4 Write any four ways used to introduce a desired DNA segment into a bacterial cell in recombinant technology experiments.

ANS Ways to introduce desired DNA into bacterial cell are

Microinjection, disarmed pathogen vectors, treatment of host cell by bivalent cation such as calcium followed by heat shock, biolistic or gene gun.

Q5 Describe the role of CaCl_2 in the preparation of competent cells?

ANS. CaCl_2 is known to increase the efficiency of DNA uptake to produce transformed bacterial cells. The divalent Ca^{2+} ions create pores on the bacterial cell wall by which the entry of foreign DNA occurs into the bacterial cells.

3 MARKS QUESTIONS-

Q1 Describe the roles of **heat, primers and the bacterium *Thermus aquaticus*** in the process of PCR.

ANS Heat: for **denaturation** of DNA, to make double stranded DNA into single stranded DNA

Primers: for extension of new strands of DNA,

***Thermus aquaticus*:** Taq polymerase is obtained, which is thermo stable enzyme.

Q2 Explain the process of gel-electrophoresis in biotechnology.

ANS Gel-electrophoresis is a technique for separating DNA fragments based on their size.

Steps- -The DNA is cut into fragments by restriction endonucleases.

-DNA being negatively charged can be separated by forcing them to move towards the anode under electric field through the medium agarose.

-DNA fragments separate out according to the size. Smaller fragments move further.

-They are visualized as orange bands after staining the DNA with ethidium bromide followed by exposure to UV radiation.

- They are cut out and extracted from the gel piece. This is called elution

Q3 DNA being hydrophilic cannot pass through the cell membrane of a host cell. Explain how does recombinant DNA get introduced into the host cell to transform the latter.

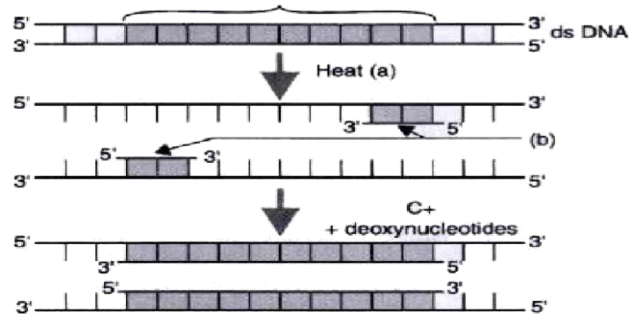
ANS Recombinant DNA is introduced into the host cell by the following methods:

(i) Heat shock method: In this method, DNA is treated with a specific concentration of a divalent cation, such as calcium, which increases the efficiency with which DNA enters the bacterium through pores in its cell wall. The rDNA is forced into the cell by incubating the cell with rDNA on ice, followed by placing them at 42°C (heat shock) and then putting them back on ice.

(ii) Micro-injection: In this method, the rDNA is directly injected into the nucleus of an animal cell.

(iii) Gene gun/Biolistics: In this method, cells are bombarded with high velocity micro-particles of gold or tungsten coated with DNA.

Q4 A schematic representation of polymerase chain reaction (PCR) upto the extension stage is given below. Answer the questions that follow:



i) Name the process 'a'.

ii) Identify 'b'

(iii) Identify 'c' and mention its importance in PCR.

ANS (i) a - Denaturation process

(ii) b - Primers

(iii) c - Taq DNA polymerase. Taq polymerase is a thermostable enzyme which remains active during the high temperature induced denaturation of DNA.

4 MARKS -CASE BASED QUESTIONS

1) **Case study** - When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of 'sticky-ends' and these can be joined together (end-to-end) using DNA ligases. The cutting of DNA by restriction endonucleases results in the fragments of DNA. These fragments can be separated by a technique known as gel electrophoresis. Since DNA fragments are negatively charged molecules they can be separated by forcing them to move towards the anode under an electric field through a medium/matrix. Nowadays the most commonly used matrix is agarose which is a natural polymer extracted from sea weeds. The DNA fragments separate (resolve) according to their size through the sieving effect provided by the agarose gel. Hence, the smaller the fragment size, the farther it moves. The separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation (you cannot see pure DNA fragments in the visible light and without staining) You can see bright orange coloured bands of DNA in an ethidium bromide stained gel exposed to UV light. The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution. The DNA fragments purified in this way are used in constructing recombinant DNA by joining them with cloning vectors.

i) On the basis of, fragments of DNA get separated in the Gel electrophoresis.

- a) Nucleotide b) Colour c) Shape d) Size

ii) is used to join sticky ends of DNA.

- a) DNA Ligase b) DNA Host c) DNA restriction d) None of them

iii) After DNA fragment separation, DNA is stained by for the visualisation.

- a) Toluidine b) Ethidium bromide c) Sulphuric acid d) Phloroglucinol Ans- i)
d ii) a iii) b

iv) Name the technique which is useful in the separation of fragments of DNA.

Ans Gel electrophoresis is the technique which is useful in the separation of fragments of DNA.

2)Case study –

Bioreactors are considered as vessels in which raw materials are biologically converted into specific products by microbes, plants and animal cells or their enzymes. They are used for large scale production as they provide optimum growth conditions such as temperature, pH, substrate, vitamins, oxygen and salts for obtaining desired product. Most commonly used bioreactors are of stirring type which include simple stirred tank bioreactor and sparged stirred tank bioreactor.

i) Which of the following is essential to obtain desired products in a bioreactor?

- a) size of the bioreactor c) quantity of
the raw material
b) sterile conditions d) all of these

ii) Bioreactors are useful in:

- a) Amplifying a gene c) Processing large volume of culture
b) Isolation of genetic material d) Infecting DNA in a cell

iii) Vessels in which raw materials are biologically converted into specific products are

- a) Bioreactors b) Fermenters c) Gene guns d) Both A & B

iv) Growth condition that could affect the quality of obtained product in a bioreactor are:

- a) Temperature and pH only b) temperature and oxygen supply only
c) pH and oxygen supply only d) temperature, pH and oxygen supply

Ans- i)-b ii) – c iii) –d iv) - d

5 MARKS QUESTIONS-

Q1 How are the DNA fragments separated by gel electrophoresis visualised and separated for use in constructing recombinant DNA?

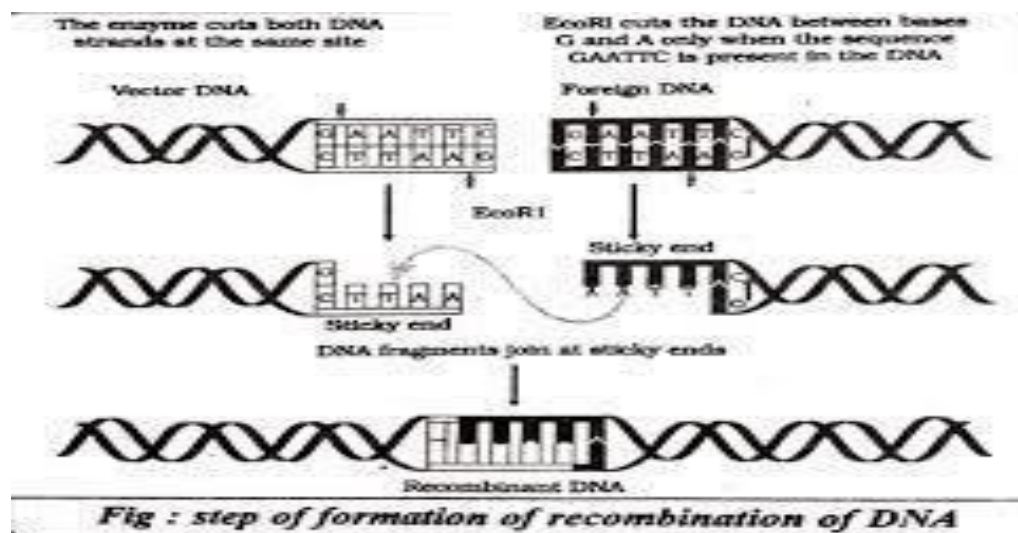
ANS Separation and isolation of DNA fragments:

- (i) The cutting of DNA by restriction endonucleases results in the short fragments of DNA, which can be separated by a technique known as gel electrophoresis.
- (ii) The DNA fragments are negatively charged and they can be separated by forcing them to move towards the anode under an electric field through a medium/matrix(agarose)
- (iii) The DNA fragments separate out according to their size through sieving effect provided by the agarose gel. Hence, the smaller fragment moves farther.
- (iv) The separated DNA fragments can be visualised after staining the DNA with ethidium bromide followed by exposure to UV radiation.
- (v) The separated bands of DNA are cut out and extracted from the gel piece, this step is called elution. (vii) The purified DNA fragments are used to form recombinant DNA which can be joined with cloning vectors.

Q2 Eco RI is used to cut a segment of foreign DNA and that of a vector DNA to form a recombinant DNA. Show with the help of schematic diagrams.

- (i) The set of palindromic nucleotide sequence of base pairs the Eco RI will recognise in both the DNA segments. Mark the site at which Eco RI will act and cut both the segments.
- (ii) Sticky ends formed on both the segments where the two DNA segments will join later to form a recombinant DNA.

ANS



Q3 Why are restriction endonucleases so called? Explain their role as ‘molecular scissors’ in recombinant DNA technology.

ANS Restriction endonucleases are called so because they restrict the growth of bacteriophages by recognising and cutting DNA at specific sites. Following are the functions of restriction endonucleases:

-Every endonuclease inspects the entire DNA sequence for the palindromic recognition. On finding the palindrome, the endonuclease binds to the DNA.

-It cuts the opposite strands of DNA in the sugar-phosphate backbone; a little away from the centre of the palindrome sites but between the same bases on both strands.

-This results in the formation of single stranded overhanging stretches at the end of each strand are called sticky ends.

-The sticky ends facilitate the action of the enzyme DNA ligase by readily forming hydrogen bonds with complementary strands.

- In genetic engineering, DNA from different sources are cut with the same restriction enzymes so that both DNA fragments have same kind of sticky ends.

-These sticky ends are complementary to each other and thus can be joined by DNA ligase (end to-end).

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Chapter 10: Biotechnology and its Application

D) Multiple Choice Questions (MCQ's):

Q.1. Animals that have had their DNA manipulated to possess and express an extra (foreign) gene are known as _____

- c) transgenic animals b) animals c) infected animals d) Bt animals

Answer- a

Q.2. Biological products can be created with the help of transgenic animals by the introduction of a portion of _____

- d) protein b) gene c) carbohydrate d) fats **Answer- b**

Q.3. the biological product used to treat emphysema is...

- a) Anti-pepsin b) α -1-antitrypsin c) Growth hormone d) Insulin **Answer- b**

Q.4. The milk produced by transgenic cow contained protein.

- a) human alpha-lactalbumin b) insulin c) human albumin d) casein

Answer- a

Q.5. Using of bio-resources without proper authorisation from countries or people concerned and without compensation is termed as

- a) patent b) exploitation c) biopiracy d) both a and b **Answer- c**

Q.6. ELISA stands for _____

- a) Enzyme Like Immuno-sorbent Assay b) Enzyme-Linked Immuno-sorbent Assay
c) Enzyme-Linked Immuno-similar Assay d) Enzyme-Linked Immuno-sorbent Array

Answer- a

Q.7. Low concentration of any pathogen can be detected by _____ of their nucleic acid.

- a) cutting b) joining c) amplification d) denaturation **Answer- c** Q.8. ELISA is based on the principle of _____ interaction.

- a) antigen-antibody b) antigen-antigen c) antibody-antibody d) DNA-RNA

Answer- a

Q.9. The first ever human hormone produced by recombinant DNA technology is-

- a. Thyroxine b. Insulin c. Growth Hormone d. Progesterone

Answer- b

Q.10. In Bt cotton, the Bt toxin present in plant tissue as pro-toxin is converted into active toxin due to -

- a. Acidic pH of the insect gut b. Alkaline pH of the insect gut
c. Presence of conversion factors in insect gut d. Action of gut microorganisms

Answer- b

Q.11. The first transgenic crop was-

- a. Tobacco b. Tomato c. Cotton d. Flax **Answer- c**

Q.12. Which one of the following is commonly used in transfer of foreign DNA into crop plants?

- a. *Agrobacterium tumefaciens* b. *Penicillium expansum*
c. *Trichoderma harzianum* d. *Meloidogyne incognita* **Answer- a**

Q.13. The two polypeptides of human insulin are linked together by:

- A. Phosphodiester bond B. Covalent bond
C. Disulphide bridges D. Hydrogen bonds **Answer- c**

Q.14. The organisation responsible for assessing the safety of introducing genetically modified organisms for public use is

- A. Indian Council of Medical Research (ICMR)
- B. Council for Scientific and Industrial Research (CSIR)
- C. Research Committee on Genetic Manipulation (RCGM)
- D. Genetic Engineering Appraisal Committee (GEAC) **Answer- d**

E) ASSERTION AND REASONING BASED QUESTIONS:

1. **Assertion:** Genetic engineering techniques involve the manipulation of an organism's genetic material.
Reasoning: Genetic engineering is a process that involves the alteration of DNA to introduce specific traits or characteristics into an organism.
Answer: *The assertion is true, and the reasoning is also true.*
2. **Assertion:** Transgenic organisms are created by inserting genes from unrelated species.
Reasoning: Transgenic organisms contain genetic material from the same species but with slight modifications.
Answer: *The assertion is generally true, whereas the reasoning is false.*
3. **Assertion:** Polymerase Chain Reaction (PCR) is a technique used to create recombinant DNA molecules.
Reasoning: PCR amplifies specific DNA sequences by copying them multiple times in a laboratory setting.
Answer: *The assertion is false, while the reasoning is true.*
4. **Assertion:** Gene therapy involves the use of genetically modified organisms to treat genetic disorders.
Reasoning: Gene therapy aims to correct or replace faulty genes in an individual's own cells to treat genetic disorders.
Answer: The assertion is true, and the reasoning is also true.
5. **Assertion:** GMOs (Genetically Modified Organisms) have no significant impact on agriculture.
Reasoning: GMOs are engineered to have improved traits, such as resistance to pests and diseases or increased crop yield.
Answer: *The assertion is false, and the reasoning is true.*

F) SHORT-ANSWER BASED QUESTIONS:

1. What is biotechnology, and what are its primary applications?
Answer: Biotechnology is the use of biological systems, organisms, or processes to develop products or applications for various fields, including medicine, agriculture, and industry. Its primary applications include genetic engineering, pharmaceutical production, agriculture (GMOs), and medical therapies (gene therapy).
2. What are GMOs, and how are they used in agriculture?
Answer: GMOs (Genetically Modified Organisms) are organisms whose genetic material has been altered using biotechnology techniques. In agriculture, GMOs are used to create crops with improved traits, such as resistance to pests, diseases, and herbicides, as well as increased nutritional value and higher yields.
3. Explain the concept of gene therapy.
Answer: Gene therapy is a medical technique that aims to treat or prevent genetic disorders by introducing functional genes into a patient's cells. This can involve replacing faulty genes with healthy ones or providing therapeutic genes to address specific genetic diseases.
4. Discuss the ethical considerations in biotechnology.
Answer: Ethical considerations in biotechnology encompass concerns about the potential impact on the environment, the welfare of living organisms used in experiments, the consequences of genetic modification,

and the societal implications of biotechnological advancements. Ethical guidelines aim to ensure responsible and safe practices in biotechnology.

5. How can biotechnology be applied in environmental conservation?

Answer: Biotechnology can be applied in environmental conservation through techniques like bioremediation, where microorganisms are used to clean up pollutants in the environment, and the development of genetically modified organisms (GMOs) that are resistant to pests and diseases, reducing the need for harmful chemical pesticides.

6. What are some of the biosafety measures implemented in biotechnology laboratories? **Answer:** Biosafety measures in biotechnology laboratories include proper containment procedures, the use of personal protective equipment (PPE), adherence to sterile techniques, controlled access to sensitive areas, and the disposal of biohazardous waste in compliance with safety regulations.

7. Give an example of a transgenic organism and explain its application.

Answer: One example of a transgenic organism is Bt cotton. Bt cotton has been genetically modified to produce a protein from the bacterium *Bacillus thuringiensis* (Bt) that is toxic to certain insect pests. This modification reduces the need for chemical insecticides in cotton farming, making it more environmentally friendly and economically viable.

G) CASE STUDY BASED

“The many applications of the Neem tree did not escape the attention of an American firm that registered a patent in the United States for an insecticide whereas in 1994 the European Patent Office also granted a patent relating to fungicides.

Many Indian associations felt that these patents were confiscating ancestral knowledge as well as knowledge accumulated by farmers and Indian researchers over hundreds of years, depriving populations of a traditional plant material.

The technical board of appeal at the European Patent Office eventually revoked the patent in its entirety after ten years of legal proceedings (for a patent with a term of 20 years...). The annulment was based on the fact that the fungicidal effect of the Neem seeds had been known in India and exploited on a large scale for centuries....”

The manipulation of living organisms by the human race cannot go on any further, without regulation. Some ethical standards are required to evaluate the morality of all human activities that might help or harm living organisms. Going beyond the morality of such issues, the biological significance of such things is also important. Genetic modification of organisms can have unpredictable results when such organisms are introduced into the ecosystem. Therefore, every Government has to set up organizations, which will make decisions regarding the validity of GM research and the safety of introducing GM organisms for public services. The modification/usage of living organisms for public services (as food and medicine sources, for example) has also created problems with patents granted for the same.

Q1. Name the organization set up by Indian Government to check safety of introducing transgenic animals for human services.

(A) WHO (B) NBRI (C) CDRI (D) GEAC **Answer- d**

Q2. Name the plant whose one popular variety was patented by an American company in 1997. This ‘new’ variety of plant had actually been derived from Indian farmer’s varieties.

(A) Wheat (B) Turmeric and Neem (C) Rice (D) Cotton **Answer- b**

Q3. **Assertion:** Biopiracy is the practice of commercially exploiting naturally occurring biochemical or genetic material, especially by obtaining patents that restrict its future use, while failing to pay fair compensation to the community from which it originates.

Reason: US patented turmeric and Neem which is a case of biopiracy.

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is NOT the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true

Answer- b

Q4. Use of bio resources by multinational companies and organizations without authorization from the concerned country and its people is called

(A) Biodegradation (B) Bio-infringement (C) Bio-piracy (D) Bio-exploitation

Answer- c

H) LONG-ANSWER BASED QUESTIONS:

Q1. Explain the process of creating genetically modified organisms (GMOs) and discuss their applications in agriculture.

Answer: Creating GMOs involves the genetic modification of organisms, typically plants, to introduce specific traits or characteristics. The process includes:

- a) **Identification of Desired Trait:** Researchers identify a trait they want to introduce into a plant, such as pest resistance or increased nutritional value.
- b) **Isolation of Genes:** Genes responsible for the desired trait are identified and isolated from another organism, often a bacterium or a closely related plant.
- c) **Insertion of Genes:** Using recombinant DNA technology, the isolated genes are inserted into the genome of the target plant.
- d) **Selection and Regeneration:** The modified plant cells are selected and grown into whole plants through tissue culture techniques.
- e) **Testing:** The resulting plants are tested for the expression of the desired trait. GMOs have several applications in agriculture:
 - a) **Pest Resistance:** GMOs like Bt cotton and Bt corn produce a protein toxic to certain insect pests, reducing the need for chemical pesticides.
 - b) **Herbicide Tolerance:** Some GMOs are engineered to tolerate specific herbicides, allowing farmers to control weeds more effectively.
 - c) **Improved Nutritional Value:** Golden rice, for example, is engineered to produce higher levels of vitamin A, addressing nutritional deficiencies.
 - d) **Disease Resistance:** GMOs can be engineered to resist diseases that affect crops, increasing crop yield and reducing losses.
 - e) **Increased Yield:** Certain GMOs can produce higher yields of crops, ensuring food security and economic benefits for farmers.

Q2. Discuss the significance of gene therapy in medicine and provide examples of genetic disorders that can be treated using this approach.

Answer: Gene therapy is a medical technique with the potential to treat or prevent genetic disorders by introducing functional genes into a patient's cells. It has significant importance in medicine:

- a) **Treatment of Genetic Disorders:** Gene therapy holds promise for treating a wide range of genetic disorders, including cystic fibrosis, muscular dystrophy, and sickle cell anaemia. For example, in the case of cystic fibrosis, a functional gene can be introduced into the patient's cells to restore normal lung function.
- b) **Cancer Treatment:** Gene therapy can be used to target cancer cells. Cell therapy, for instance, modifies a patient's T cells to target and destroy cancer cells.
- c) **Inherited Blindness:** Leber congenital amaurosis, an inherited form of blindness, has been successfully treated with gene therapy.

- d) Hemophilia: Gene therapy can be used to introduce genes responsible for blood clotting factors in patients with hemophilia, reducing bleeding episodes.
- e) Immunodeficiency Disorders: Severe combined immunodeficiency (SCID), also known as "bubble boy" disease, can be treated using gene therapy to restore a functional immune system.

Gene therapy offers the potential for long-term or permanent treatment of these disorders by addressing their genetic root causes.

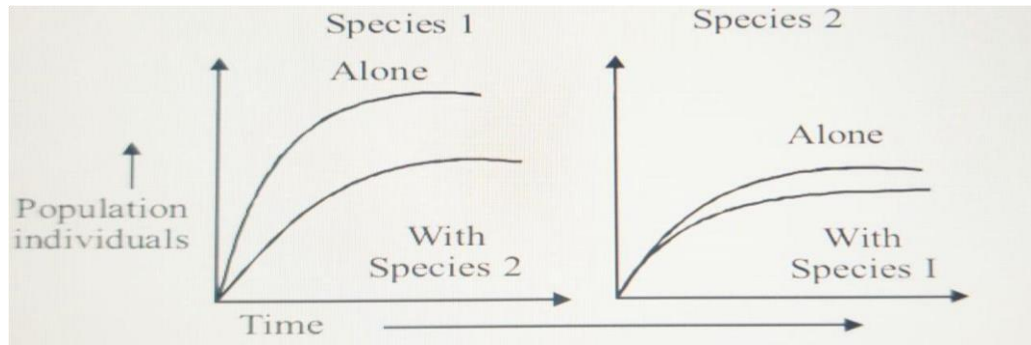
CHAPTER : 11 ORGANISMS AND POPULATION

Multiple Choice Question

1. Which if the following is not an example of commensalism ?
 - a. An orchid growing as an epiphyte on a mango branch
 - b. Barnacles growing on the body of whales
 - c. Cattle egret and grazing cattle
 - d. Wasp and fig plant **Ans - d**
2. If a new habitat is just being colonized, which of the following would contribute more to population growth?

a) Birth rate b) Growth rate c) Immigration d) Emigration **Ans - c**

3. In a laboratory experiment, two species of Paramecium were first grown alone and then in the presence of the other species. The following graphs show growth of the Species 1 (left) and species 2(right), both alone and when in mixed culture.



Interpretation of the graphs show that:

a. Competitive exclusion occurred in these experiments.

b. Both species are affected by the interspecific competition but species 1 is less affected.

c. Both species are affected by the interspecific competition but species 2 is less affected.

d. Both species are affected equally by interspecific competition. **Ans - c**

4. Which of the following statements is not correct while measuring population size?

a. Tiger census is done based on pug marks and fecal pellets.

b. The number of fish caught per trap can measure the density of fish in a river.

c. For *Chlamydomonas* in a pond, population size is measured in numbers of species.

d. Population size of Siberian cranes at Bharatpur wetlands can be measured in numbers. **Ans - c**

5. Which of the following is not an adaptation in endoparasites?

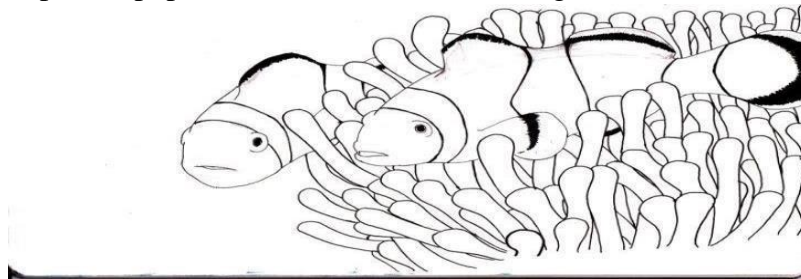
a) Presence of sense organs like eyes

b) Presence of adhesive organs or suckers

c) High reproductive capacity

d) Loss of digestive system **Ans - a**

6. Identify the type of interspecific population interaction in the image below:



a) Commensalism b) Mutualism c) Amensalism d) Parasitism **Ans - b**

7. Which of the following statement(s) are related to 'resource partitioning'?

i. Different times of feeding or foraging behavior.

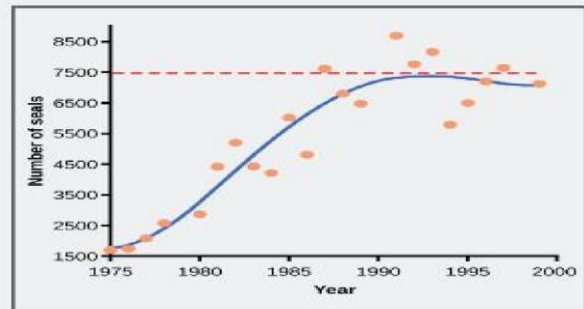
ii. Avoiding competition by resource sharing

iii. Eliminating the competitively inferior one by the superior one.

iv. Increase in distribution of the inferior species when the superior species is removed.

a) I, II, III. are correct b) I and II are correct c) I, II and IV are correct d) Only I is correct **Ans - b**

8. If the major food source of the seals declines due to pollution or overfishing, which of the following would likely occur?



- The carrying capacity of seals would decrease, as would the seal population.
- The carrying capacity of seals would decrease, but the seal population would remain the same.
- The number of seal deaths would increase but the number of births would also increase, so the population size would remain the same.
- The carrying capacity of seals would remain the same, but the population of seals would decrease.

Ans - a

9. Swathi was growing a bacterial colony in a culture flask under ideal laboratory conditions where the resources are replenished. Which of the following equations will represent the growth in this case? (Where population size is N , birth rate is b , death rate is d , unit time period is t , and carrying capacity is K).

- . $dN/dt = KN$ (b) $dN/dt = rN$ (c) $dN/dt = rN(K-N/K)$ (d) $dN/dt = rN(K+N/K)$ **Ans - b**

10. If '+' sign is positive interaction and '-' sign is detrimental, then which type of population interaction will be shown by (-) (-)

- . Predation b) Amensalism c) competition d) both a and c **Ans - c**

Assertion-reason type questions

Question No. 11 to 15 consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below: . Both A and R are true and R is the correct explanation of A.

- Both A and R are true and R is not the correct explanation of A.
- A is true but R is false.
- A is false but R is true.

11. Assertion: The eggs of Koel have evolved to resemble the crow's egg in size and colour. Reason: This reduces the chances of the host bird detecting the foreign eggs and ejecting them from the nest. **Ans - a**

12. Assertion: An orchid grows as an epiphyte on a mango branch. Reason: Both are benefited in this interaction. **Ans - c**

13. Assertion: All the cormorants in a wetland constitute a population
Reason: Individuals resulting from asexual reproduction are also considered a population for the purpose of ecological studies. **Ans - b**

14. Assertion: Population size of Siberian cranes in Bharatpur wetland can be determined by absolute population density.
Reason: Absolute population density measures the actual number of individuals in a population **Ans - a**

15. Assertion: Herbivores in a broad ecological context are considered as predators.
Reason: Herbivores act as the channel to transfer the energy to higher trophic level. **Ans - a**

SECTION B (2 marks Questions)

1. Provide an instance where the population size of a species can be estimated indirectly, without actually counting them or seeing them.

Answer: Tiger census in National parks and Tiger reserves was done on the basis of counting pug marks/faecal pellets

2. It is generally believed that competition occurs when closely related species compete for the same resources, like cows and buffaloes compete for the grass. However totally unrelated species can also compete for the same resources. -Justify using example. **Answer:** In some shallow South American lakes, visiting flamingoes and the resident fish compete for the common food-zooplankton in the lake.

3. Mention two features that help the parasite to survive in host?

Answer: Loss of unnecessary sense organs , Hooks and sucker, Loss of digestive system
High Reproductive capacity (any two)

4. The roots of leguminous plants have nodules in their roots formed by the soil bacterium *Rhizobium*. Name the type of interspecific interaction between the two? How have the two species benefited from each other?

Answer: Mutualism, The bacterium helps in fixing atmospheric Nitrogen and makes it available to plant . In turn the plant provides the bacteria shelter and food.

5. If in a pond there were 30 lotus plants last year and through reproduction 6 new plants are added, calculate the birth rate of lotus plants in that time period?

Answer: $6/30=0.2$ offspring per lotus plant per year.

6. Why can one never see any cattle or goats browsing on *Clatropis*?

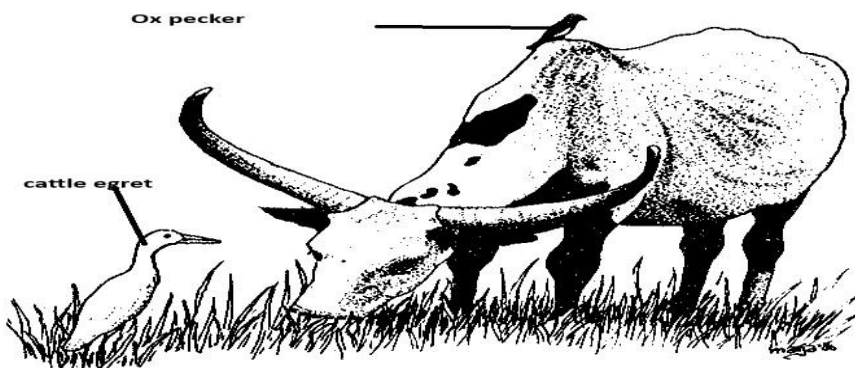
Answer: The plant produces highly poisonous cardiac glycosides as a method of chemical defense against grazing animals.

7. What is brood parasitism? How does the parasitic bird prevent its eggs from being discarded from the host's nest?

Answer: The parasitic bird lays its eggs in the nest of the host bird and lets the host incubate them. During the course of evolution, the eggs of the parasitic bird evolved to resemble the host's egg in size and colour

SECTION C (3 marks)

1. Study the image and answer the question that follows:



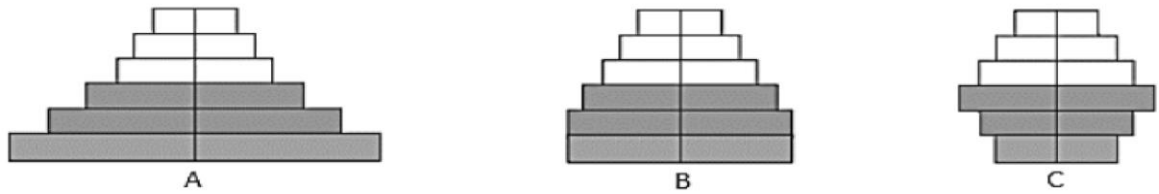
a. Identify the association between the Cattle egret and buffalo and mention the nature of benefit both the species derive.

b. The ox-pecker eats the insects on the body of the buffalo and helps the buffalo to get rid of parasites.

What type of interaction do they show?

Answer: a) Commensalism- as the cattle move, they stir up and flush out the insects from the grass which are fed upon by the cattle egret. b) Mutualism

2. What is an age pyramid? Identify the age pyramids-A, B, C. How does analysis of age pyramids can provide inputs for long term planning strategies?



Answer: If the age distribution is plotted for the population such that the pre-reproductive age group forms the base, reproductive in the middle and post-reproductive at the top, the resulting structure is an age pyramid. A= Expanding, B- Stable, C= Declining

Age pyramids can provide us the inputs to find ways to control population size in case of an expanding population. eg- family planning measures.

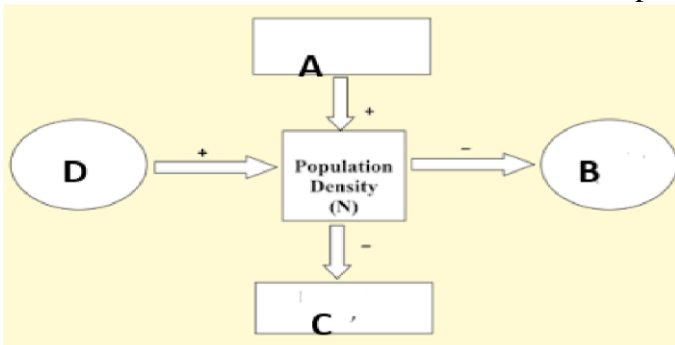
3. When certain exotic species are introduced into a geographical area, they become invasive and grow at the expense of the native species because of absence of natural predators. – Explain citing examples. Mention any two roles of predators in the ecosystem.

Answer: The prickly pear cactus introduced into Australia in the early 1920s caused havoc by spreading into millions of hectares of rangeland. Finally, the invasive cactus was brought under control after a cactus feeding moth (its predator) from its natural habitat was introduced into the country.

Roles of Predators

Keep prey population under control, maintain diversity of prey population by decreasing competition among prey species.

4. What does the letters- A, B, C and D denote with respect to affecting population density?



Which factor contributes to rise in population density in case of a new island just colonised?

Answer: A= Natality, B= Mortality, C= Emigration, D= Immigration

For a newly colonised land immigration may contribute significantly to population growth.

5. With the decline in the population of fig species it was noticed that the population of wasp species also started to decline. What is the relationship between the two and what could be the possible reason for decline of wasps? Does the fig plant derive any benefit from the wasp?

Comment.

Answer: Mutualism. The fig plant has a tight one-to-one relationship with the wasp species. The wasp uses the fig fruit to lay eggs and the developing larvae feeds on the seeds of the fig . The Fig plant in turn is pollinated by the wasp species.

CASE BASED QUESTIONS

1. Read the passage and answer the questions that follows:

At the most basic level, predators kill and eat other organisms. Conventionally parasites are thought not to kill their hosts. micro predators are small animals that, like predators, feed entirely on other organisms; they include fleas and mosquitoes that consume blood from living animals, and aphids that

consume sap from living plants. However, since they typically do not kill their hosts, they are now often thought of as parasites. Animals that graze on phytoplankton or mats of microbes are predators, as they consume and kill their food organisms; but herbivores that browse leaves are not, as their food plants usually survive the assault. When animals eat seeds (*seed predation* or *granivory*) or eggs (*egg predation*), they are consuming entire living organisms, which by definition makes them predators. Scavengers, organisms that only eat organisms found already dead, are not predators, but many predators such as the jackal and the hyena scavenge when the opportunity arises. Among invertebrates, social wasps (yellow jackets) are both hunters and scavengers of other insects.

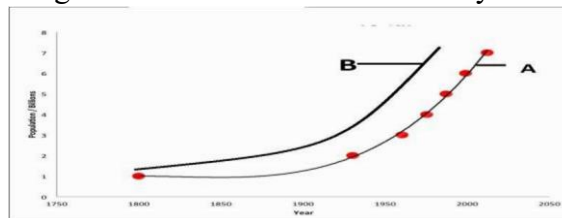
1. Mention the difference between predation and parasitism.
2. Why is a bird eating seeds considered a predator whereas an herbivore grazing on the leaves of a plant is not considered predation?
3. Mention two animals that can be classified both as predator and scavenger.
4. Can a mosquito feeding on blood be considered as a parasite or a predator? -Justify. **Answer:**
 1. Predators generally kill and eat the prey whereas the parasites conventionally do not kill the host.
 2. A bird eating a seed kills the entire organism i.e. that baby plant within the seed while eating it. However, herbivores that browse leaves are not, as their food plants usually survive the assault.
 3. Jackal and hyena
 4. If you're to define that a parasite needs to live on its host, then a mosquito is *not* a parasite and is thus a predator that feeds on the blood of a host. However, to be a true predator the predator should kill the prey and devour it. Hence in broad sense it cannot be considered a predator too.

2. Study the table below and answer the questions that follows:

Intrinsic rate of increase (r)* calculated for populations of species that differ greatly in their potential for the rate of population growth	
species	intrinsic rate of increase (r)
elephant seal	0.091
ring-necked pheasant	1.02
field vole	3.18
flour beetle	23
water flea	69

If the birth rate of a population is 1.05 and its death rate is 1.025, what is the value of 'r' for the population?

- a. If the value of 'r' of a population is zero, what does it signify?
- b. Which of the two populations has greater value of 'r' A or B. Justify.



d. Of the given species in the table which one has the least and which one has the maximum biotic potential?

Answer:

r is calculated as the difference between the birth rate and the death rate. $r = (b - d)$, $= 1.05 - 1.025 = 0.025$

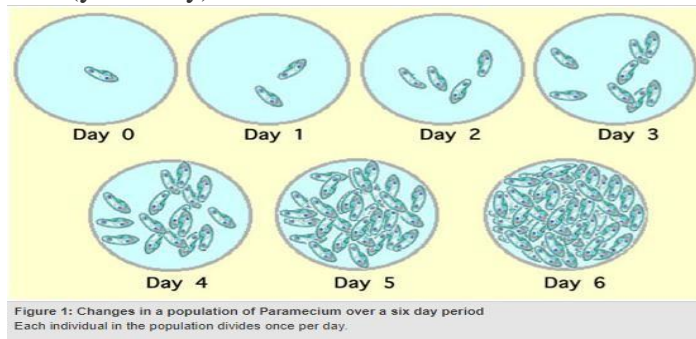
b. r value zero indicates that the population growth is in equilibrium i.e. the death rate and the birth rate have the same values.

. Population 'B' has the greater value of ' r '. More the steepness of the curve more is the value of ' r '

. The maximum biotic potential is that of water fleas and least is that of elephant seals. Higher the value of ' r ' higher is the biotic potential.

5 marks Questions

0. In the figure, a population of *Paramecium* in a small laboratory depression slide is pictured. In this population the individuals divide once per day. So, starting with a single individual at day 0, we expect, in successive days, 2, 4, 8, 16, 32, and 64 individuals in the population. On any particular day, the number of individuals in the population is simply twice what the number was the day before, so the number today i.e. $N(\text{today}) = 2N(\text{yesterday})$.

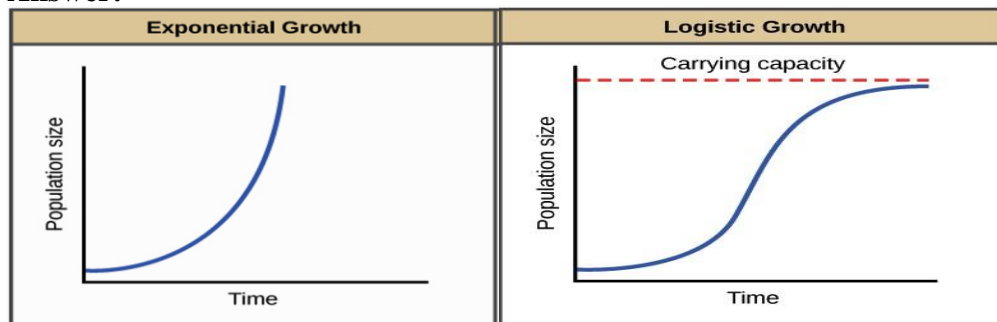


. Draw the population growth curve of the *Paramecium* in the above experiment provided food and space are replenished and write the equation of the curve obtained.

a. How would the growth curve vary in a natural setting? Give the graphical representation and mention the cause of such a growth curve.

b. What does the letter 'K' represent in the equation of Logistic growth curve?

Answer:



$$dN/dt = rN$$

b.

Limited resources, interspecific competition, outbreak of disease

c. The maximum number of individuals of a population that can be supported with resources by an environment.

0. Insect pollinators are paid 'fees' by the plants in the form of pollens, nectar or oviposition. But some plants like Mediterranean orchid *Ophrys* employs 'sexual deceit' to get pollinated by a species of bumble bee.

. Elaborate how the orchid employs 'sexual deceit' to the bee species.

a. What would happen if there is any change in the morphology of the flower of the orchid?

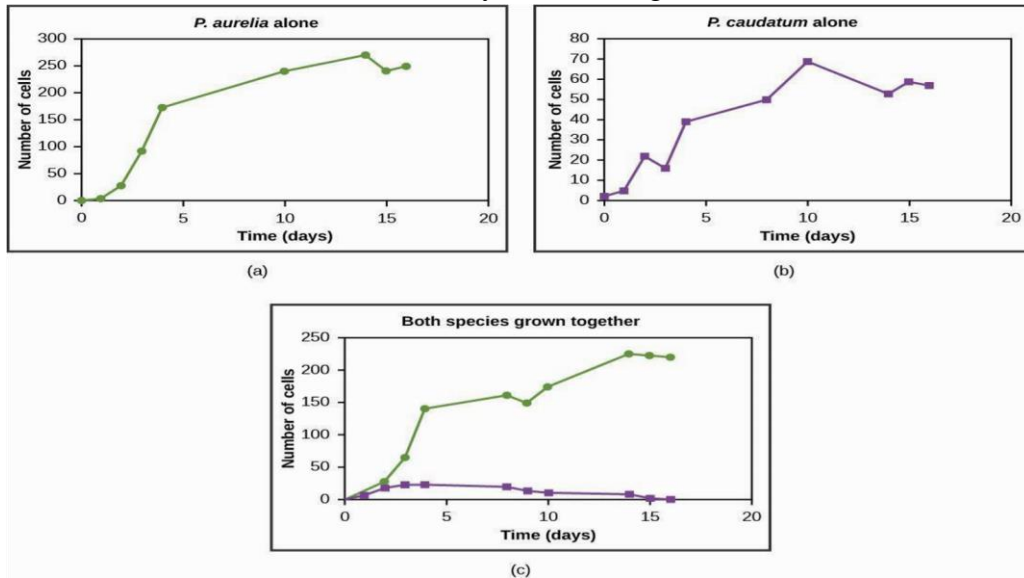
b. What fees are paid by the fig plant to a wasp species to bring about pollination of it? **Answer:**

One of the petals of *Ophrys* bears an uncanny resemblance to that of the female bee in size, colour and markings. The male bee pseudo-copulates with the flower, and during that process the pollen is dusted. When the same bee pseudo-copulates with another flower, transfer of pollen takes place.

a. Any change in the pattern of the petal for any evolution, the success of pollination will be reduced unless co-evolution takes place to maintain the resemblance of its petal.

b. The fig plant offers its fruit for laying eggs and the developing larvae of the wasp are fed on the seeds of fig.

0. Georgy Gause formulated the law of competitive exclusion based on laboratory competition experiments using two species of *Paramecium*, *P. aurelia* and *P. caudatum*. Although *P. caudatum* initially dominated, *P. aurelia* recovered and subsequently drove *P. caudatum* extinct via exploitative resource competition. However, Gause was able to let the *P. caudatum* survive by differing the environmental parameters (food, water). Thus, Gause's law is valid only if the ecological factors are constant.



State Gause's Competitive exclusion principle.

a. In the above experiment which species of *Paramecium* is competitively superior and why?

b. Using examples explain how two closely related species can avoid competition and coexist?

Answer:

Gause's competitive exclusion principle states that two closely related species competing for the same resources cannot coexist indefinitely and the competitively inferior one will be eliminated eventually.

a. *P. aurelia* is competitively superior over *P. caudatum*. This may be because of its higher efficiency in capturing food and greater value of intrinsic value of natural increase.

b. Two closely related species can avoid competition and co-exist by resource partitioning. MacArthur showed that five closely related species of warblers living on the same tree were able to avoid competition by behavioral differences in their foraging activities.

CHAPTER : 12 ECOSYSTEM

MCQ TYPE QUESTIONS

1. Photosynthetic active radiation (PAR) has the following range of wavelengths
a. 340-450 nm b) 400-700nm c) 500-600nm d) 450-950nm **Ans: b**
2. Pyramid of energy in aquatic ecosystem is
a. Always upright b) Bell shaped c) Always inverted d) None of these **Ans: a**
3. Mass of living matter at a trophic level in an area at anytime is called
a. Standing crop b) Detritus c) Humus d) Standing state **Ans: a**
4. Identify the possible link 'A' in the following food chain:
Plant insect frog 'A' Eagle
a. Rabbit b) Wolf c) Cobra d) Parrot **Ans: c**
5. Which one of the following is not a functional unit of an ecosystem?
a. Energy flow b) Decomposition c) Productivity d) Stratification **Ans: d** 6. If 20 J of energy is trapped at producer level, then how much energy will be available to peacock as food in the following chain?
a. 0.02 J b) 0.002 J c) 0.21 J d) 0.0002 J **Ans: b**
7. Energy transferred from one trophic level to another at
a. 5% b) 10% c) 15% d) 20% **Ans: b** 8. Which of the following is called a detritivore?
a. An animal feeding on decaying organic matter b) An animal feeding on a plant
c) A plant feeding on an animal d) An animal feeding on another animal **Ans: a**
9. These belong to the category of primary consumers -
a. Insects and cattle b) Eagle and snakes c) Water insects d) Snakes and frogs **Ans: a**
10. Maximum productivity is found in
a. Grassland b) Desert c) Ocean d) Tropical rainforest **Ans: d**

ASSERTION-REASON TYPE QUESTIONS

The following questions consist of two statements: Assertion(A) and Reason(R). To answer these questions, mark the correct alternative as directed below:

- a. If both A and R are true and R is the correct explanation of A
 - b. If both A and R are true and R is not the correct explanation of A
 - c. If A is true but R is false
 - d. If both A and R are false
11. A- Productivity generally increases from polar regions toward the tropics
R- It is due to increasing sunlight and temperature towards the tropics **Ans: a**
 12. A network of food chains existing together in an ecosystem is known as food web R- An animal like a kite cannot be a part of a food web. **Ans: c**
 13. A- Deforestation is one of the main factors contributing to global warming.

R- Besides CO₂, two other gases methane and CFCs are also included under green house gases

Ans: b

14. A- most food chains or webs have only about 4 or 5 trophic levels.

R- Trophic efficiencies are generally only about 10% in different ecosystems **Ans: a**

15. A- Biosphere is a closed system for energy

R- Biosphere receives a lot of material from outside. **Ans: d**

(2 Marks questions)

16. What are decomposers? Write their function.

Ans: Decomposers are the microorganisms which break down the dead organic matter into inorganic substances like CO₂, water and nutrients.

Function:i) It helps in breaking down complex organic matter into simpler ones ii) Help in the recycling of nutrients by breaking down the dead organic matter and solubilizing with the soil

17. Why is the length of a food chain in an ecosystem generally limited to 3-4 trophic levels?

Ans: The transfer of energy follows 10% law. At higher trophic levels, the residual energy is decreased to such an extent that no further trophic level can be supported by its transfer. Hence, the length of a food chain is limited to 3-4 trophic levels.

18. What is primary productivity? How is it different from net primary productivity? **Ans:** The amount of biomass or organic matter produced per unit area over a period of time by the plants during photosynthesis is called primary productivity.

Gross primary productivity minus respiration loss is called the net primary productivity.

$NPP = GPP - R$

Food chain	Food web
Transfer of food energy from the producers through a series of organisms.	A number of interconnected food chains
Organism belonging to higher trophic level can feed upon only one type of organism of lower trophic level	Organism belonging to higher trophic level can feed upon only several types of organism of lower trophic level

19. Differentiate between food chain and food web.

20. What is the shape of a pyramid of biomass in the sea? Why?

Ans: Inverted, because the biomass of fishes far exceeds that of phytoplankton

21. The pyramids of energy are upright in all ecosystems. Give reasons.
Ans: Energy at lower trophic levels is always more than at higher levels because of the 10% law.

22. Differentiate between DFC and GFC. What is the major conduit of energy in a terrestrial and in an aquatic ecosystem? **Ans:**

Detritus food chain(DFC)	Grazing food chain(GFC)
It is the food chain where transfer of energy starts from decaying organic matter	It is the food chain where transfer of energy starts from producers

Terrestrial ecosystem- DFC

Aquatic ecosystem- GFC

(3 Marks type questions)

23. Define decomposition? Briefly describe the process of decomposition.

Ans: The process of breakdown of complex organic matter into inorganic substances. Steps involved in the process of decomposition:

i) Fragmentation ii) Leaching iii) Catabolism iv) Humification v) Mineralisation (Brief explanation of each steps)

24. Explain the factors affecting the rate of decomposition.

Ans: Factors affecting the rate of decomposition are:

- i. If detritus is rich in lignin and chitin, decomposition is slow
- ii. Decomposition is faster if detritus is rich in nitrogen and water soluble substances like sugars.
- iii. Warm and moist environment favours decomposition
- iv. Low temperature and anaerobic conditions inhibit decomposition.

25. Define ecological pyramids. Describe with examples, pyramid of number and biomass.

Ans: The food or energy relationship among organisms at different trophic levels can be expressed in terms of number, biomass or energy. The expression assumes the shape of a pyramid called ecological pyramids.

All pyramids (number, biomass and energy) are upright. However there are some exceptions, e.g. i. insects feeding on a tree- represent an inverted pyramid of number ii. The pyramid of biomass in sea is inverted where the biomass of fish far exceeds that of phytoplankton.

26. Explain the ten percent law with the help of a diagram.

Ans: Ten percent law states that only 10% of energy is transferred to each trophic level from the lower trophic level.

Diagram NCERT textbook fig 14.3

27. Construct a pyramid of biomass starting with phytoplankton. Label the trophic levels. Is the pyramid upright or inverted? Why?

Ans: Diagram NCERT Textbook fig. 14.4

The pyramid is inverted, because the biomass of zooplanktons exceeds the phytoplankton and that of fishes far exceeds the zooplanktons in a given area.

Aquatic ecosystem- GFC

CASE BASED QUESTIONS

28. Read the passage and answer the following questions:

Primary production is defined as the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis. It is expressed in terms of weight (gm^{-2}) or energy (kcal m^{-2}). The rate of biomass production is called productivity. It is expressed in terms of $\text{gm}^{-2} \text{ yr}^{-1}$ or $(\text{kcal m}^{-2}) \text{ yr}^{-1}$ to compare the productivity of different ecosystems. It can be divided into gross primary productivity (GPP) and net primary productivity (NPP). Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis. A considerable amount of GPP is utilised by plants in respiration. Gross primary productivity minus respiration losses (R), is the net primary productivity (NPP). $\text{GPP} - \text{R} = \text{NPP}$ Net primary productivity is the available biomass for the consumption of heterotrophs (herbivores and decomposers). Secondary productivity is defined as the rate of formation of new organic matter by consumers. Primary productivity depends on the plant species inhabiting a particular area. It also depends on a variety of environmental factors, availability of nutrients and photosynthetic capacity of plants. Therefore, it varies in different types of ecosystems. **1) In the ecosystem, the is expressed in terms of $\text{gm}^{-2} \text{ yr}^{-1}$.**

- (a) Energy flow (b) Productivity (c) Decomposition (d) Cycle of nutrients

Ans: **b) Productivity**

2) Complete the following equation of Net primary productivity.

NPP = GPP _____

- (a) + P (b) +R (c) -P (d) -R Ans: **(d) -R. 3) Productivity is defined as the rate of production.**

(a) Net primary (b) Biomass (c) Inorganic matter (d) All of them Ans: **(b) Biomass.**

4) Explain the factors on which primary productivity is dependent?

Ans: Availability of nutrients, environmental factors, plant species, and photosynthetic capacity of plants these are the factors on which primary productivity is dependent.

29. Read the passage and answer the following questions:

The consumers that feed on these herbivores are carnivores, or more correctly primary carnivores (though secondary consumers). Those animals that depend on the primary carnivores for food are labelled secondary carnivores. A simple grazing food chain (GFC) is depicted below:

Grass	Goat	Man
Producer	Primary consumer	Secondary consumer

The detritus food chain (DFC) begins with dead organic matter. It is made up of decomposers which are heterotrophic organisms, mainly fungi and bacteria. They meet their energy and nutrient requirements by degrading dead organic matter or detritus. These are also known as saprotrophs (sapro: to decompose). Decomposers secrete digestive enzymes that breakdown dead and waste materials into simple, inorganic materials, which are subsequently absorbed by them. In an aquatic ecosystem, GFC is the major conduit for energy flow. As against this, in a terrestrial ecosystem, a much larger fraction of energy flows through the detritus food chain than through the GFC. Detritus food chain may be connected with the grazing food chain at some levels: some of the organisms of DFC are prey to the GFC animals, and in a natural ecosystem, some animals like cockroaches, crows, etc., are omnivores. These natural interconnections of food chains make it a food web. **1) is the beginning of Detritus' food chain.**

(a) Living organic matter (b) Producers (c) Dead organic matter (d) Consumers Ans: **(c) Dead organic matter.**

2) The meaning of 'sapro' word in the saprotrophs is

a) To produce (b) To divide (c) To consume (d) To decompose Ans: **(d) To decompose.**

3) GFC is a

(a) Global food chain (b) Grazing food chain (c) Global food consumers (d) Grazing form chain

Ans: **(b) Grazing food chain. 4) What is 'Food web'.**

Ans: The normal interconnection of the food chain is known as Food web.

5 Marks type questions

30. Describe the major components of the ecosystem.

Ans: The ecosystem components are of two types: abiotic and biotic

The abiotic components include the physical factors such as soil, air, water, light and temperature.

The biotic components are: producers, consumers and decomposers.

Producers: the green plants in an ecosystem are producers.

Consumers: all animals that depend on plants for their food are consumers

Decomposers: the bacteria and fungi that decompose dead organic matter of plants and animals are called decomposers.

**CHAPTER 13:
BIODIVERSITY AND CONSERVATION**

MULTIPLE CHOICE QUESTIONS

Q1. The most important cause of biodiversity loss is

- a. Over exploitation of economic species b) Habitat loss and fragmentation
c) Invasive species d) Breakdown of plant-pollinator relationships **Ans: b**

Q2. Organisation responsible for maintaining RED DATA BOOK is

- a. IUCN b) BNHS c) IBWL d) WWF **Ans: a**

Q3. Which is an example of ex situ conservation?

- a. National park b) Zoological park c) Wildlife sanctuary d) Biosphere reserves **Ans: b**

- Q4. Which of the following regions of our country are biodiversity hotspots?
 a. Western ghats and Eastern Himalaya b) Western ghat and Deccan Plateau
 c) Eastern Himalaya and Gangetic plain d) Trans Himalayas and Deccan Peninsula **Ans: a**
- Q5. The historic convention on biological diversity held in Rio De Janerio in 1992 is known as a. CITES convention b) The Earth summit c) G-16 summit d) MAB Programme **Ans: b**
- Q6. Germplasm conservation at liquid nitrogen temperature is called
 a. Stratification b) Scarification c) Cryopreservation d) None of the above **Ans: c**
- Q7. Which one of the following pairs of organisms are exotic species introduced in India?
 a. *Lantana camara*, water Hyacinth b) Water hyacinth, *Prosopis cineraria*
 c) Nile Perch/*Ficus religiosa* d) *Ficus religiosa*/*Lantana camara* **Ans: a**
- Q8. Genetic diversity in agricultural crops is threatened by
 a. Intensive use of pesticides b) Extensive intercropping
 c) Intensive use of fertilizer d) Introduction of high yielding varieties **Ans: d**
- Q9. Species-area relationship is represented on a log scale as
 a. Hyperbola b) Rectangular hyperbola c) Linear d) Inverted **Ans: c**
- Q10. A collection of plants and seed having diverse alleles of all the genes of a crop is called a. Herbarium
 b) Germplasm c) Gene library d) Genetic drift **Ans: b**

ASSERTION-REASONING

Question No 11 to 15 consists of two statements-Assertion(A) and Reason(R) Answer these questions selecting the appropriate option given below:

- a. Both A and R are true and R is the correct explanation of A
 b. Both A and R are true and R is not the correct explanation of A.
 c. A is true but R is False
 d. A is false but R is true

Q11. **A-** In ex situ conservation, threatened animals and plants are taken out from their natural habitat and placed in special setting where they can be protected and given special care **R-** In-situ conservation refers to the conservation of endangered species in their natural habitats. **Ans: b**

Q12. **A:** Tropical regions have got a long evolutionary time for species diversification as compared to temperate regions.

R- Temperate regions have undergone frequent glaciations in the past whereas tropical regions have remained relatively undisturbed for million of years **Ans: a**

Q13. **A** -The Nile perch introduced into lake Victoria in East Africa lead to extinction of more than 200 species of cichlid fish in the lake.

R -When alien species are introduced deliberately for economic or other uses they often become invasive and cause extinction of indigenous species.

Ans: a

Q14. **A-** If the species-area relationships are analysed among very large areas like entire continents, the value of Z i-e slope of line lies in the range of 0.1 to 0.2.

R- The value of Z i-e slope of line of species area relationships lies in the range of 0.6 to 1.2 when analysis is done among frugivorous birds of tropical forest. Thus the larger the explored area the more steep it is.

Ans: d

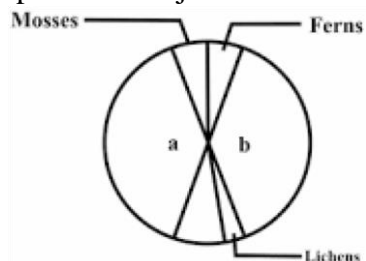
Q15. **A-** Threatened species are those living species which have been greatly reduced in their number and are liable to become extinct if the causative factors continue.

R-IUCN is an international organisation which maintains the IUCN Red list of threatened species, to assess the conservation status of different species.

Ans: b

VERY SHORT ANSWER QUESTIONS(2M)

Q16. Name the unlabelled areas 'a' and 'b' of the pie chart representing the biodiversity of plants showing their proportionate number of species of major taxa.



Ans: (a) Fungi (b) Angiosperm

Q17. Where would you expect more species biodiversity- In tropics or in polar regions? Give reasons in support of your answer.

Ans: More biodiversity is found in tropics

Reasons- In tropics frequent glaciation is absent /Tropics are less seasonal and more constant. Q18. Justify with an example where a deliberate attempt by humans by invasion of an alien species has led to the extinction of a particular species.

Ans: The Nile perch introduced into Lake Victoria in east Africa led eventually to the extinction of an ecologically unique assemblage of more than 200 species of cichlid fish in the lake. Q19. The Amazon rainforest is referred to as 'lungs of planet' Mention any two human activities which causes loss of Biodiversity in this region.

Ans: Human activities causing loss of biodiversity in Amazon rainforest are- a. Many plants are cut for cultivation of Soybean.

b. Forest is converted to grasslands for raising beef cattle.

Q20. Why are sacred groves highly protected?

Ans: Sacred grooves are patches of forest with special religious importance. They help in protection of rare, endangered and endemic species.

Q21. Mention the kind of biodiversity represented by more than 1000 varieties of mangoes in India. How is it possible?

Ans: Genetic diversity

Greater the genetic diversity among the organism of a species, the more sustenance it has against environmental disturbances.

Q22. Differentiate between *in situ* and *ex situ* approaches of biodiversity conservation Ans:

Differences between	
In situ	Ex situ
Onsite conservation	Offsite conservation
Conservation of species in their natural habitat	Conservation of endangered species in man made habitat

Q23. What is mass extinction? Give an example.

Ans: Study of fossil record shows large scale loss of species has also occurred before human appeared on the scene. There have been five episodes of mass extinction during the long period of more than 3 billion years.

Example- Extinction of Dinosaurs.

Q24. What is the significance of the slope of Regression in a species area relationship?

Ans: Slope of regression represents the changes in the species richness with the area. Species richness decreases with decrease in area. Value of 'Z' lies in between 0.1 to 0.2 in a country regardless of taxonomic group or the region. Value of 'Z' increases to 0.6 to 1 if the area increases like the area of the continent. 'Z' becomes steeper.

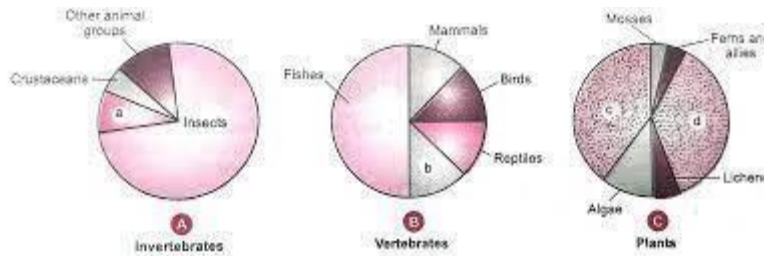
Q25. List any four techniques where the principles of ex-situ conservation of biodiversity has been employed.

Ans: Four technique of ex situ conservation are

- a. Tissue culture b) Cryopreservation c) botanical garden d) Zoological park

SHORT ANSWER TYPE QUESTIONS (3 MARKS)

Q26.



In the pie chart given above write the group of organism would you name in 'a' 'b' 'c' and 'd'. In which kind of Habitat would you find these kinds of organism.? **Ans:**

- a) Mollusca b) Amphibian c)Fungi d) Angiosperm Q27.

In a study comparing two continents Antartica and Asia, the species -area relationship was investigated using the following data:

PARAMETER	ANTARCTICA	ASIA
Area	14x10 ⁶ sq km	44x10 ⁶ sq km
Regression coefficient	1	1
Y intercept	5	10

- a. Calculate the species richness value for each region.
 b. Based on (a), which continent will have greater biodiversity and why?

Ans: (a)

$$S=CA^Z$$

S= Species richness

C=Y intercept

Z=Regression coefficient

A= Area

$$\text{Antartica- } S= 5*(14*10^6) =70*10^6$$

$$\text{Asia- } S= 10*(44*10^6) = 440 * 10^6$$

Asia is having greater biodiversity

Q28. Explain the concept of co-extinction by taking two examples.

Ans: Coextinction-When a species become extinct, then plant and animals dependent on it also became extinct.

Examples a)if a Fish gets extinct ,parasites dependent on fish will also die.

b) Flower-pollinator relationship

Q29. Bio-diversification of life started to occur 3 billion years ago. Since then new species are evolving and disappearing en-masses from earth.

- How many episodes of mass extinction of species have already taken place and which one is in progress in the current era?
- How are current episodes in progress different from the previous episodes and why?

Explain.

Ans:

- Five mass extinctions had already occurred.
Sixth is in progress

- Sixth extinction is faster. 100 to 1000 times faster

Human activities like industrialisation, loss of habitat ,over exploitation etc

Q30. Explain 'Rivet-Popper Hypothesis'. Name the scientist who proposed it.

Ans: Rivet popper hypothesis

- Proposed by Paul Ehrlich
- In an aeroplane all parts are joined together using thousands of rivets
- If every passenger travelling in it starts popping a rivet to take home, it may not affect the flight safety initially but when many rivets are out the flight safety will be affected.
- In the same way loss of one species or two will not affect biodiversity initially but when loss of species increases it will affect the functioning of the ecosystem.

Q31. List the advantages of the "ex-situ" approach to conservation of biodiversity .

Ans: The advantages of ex-situ approach are

- Threatened species can be protected
- Gametes can be preserved using cryopreservation techniques. □ Eggs can be fertilised in vitro by tissue culture technique.
- Seeds can be stored in seed banks for a long period of time

Q32. Compare narrow utilitarian and broadly utilitarian approaches to conserve biodiversity with suitable examples.

Ans: Narrowly utilitarian approach- Direct economic benefits from nature/Medicines etc Broadly Utilitarian approach- Ecological services

(CASE BASED QUESTION) 4 MARKS EACH

Read the following passage and answer the question below

Q33 CASE-1

The Kakapo is the world's largest and heaviest parrot, found only in New Zealand. It is unusual in that it is nocturnal, flightless and ground-dwelling. It is an excellent climber of trees, has strong legs that allow it to "jog" several kilometres. The Kakapo is also critically endangered as of now, there are only few known living individuals left.

All known surviving Kakapo have been relocated by the New Zealand government to three predator-free islands, where they are monitored year round by staff and volunteers to ensure that the birds are safe, healthy and well-fed. The extremely low population of Kakapo is a hurdle to the species becoming viable in the long term, despite such dedicated conservation efforts. When humans started to settle in New Zealand, they took with them non-native animals, including mammals such as cats, dogs and stoats.

Answer the following questions-

A) Which could be the possible reason for Kopako to be well adapted to its environment prior to the arrival of humans in New Zealand?

- Kakapo was active only in the night when its potential predator would not be out hunting.
- Kakapo would likely be well camouflaged among the forest foliage.

c) It was able to effectively hunt for food in the night. d) All of these

Ans: d) All of these

B). Write the two possible reasons from the passage by which the human settlement has likely contributed to a near decimation of Kakapo populations in New Zealand.

Ans: As humans settled in New Zealand, they would have cleared the land to make way for their own needs e.g., farmland, hence shrinking the natural habitats of the Kakapo.

The new mammals that were introduced by humans into the Kakapos habitats might have outcompeted the Kakapo for the limited food resources available.

C) By which conservation method do you think Kokako has been conserved in New Zealand **Ans:** Ex situ conservation

Q34. CASE-2

Wetlands are called Ramsar sites because the first international convention on their conservation was held in Ramsar in Iran in 1971. Wetlands or Ramsar sites are low lying marshy areas which get filled up during rains due to runoff and overflow from other water bodies. They are often considered to be waste lands which are used as dumping area and filled up to recover land for various constructions activities. As a result, a large number of wetlands have disappeared. i. RAMSAR convention protects

a. Water bodies b) Wetlands c) Waste lands d) Islands **Ans: b** ii. Why do wetlands need to be conserved?

a. They are very few left b) They are rich in biodiversity

c) They are dumping areas d) They are filled up for construction **Ans: b** iii. Why are a large number of wetlands disappearing nowadays? **Ans:** Due to use it as dumping land/ construction sites etc iv. Why are wetlands called Ramsar sites?

Ans: Wetlands are called Ramsar sites because the first international convention on their conservation was held in Ramsar in Iran in 1971.

LONG ANSWER QUESTIONS TYPE (5 MARKS EACH)

Q35. The ' Evil Quartet' describes the rates of species extinction due to human activities. a. Explain how the population of organisms is affected by fragmentation of the habitats.

b. Introduction of alien species has led to environmental damage and decline of indigenous species. Give any one example of how it has affected the indigenous species.

c. Could the extinction of Steller's sea cow and passenger pigeon be prevented? Give reasons to support your answer. **Ans:**

a. When a large habitat is broken into smaller fragments i.e fragmentation, certain animals like mammals and birds requiring large territories and animals with migratory habitats are badly affected leading to population decline.

b. Nile perch introduced into lake Victoria. Water hyacinth/Lantana

c. Humans have exploited natural resources leading to extinction of animals. Sustainable harvesting could have prevented extinction. 2+2+1

Q36. (a) What are the two types of desirable approaches to conserve biodiversity? Explain with examples.

b. How would the association between bumblebee and its favourite orchid Ophrys be affected by a change in colour of bee or extinction of any one of them?

Ans:

a. Two basic approaches for conservation of biodiversity are-

1. In-situ conservation includes- Biodiversity hotspots/protected areas/Ramsar sites/ sacred grooves.

2. Ex-situ conservation- Cryopreservation/tissue culture methods/botanical gardens/zoological parks etc.

- b. Ophrys employs sexual deceit to get pollination by certain species of bee as petals of its flower bear resemblance to female bees in size, colour and marking. If female bee colour patterns change due to any reason during evolution, pollination will be reduced unless the orchid flower co-evolves. As both are dependent on each other, extinction of one will lead to the extinction of another also.

Q37. How is biodiversity important for ecosystem functioning?

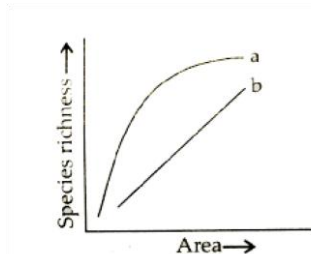
Ans: Biodiversity is very important for ecosystem functioning. More diverse ecosystems are considered more stable. Stable communities are resilient to change. Higher the biodiversity lower the rate of extinction.

Extinction of even one key -species has a negative impact on the entire ecosystem.

A stable community shows following characteristics

- It does not show too much variation in the year to year productivity.
- Resistant to occasional disturbance.
- Resistant to invasion by alien species.

Q38.



The graph shows species-area relationships.

- a. If b denotes the relationship on log scale-Describe 'a' and 'b' How is slope represented? Give the normal range of slope.

What kind of slope will be observed for frugivorous birds and mammals in a tropical forest?

- b. Species diversity of plants(22%) is much less than that of animals(72%). Analyse the reasons for the greater diversity of animals as compared to plants.

Ans: a) 'a' is $S = CA^Z$

'b' is $\log S = \log C + Z \log A$.

Slope is Z (regression coefficient) Normal value ranges from 0.6 to 1.2 In frugivorous birds and mammals, the value of Z=1.15.

- b) Reasons for greater diversity of animals are- Animals are mobile and can avoid predator or unfavorable event

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