XII
ZOOLOGY
FOCUS AREA NOTE
2020 - 2021

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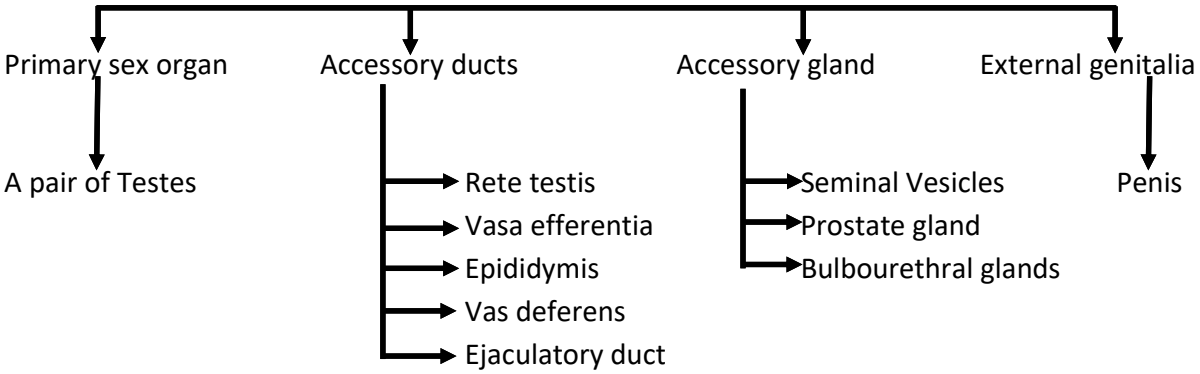
Chapter - 3

HUMAN REPRODUCTION

MALE REPRODUCTIVE SYSTEM



MALE REPRODUCTIVE SYSTEM

The male reproductive system includes a pair of testes, accessory ducts, glands and external genitalia.

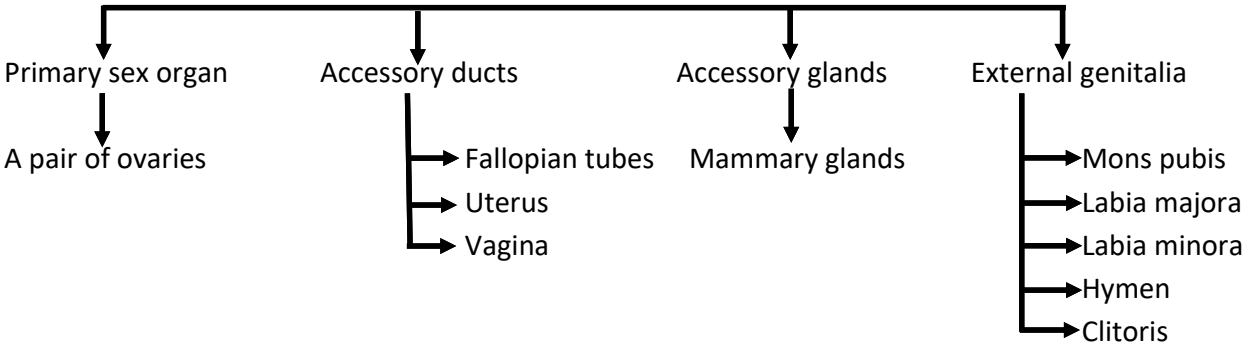
TESTES

- Testes are situated outside the abdominal cavity within a pouch called scrotum.
- **Scrotum helps to maintain a low temperature (2 – 2.5°C lower than the internal body temperature) essential for spermatogenesis**
- Each testes internally contains about 250 compartments, called **testicular lobules.**
- Testicular lobule contains one to three highly coiled **seminiferous tubules**.
- Seminiferous tubules internally contain two types of cells
    1. **Spermatogonia or Male germ cells** - Produce sperms or male gametes.
    2. **Sertoli cells** - Provide nutrition to the germ cells.
- **Leydig cells or Interstitial cells** found between the seminiferous tubules secrete testicular hormones called androgens.

ACCESSORY DUCTS

- It includes **rete testis**, **vasa efferentia**, **epididymis**, **Vas deferens**, and **ejaculatory duct**.
- Ejaculatory duct finally open into **urethral meatus** (external opening) through the urethra.

FEMALE REPRODUCTIVE SYSTEM



Ovaries

- Ovaries are the primary sex organs in females.
- Each ovary contains many ovarian follicles with developing ova.
- Matured follicle called graafian follicle breaks and releases the ovum by a process called **Ovulation**.

Oviducts (Fallopian tubes)

- Each fallopian tube possess an **infundibulum**, **ampulla** and **isthmus**.
- Infundibulum is the funnel shaped part possessing finger like projections called **Fimbriae** .
- The fimbriae helps to collect the ovum after ovulation.
- The wider curved portion of oviduct is called ampulla.

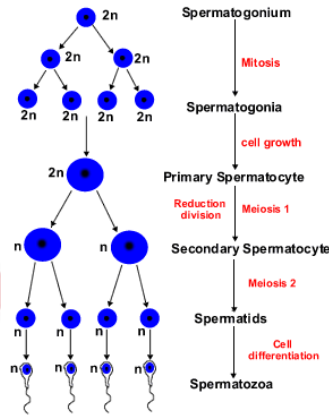
Uterus (Womb)

- It is a thick walled muscular structure within which the embryo grows.
- The wall of the uterus consists of three layers called outer **perimetrium**, middle muscular **myometrium** and inner glandular **endometrium**.
- The lower end of the uterus is called **cervix**.

External genitalia

- The external genitalia includes **mons pubis**, **labia majora**, **labia minora**, **hymen** and **clitoris.**
- **Hymen** - Membrane partially covering the vaginal opening.

Significance of Hymen :- Hymen is often torn during first intercourse. It can be broken by sudden fall, active participation in sports and insertion of vaginal tampon.



GAMETOGENESIS

The process of formation of gametes are called gametogenesis. It include spermatogenesis and oogenesis.

Spermatogenesis

The process of formation of sperms within the seminiferous tubules of testes is called spermatogenesis and it starts at puberty.

The different steps in spermatogenesis are,

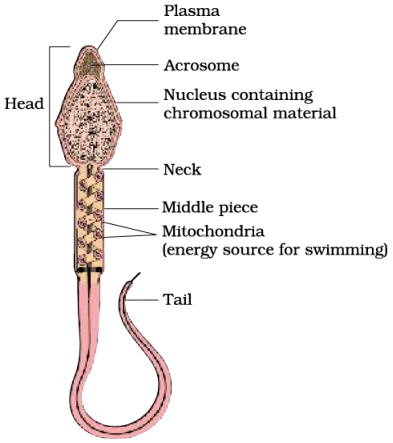
Spermatogonia —Mitosis→ Primary Spermatocyte —Meiosis - I→ Secondary Spermatocyte —Meiosis - II→ Spermatids —Spermiogenesis→ Spermatozoa

Spermiogenesis

- The process of transformation of spermatids into sperms is called spermiogenesis.

Spermiation

- The release of sperms from the seminiferous tubules is called spermiation.



Structure of Sperm

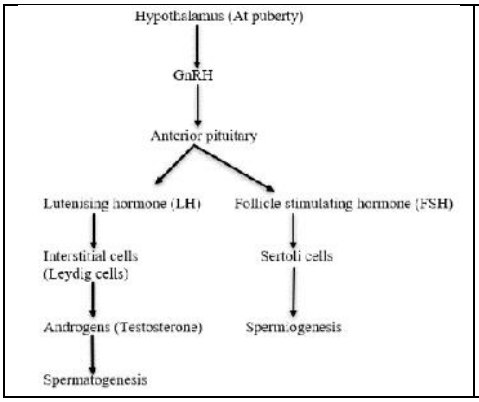
- Sperms are microscopic structures composed of **head**, **neck**, **middle piece** and **tail**.
- Sperm head contains a large haploid nucleus and acrosome.

Acrosome

- Anterior cap like structure present in sperm head.
- Acrosome is filled with lytic enzyme that helps in the penetration of ovarian wall layers.
- Middle piece possess numerous mitochondria, which produce energy for the movement of sperms.

Semen – The seminal plasma along with the sperms constitute the semen.

Hormonal control of spermatogenesis



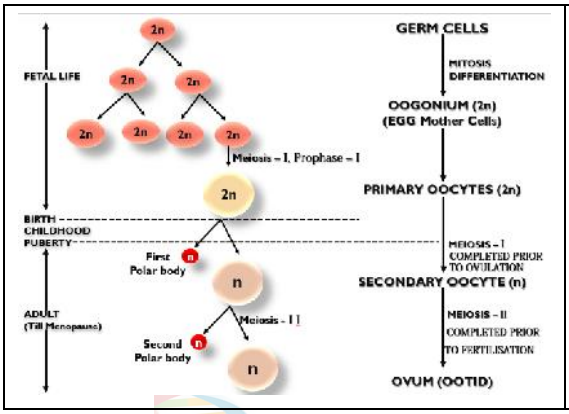
GnRH – Act on anterior pituitary gland and stimulate the production of gonadotropins (LH & FSH).

LH – Act on Leydig cell to stimulate the synthesis of androgens.

FSH – Act on Sertoli cells for secretion of factors that help in spermatogenesis.

Androgens – Stimulate the process of spermatogenesis.

Oogenesis



The process of formation of ovum within the ovaries is called oogenesis.

It starts at the embryonic stage itself. During this process,

Germ cells (Oogonia) undergo repeated mitosis to form diploid cells called primary oocytes.

Each primary oocyte undergo meiosis - I (temporarily arrested at Prophase - I stage) to form a small haploid cell called first polar body and a large haploid cell called secondary oocyte.

Each secondary oocyte undergo meiosis - II to form a large haploid cell called ootid or ovum and a small haploid cell called second polar body.

Structure of Egg

Egg or ovum has a central haploid nucleus with rich cytoplasm. It has following three layers

- Plasma membrane – innermost layer
- Zona pellucida – Middle layer
- Corona radiata – Outer layer with cells of follicle.

Follicle

Developing oocytes surrounded by the granulosa cells of ovary develop into follicles. Follicles develops as primary, secondary, tertiary and finally into **graafian follicle or mature follicle**.

Antrum - Fluid filled cavity present in the teritary follicle of ovary is called antrum

Differences between spermatogenesis and oogenesis

Spermatogenesis	Oogenesis
It is the process of formation of sperms.	It is the process of formation of ovum.
It starts at puberty.	It starts at the embryonic stage
Meiosis - I in the primary spermatocytes is continuous.	Meiosis - I in the primary oocytes is not continuous
Four sperms are formed from a primary spermatocyte.	Only one ovum is formed from a primary oocyte.
Sterile cells called polar bodies are not formed.	Sterile cells called Polar bodies are formed.

Menstrual Cycle

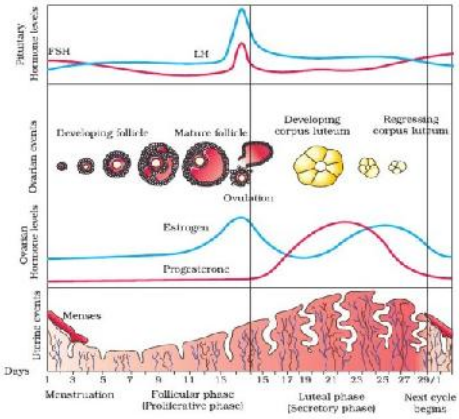
- It is the reproductive cycle found in primate females (Monkey, Apes and Human).
- In human beings, menstruation is repeated at an average interval of 28/29 days.
- Menstrual cycle is divided into menstrual phase , follicular phase, ovulatory phase and luteal phase.

Menstrual phase.

- Endometrium of uterus breaks and releases blood and mucus through the vagina if there is no fertilisation(menstruation).
- **Endometrium break due to the lack of progesterone**. It lasts for 3-5 days.

Follicular phase (Proliferative phase).

- The primary follicles in the ovary grow and develop into mature graafian follicle.
- The endometrium of uterus regenerates through proliferation during this phase.
- These changes are induced by the levels of **pituitary hormones called LH and FSH and follicular hormone called estrogen**.



Ovulatory phase

- This phase is characterized by ovulation (Release of ovum) from ovary.
- It occurs in the middle of menstrual cycle (14th day).
- Rapid increase of **LH** (**LH surge**) helps in ovulation.
- **The LH surge induces the rupture of graafian follicle** and there by the release of ovum (in the **secondary oocyte stage**). This process is called **Ovulation**.

Luteal phase (Secretory phase)

- The ruptured graafian follicle is transformed in to corpus luteum.
- The **corpus luteum secretes a large amount of progesterone, which maintain the endometrium of uterus.**
- In the absence of fertilization , the corpus luteum degenerates around the 28th day and it causes the disintegration of endometrium leading to menstruation.

Menarche and menopause

- First menstruation at the time of puberty is called **menarche**.
- Permanent stopping of menstrual cycle around the age of fifty is called **menopause**.

Fertilisation.

- The process of fusion of sperm and ovum is called fertilisation.
- It takes place at the **ampullary – isthmic junction** of fallopian tube.

Embryonic development

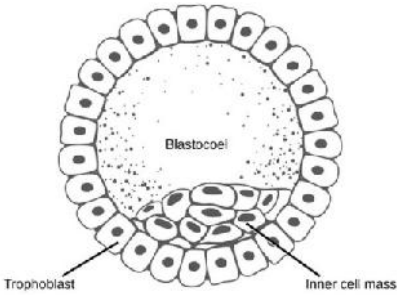
- The different stages in embryonic development are ,

ZYGOTE —Cleavage→ **MORULA** → **BLASTOCYST** —Implantation→ **GASTRULA** → **EMBRYO**

Morula - The embryo with 8-16 blastomeres is called morula.

Blastocyst

- The morula continues to divide and transforms into a hollow structure called blastocyst.
- It consists of an outer layer called **trophoblast** and an **inner cell mass**.
- The trophoblast get attaches to the endometrium and the inner cell mass gets differentiated into embryo.



Placenta

Structural and functional connection between embryo and maternal body is called placenta.

- Chorionic villi and uterine tissues together form the placenta.
- The placenta is connected to the embryo through an umbilical cord.

Functions of Placenta

- It facilitates the supply of oxygen and nutrients to the embryo.
- It helps to remove CO_2 and excretory wastes produced by the embryo
- It acts as an endocrine gland and produces hormones like,

1. Human chorionic gonadotropin (hCG) **2. Human placental lactogen (hPL)**

3. Estrogen **4. Progestogens**

Parturition

- Parturition (Child birth) is the process of delivery of foetus.
- It is induced by complex neuro endocrine mechanism.
- The signal for parturition originates from the fully developed foetus and the placenta as mild uterine contraction called **foetal ejection reflex**.
- Foetal ejection reflex stimulate the secretion of oxytocin from pituitary gland.
- **Oxytocin** increases contraction of uterine muscle.

Colostrum

- The milk produced during the initial few days of location is called **colostrum** (yellow milk)
- It contains several antibodies essential to develop resistance for the new born babies.

Relaxin

Hormone released by the ovary during the later stages of pregnancy.

Lactation

Production of milk from the mammary glands are called lactation.

Chapter - 4

REPRODUCTIVE HEALTH

Reproductive health refers to healthy reproductive organs with normal functions.

According to **WHO (World Health Organisation)**, it refers to total well-being in physical, emotional, behavioural and social aspects of reproduction.

Amniocentesis

Study the chromosomal pattern in the amniotic fluid surrounding the developing embryo.

It help in foetal sex determination and help to identify chromosomal disorders.

Amniocentesis is legally banned in India due to increased female foeticides.

Population Explosion

It is the explosive growth of human population.

The reason for human explosion are

1. Decline in **death rate (Mortality)** 2. Increase in **birth rate (Natality)**
3. Decline in **Maternal Mortality Rate (MMR)**.4. Decline in **Infant Mortality Rate (IMR)**.
5. Improved health and living conditions.

Birth Control Measures

CONTRACEPTIVE METHODS

- **Natural Methods**
  - 1. Periodic Abstinence
  - 2. Coitus interruptus (Withdrawal)
  - 3. Lactational amenorrhea
- **Barrier methods**
  - 1. Condoms
  - 2. Diaphragms
  - 3. Cervical cap
  - 4. Vaults
- **IUD's**
  - 1. Non-medicated IUD's
  - 2. Copper releasing IUD's
  - 3. Hormone releasing IUD's
- **Oral contraceptives**
  - 1. Progestogen
  - 2. Progestogen-Estrogen
  - 3. Saheli
- **Surgical Methods**
  - Vasectomy
  - Tubectomy

Natural Methods – Work on the principle of avoiding the chance of meeting sperm and ovum.

Since no medicines or devices are used side effects are almost nil but chance of failure is high.

1. Periodic abstinence - Avoiding coitus from day 10 to 17 days (Fertile Period) of the menstrual cycle.
2. Coitus interruptus - Withdraws his penis from vagina just before ejaculation in order to avoid insemination.
3. Lactational amenorrhea - Absence of menustration / ovulation during the intense period of lactation.

Barrier Methods – Sperm and ovum are prevented from physical meeting with the help of a barrier.

1. Condoms – Is a barriers made of thin rubber or latex sheath.

   Condoms are used to cover penis in the male or vagina and cervix in the female.

   Use of condoms prevent the STD's and AIDS.

2. Diaphragms, Cervical cap & Vaults – These are barriers made up of rubber inserted to the female reproductive tract to cover cervix. They are reusable.

IUD's (Intra Uterine Devices) –These devices are inserted by doctor or expert nurse into the uterus through vagina.

1. NON-MEDICATED IUDs . **Eg :- Lippes loop**

2. COPPER RELEASING IUDs . **Eg :- CuT, Cu7 & Multiload 375**

3. HORMONE RELEASING IUDs . **Eg :- Progestasert, LNG -20**

Copper T (CuT)

IUDs increases phagocytosis of sperms inside the uterus.

Copper ions supress sperm motility and fertilising capacity of sperms.

Hormone released from IUDs makes the uterus unsuitable for implantation.

Oral Contraceptives –They are commonly known as contraceptive pills.

Pills contain either Progestogens or Progestogen- estrogen combinations.

Mode of action - It inhibit ovulation and implantation. Alter the quality of cervical mucus to prevent or retard entry of sperms.

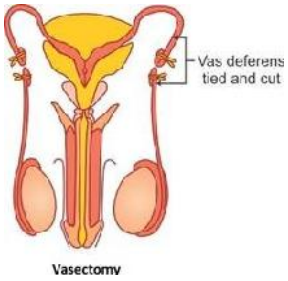
SAHELI :- Non-steroidal oral contraceptive pill produced by **CDRI (Central Drug Research Institute).**

It is an **'Once in a Week' pill**. It has less side effect.

Surgical Methods /Sterilization method – It is an effective permanent method of contraception.

This method is not reversible.

1. **Vasectomy – Male sterilization method** in which small part of **vas deferens** is removed or tied up.
2. **Tubectomy – Female sterilization method** in which small part of **fallopian tube** is removed or tied up.



Vasectomy

Medical Termination of Pregnancy (MTP) –

Intentional or voluntary termination of pregnancy before full term.

MTP is also known as induced abortion.

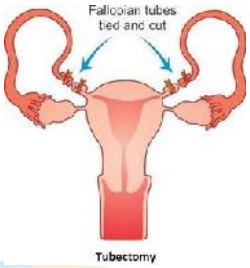
Government of India legalized MTP in 1971 due to increased rate of female foeticides.

Advantage of MTP

To get rid of unwanted pregnancies (Casual intercourse or rape).

To get rid of genetically or physiologically unhealthy foetus.

If continuation of pregnancy could be harmful or even fatal to mother or foetus.



Tubectomy

Sexually Transmitted Diseases (STD's)

Diseases or infection which are transmitted through sexual intercourse.

STD are also called **Venereal Diseases (VD) or Reproductive Tract Infection (RTI).**

EXAMPLES FOR STD'S

1. GONORRHOEA	2. SYPHILIS	3. GENITAL HERPES
4. CHLAMYDIASIS	5. GENITAL WARTS	6. TRICHOMONIASIS
7. HEPATITIS - B	8. AIDS (HIV INFECTION)	

Assisted Reproductive Technologies

Medical technologies used to overcome infertility are called Assisted Reproductive Technologies (ART).

Important ARTs are,

1. ***IN VITRO* FERTILISATION (IVF)**

   Fertilisation outside the body providing similar conditions as that inside the body.

   It is followed by Embryo Transfer.

   EMBRYO TRANSFER (ET)

   Transfer of embryo developed through IVF into reproductive part of female.

   ET are of two types, ZIFT & IUT.

   a. ZYGOTE INTRA FALLOPIAN TRANSFER (ZIFT)

   Transfer of zygote or early embryo with up to 8 blastomere.

   Zygote/Embryo is transferred into the fallopian tube.

   b. INTRA UTERINE TRANSFER (IUT)

   Embryo transfer with more than 8 blastomere.

   Embryo is transferred into the uterus.

2. **GAMETE INTRA FALLOPIAN TRANSFER (GIFT)**

   GIFT is done **if the female individual cannot produce ovum**.

   Ovum from a donor female is collected and transferred into the fallopian tube.

3. **INTRA CYTOPLASMIC SPERM INJECTION (ICSI)**

   It is a type of invitro fertilization in which Sperm is directly injected into the cytoplasm of ovum.

If the male partner is not able to inseminate, following ART's are used

4. **ARTIFICIAL INSEMINATION (AI)**

   Semen collected from the male partner is artificially introduced into the vagina of the female.

5. **INTRA UTERINE INSEMINATION (IUI)**

   Semen collected from the male partner is artificially introduced into the uterus of the female.

TEST TUBE BABY – Children produced through IVF followed by ET is called test tube baby.

Chapter - 5

PRINCIPLES OF INHERITANCE AND VARIATION

GENE

Fundamental units of inheritance or variation and control the expression of a character.

Mendel proposed the term 'factors' for gene.

Genes are located on the specific portion of chromosomes called locus.

ALLELES

Alternate forms of the gene located on the homologous chromosome is called alleles or allelomorphs.

Usually capital and small letters are used to represent the alleles of a gene.

GENOTYPE

Genetic or allelic constitution of a phenotype is called genotype. Usually genotype have two alleles.

PHENOTYPE

Physical appearance of a character is called phenotype.

Phenotype represent one of the trait of a character.

Eg :- Tall and dwarf, A blood group, AB blood group.

GREGOR JOHANN MENDEL

Gregor Johann Mendel is known as **Father of modern genetics**.

Mendel conducted hybridization experiments in Garden Pea (*Pisum sativum*) for seven years (1856 – 1863).

G. J. Mendel proposed laws of inheritance in living organisms.

Contrasting Traits Studied by Mendel in Pea

S.No.	Characters	Contrasting Traits Dominant/Recessive
1.	Stem height	Tall/dwarf
2.	Flower colour	Violet/white
3.	Flower position	Axial/terminal
4.	Pod shape	Inflated/constricted
5.	Pod colour	Green/yellow
6.	Seed shape	Round/wrinkled
7.	Seed colour	Yellow/green

Incomplete Dominance

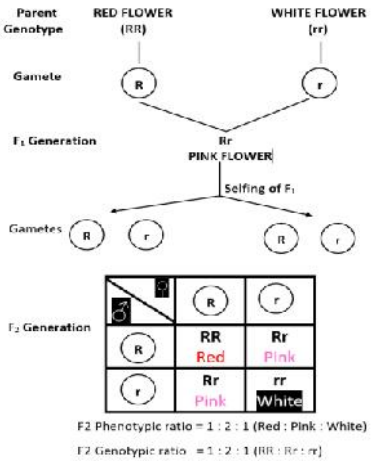
Incomplete dominance is an example for non-Mendelian Inheritance.

It is a type of inheritance in which the phenotype of F_1 hybrid did not resemble either of the two parents.

The F_1 hybrid has a phenotype intermediate or in between the phenotype of parents.

The inheritance of **flower colour in the dog flower (Snapdragon or *Antirrhinum*)** is an example for incomplete dominance.

In Snapdragon homozygous **red flowered plant crossed with homozygous white flowered plant produce pink** coloured hybrid F_1 plants.



The **Self-pollination of F_1 produce F_2 generation with red , pink and white flower colour .**

✵GENOTYPIC & PHENOTYPIC RATIO ARE SIMILAR

F_2 phenotypic ratio = 1 : 2 : 1

F_2 genotypic ratio = 1 : 2 : 1

Co-dominance

Co-dominance is an example for non-Mendelian Inheritance.

It is a type of inheritance in which the phenotype of F_1 resemble both parents.

ABO blood group is a typical example for co-dominance.

ABO blood group is controlled by the gene '*I*'.

The gene 'I' has three alleles I^A, I^B and *i*.

I^A and I^B alleles are dominant over i allele. ie. when I^A and i alleles are present I^A express.

I^A allele is co-dominant over I^B allele. ie. when I^A and I^B alleles are present both I^A and I^B express.

ABO blood group inheritance is an example for both co-dominance and multiple allelism.

Table showing the genetic basis of Blood group inheritance in Human

Allele from male parent	Allele from female parent	Genotype of offspring	Blood group of offspring
I^A	I^A	$I^A I^A$	A
I^A	i	$I^A i$	A
I^A	I^B	$I^A I^B$	AB
I^B	I^B	$I^B I^B$	B
I^B	i	$I^B i$	B
I^B	I^A	$I^A I^B$	AB
i	i	$i i$	O

Chromosomal theory of inheritance

Chromosomal theory of inheritance was proposed by Sutton and Boveri.

The theory states that behaviour of chromosomes was parallel to the behaviour of genes.

The two alleles of a gene pair are located on homologous chromosomes.

Pairing and separation of a pair of chromosomes would lead to the segregation of a pair of factors they carried.

Experimental proof for chromosomal theory was given by T. H. Morgan's experiment on Drosophila.

Reason for selecting Drosophila as experimental animal by T. H. Morgan

- They have short lifespan.
- Male and female can be easily identified.
- Single mating could produce large number of progeny flies.
- They can be grown in simple synthetic medium.
- Hereditary variation can be observed using low power microscope.

Sex determination

Sex determination based on genetic/chromosomal basis was first Proposed by HENKING (1891)

Sex determination in Humans

Sex determination in human is XX-XY type.

Sex determination in **human is an example of male heterogamety type.**

Male has 22 pairs of autosomes and X and Y chromosome.

female has 22 pairs of autosomes and a pair of X chromosome.

During gamete production **male produce two different types of gametes.**

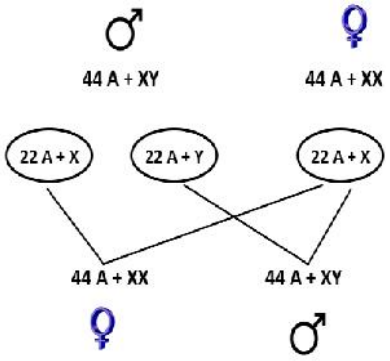
50 per cent of gametes (Sperm) have X- chromosome.

50 per cent of gametes (Sperm) have Y- chromosome.

Females produce ovum with only X-chromosome.

If the sperm with Y-chromosome fertilize an egg the zygote develop into male.

If the sperm with X-chromosome fertilize an egg the zygote develop into female.

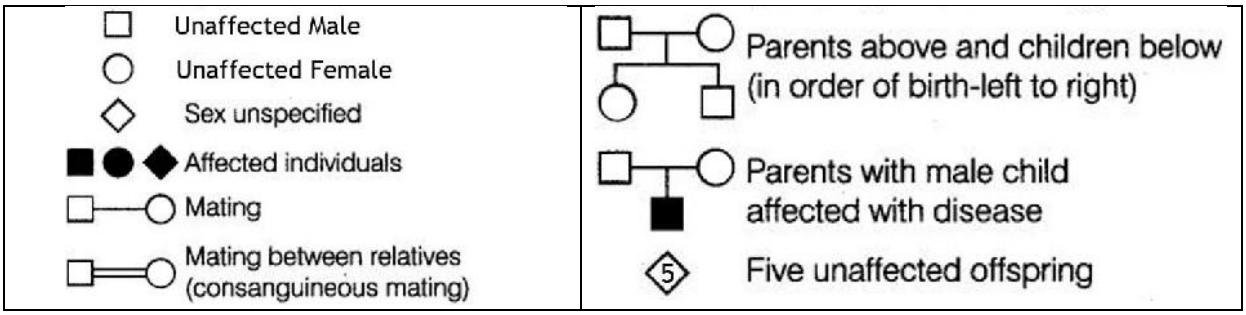


Pedigree Analysis

Analysis of a genetic trait in a several generations of a family is called pedigree analysis.

In human genetics, pedigree is used to trace the inheritance of a specific trait, abnormality or disease.

Symbols used in the Human Pedigree Analysis



Mendelian Disorders

HAEMOPHILIA

Sex - linked or X – chromosome linked recessive disorder.

This disorder is also called **ROYAL DISEASES** since it was first observed in the family pedigree of Queen Victoria.

In this disorder a single protein (Anti- haemophilic factor) involved in the blood clotting is affected.

This will affect the blood clotting leading to loss of blood through wound.

The possibility of female becoming haemophilic is extremely rare because father of such a female should be haemophilic and mother has to be at least carrier.

SICKLE CELL ANEMIA

An autosome linked recessive disorder.

Controlled by allele Hb^A and Hb^S.

Substitution mutation or **point mutation at sixth codon (GAG to GUG)**

Defect due to **substitution of GLUTAMIC ACID (Glu) by VALINE (Val) at sixth position of beta globulin chain of haemoglobin.**

It causes RBC become sickle cell shape.

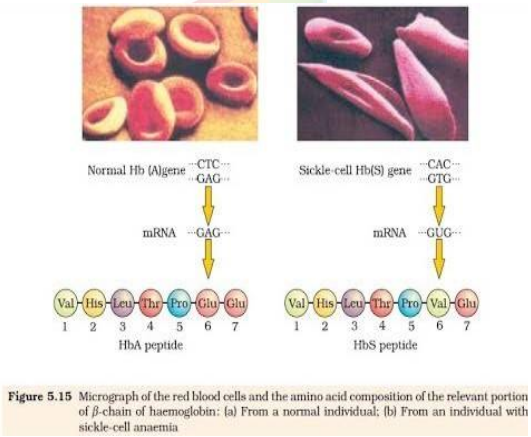


Figure 5.15 Micrograph of the red blood cells and the amino acid composition of the relevant portion of β-chain of haemoglobin: (a) From a normal individual; (b) From an individual with sickle-cell anaemia

Chromosomal Disorders

DISORDER	CHROMOSOMAL CONDITION	CHROMOSOME NUMBER	SYMPTOMS
DOWN'S SYNDROME	**Trisomy of 21** **45 + XX/XY**	**47**	➢ **Short stature.** ➢ **Small round head.** ➢ **Furrowed tongue.** ➢ **Partially open mouth.** ➢ **Mentally retarded.**
KLINEFELTER'S SYNDROME	**44 + XXY**	**47**	➢ **Sterile male.** ➢ **Masculine development.** ➢ **Gynaecomastia – development of breast.**
TURNER'S SYNDROME	**Monosomy of sex chromosome** **44 + XO**	**45**	➢ **Sterile female** ➢ **Ovaries are rudimentary.** ➢ **Secondary sexual characters absent.**

Chapter - 6

MOLECULAR BASIS OF INHERITANCE

NUCLEIC ACIDS

Nucleic acids are polynucleotides. Nucleotides are the building blocks.

Nucleotides contain

a. **Heterocyclic nitrogen containing compound** – **Purines** (Adenine & Guanine) & **Pyrimidines** (Thymine, Uracil & Cytosine).

b. **Pentose Sugar** - Ribose in RNA & Deoxyribose in DNA.

c. **Phosphoric acid.**

Nucleotides

Building blocks of nucleic acids Nucleotide = nucleoside + phosphate group Nucleoside = Ribose sugar + heterocyclic nitrogen base	Nitrogen base	Nucleoside	Nucleotide
	Adenine	Adenosine	Adenylic acid
	Thymine	Thymidine	Thymidylic acid
	Guanine	Guanosine	Guanylic acid
	Cytosine	Cytidine	Cytidylic acid
	Uracil	Uridine	Uridylic acid

N-glycosidic bond – Nitrogen base linked to the pentose sugar through N-glycosidic bond.

Phosphodiester bond- The bond between the two nucleotide is called phosphodiester bond.

DNA and RNA has 2 ends

- a phosphate group remains free at 5′ end of ribose sugar called 5′end
- an -OH group remains free at 3′ end of ribose called 3′ end

Double Helix Structure of DNA

James Watson and Francis Crick in 1953 proposed double helix structure model for DNA based on the **X-ray diffraction data by Wilkins and Franklin** and **base pairing rule by Erwin Chargaff**.

Double helix structure

DNA has two polynucleotide chains and are coiled like a helix called double helix.

Sugar-phosphate forms the backbone of this helix.

The bases in two strands are paired -Purines always pair with their corresponding pyrimidines.

Adenine pairs with Thymine through two hydrogen bonds.

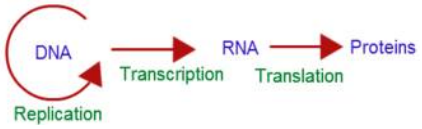
Guanine pairs with Cytosine through three hydrogen bonds.

The double helix is right-handed. The pitch of the helix is 3.4 nm.

The two chains have anti-parallel polarity i.e. one chain has the polarity 5′→3′ and the other has 3′→5′.

THE CENTRAL DOGMA

The flow of information from DNA to protein through RNA is known as central dogma. Central dogma in molecular biology is proposed by **Francis Crick.**



Structure of Nucleosome

The basic repeating units in the structure of chromatin is called nucleosome.

A typical nucleosome contain 200 base pairs of DNA helix.

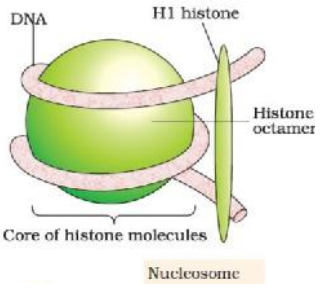
Each nucleosome contain histone proteins and DNA strand.

Histones are organised to form a unit of eight molecule called histone octamer.

The negatively charged DNA wrap around the histone octamer.

The histone protein namely H1 histone bind externally to the wrapped DNA.

The nucleosome in chromatin has a bead-on-string like structure .



Euchromatin – Loosely packed and less stained region of chromatin is called euchromatin.

Heterochromatin – More densely packed and dark stained region of chromatin is called heterochromatin.

Search for Genetic Material-Transforming Principle.

Frederick Griffith's experiments with the bacteria ***Streptococcus pneumoniae (Pneumococcus)***.

This bacterium has two strains

S strain (smooth strain/Virulent) : Has mucopolysaccharide coat that cause Pneumonia.

R strain (rough strain/Non-virulent) : Mucous coat absent and did not cause Pneumonia.

Steps in Griffith's experiment

S-strain → Inject into mouse → Mouse dies of pneumonia.

R-strain → Inject into mouse → Mouse lives

Heat killed S-strain → Inject into mouse → Mouse lives

Heat killed S-strain + Live R-strain → Inject into mouse → Mouse dies

Griffith's postulated that some **'transforming principle'** transferred from the heat- killed S-strain to R-strain and make them virulent.

Oswald Avery, Colin MacLeod and Maclyn McCarty experimentally proved that transforming principle is DNA.

Hershey-Chase Experiment

Hershey and Chase worked on bacteriophages. They produce two colonies of bacteriophages.

First colony grown in a medium containing radioactive sulphur (^{35}S) their protein capsid labelled with ^{35}S.

Second colony grown in a medium containing radioactive Phosphorous (^{32}P) their DNA labelled with ^{32}P.

These radioactive phages were used to infect E. coli.

After the infection E.coli was blended and centrifuged to remove viral particles.

It was observed that bacteria with radioactive DNA were infected by phage with radioactive (labelled with ^{32}P) DNA, while those with non-radioactivity were infected by phage with radioactive (labelled with ^{35}S) protein capsid .

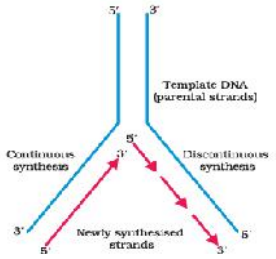
This showed that it is the DNA that enters the bacteria from viruses and not proteins. This proves that DNA is the genetic material.

DNA replication Machinery and the enzymes

Synthesis of new DNA from the parental DNA is called replication.

Since the newly synthesised DNA have one parental and one newly synthesised DNA, this type of replication is called **semiconservative DNA replication.**

Semiconservative DNA replication.



DNA dependent DNA polymerase :-

The main enzyme involved in semiconservative DNA replication.

The enzyme that catalyse the polymerisation of deoxyribonucleotides.

It catalyse the polymerisation of DNA in 5' – 3' direction only.

Replication fork

Small regions of parent DNA from where the replication start is called replication fork.

Continuous Synthesis

The template or parental DNA strand with polarity 3' – 5' undergo continuous synthesis.

In this strand new strand is produced towards the replication fork in 5' - 3' direction.

Discontinuous Synthesis

The template or parental DNA strand with polarity 5' – 3' undergo discontinuous synthesis.

In this strand new strand is produced away from the replication fork in 5' - 3' direction.

New DNA strands are formed as short pieces in discontinuous synthesis.

DNA Ligases

The short piece of DNA produced through discontinuous synthesis are joined by DNA ligases.

Origin of Replication

The region of the DNA in bacterial cell where replication start is called origin of replication.

TRANSCRIPTIONAL UNIT

The part of DNA that undergo transcription (Process of formation of RNA) is called transcriptional unit.

A transcriptional unit has primarily three regions:

1. A Promoter

Promoter is located upstream (towards 5' end of coding strand) of the structural gene.

It has specific DNA sequence that provide binding site for RNA polymerase.

The promoter region determine the coding and template strand of structural gene.

2. The Structural gene

Part of the DNA that is actually transcribed is known as structural gene.

It has a **template strand** (Strand with polarity 3' – 5') and a **coding strand** (Strand with polarity 5' – 3').

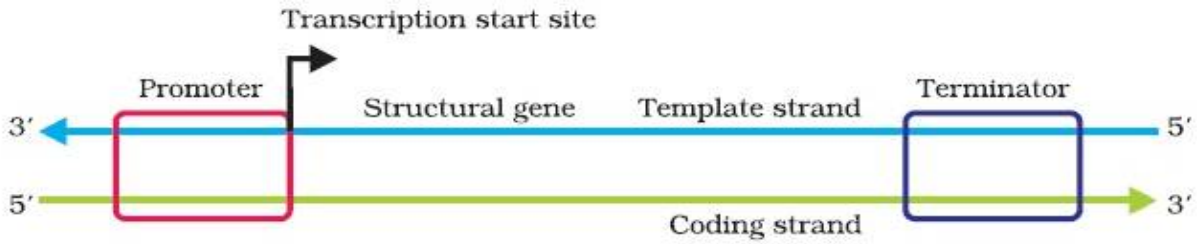
DNA dependent RNA polymerase enzyme produce RNA from the template stand.

✵ **Newly produced RNA has same polarity and nucleotide present on coding strand except nitrogen base thymine is replaced by uracil.**

3. A Terminator

Terminator is located downstream (towards 3' end of coding strand) of the structural gene.

Transcription stops at the terminator part.



Split gene

Interrupted coding sequences in the monocistron of eukaryotes is called split gene.

It has two sequences,

Exon – The coding sequences or Expressed Sequences that are present in a matured and processed mRNA.

Intron – intervening non coding sequences that do not appear in a mature and processed mRNA.

Genetic code

- sequence of nucleotides in mRNA that codes amino acids during translation.

✵ **Salient features of genetic code:**

- **Codon is a triplet** (3 nucleotide combination).
- **Codons are unambiguous and specific** - One codon codes for a single specific amino acid.
- **Codons are degenerate** - some amino acids are coded by more than one codon.
- **Genetic code is universal**. 1 codon codes for same amino acid in all species.
- **AUG has dual functions** − Codes for Methionine (met) and it also acts as a **start / initiator codon**.
- Codons are continuous(no punctuations, non-overlapping & comma less).
- Out of 64 codons 61 codons code for amino acids, while 3 codons do not code for any amino acid. They are **stop codons(UAA,UAG & UGA).**

Human Genome Project (HGP)

HGP is a megaproject aim to elucidate the DNA sequence and to identify the all the genes in human genome.

The commonly used vectors in human DNA sequencing are BAC and YAC

BAC – Bacterial Artificial Chromosome

YAC – Yeast Artificial Chromosome

The Lac Operon

The **regulation of a polycistronic gene** in prokaryotes **at transcriptional level** is reffered as **Operon model**.

According to **Operon model the structural genes** involved in a metabolism is **controlled by a common promoter and regulator gene.**

The expression of polycistronic genes involved in **lactose metabolism is called Lac operon**.

The Lac operon was proposed by **Francois Jacob and Jacque Monad.**

The Genes involved in *Lac* Operon and their functions are,

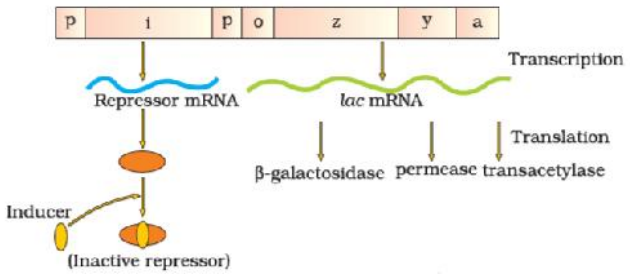
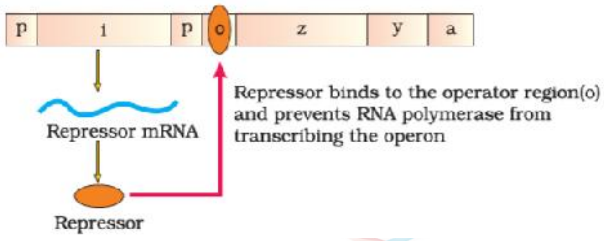
Type of Gene	Name of genes	Enzyme /Product	Function
Regulator Gene	i- gene ('i' refers to inhibitor)	Repressor protein	Active repressor can bind to o-gene
Promoter Gene	p- gene		RNA polymerase bind and start transcription
Operator gene	o-gene		
Structural Genes	Lac- z	β – galactosidase	Hydrolysis of lactose (Disaccharide) Lactose ⟶ galactose + glucose
	Lac- y	Permease	Increases the cell membrane permeability
	Lac - a	transacetylase	

Inducer

The molecule that regulate the switching on and off the operon is called inducer.

In *Lac* operon the inducer is lactose or allolactose.

Regulation of *Lac* Operon

In the presence of Inducer (Lactose/Allolactose)	In the absence of Inducer (Lactose/Allolactose)
	
Lactose bind to repressor protein and make it inactive Inactive repressor cannot bind operator gene. Structural genes undergo transcription.	Repressor protein is active. Active repressor bind to operator gene. Structural genes doesn't undergo transcription.

DNA Fingerprinting - This technique was initially developed by Alec Jeffreys.

Steps in DNA fingerprinting

Isolation of DNA

Digestion of DNA by restriction endonuclease enzyme

Separation of DNA fragments by electrophoresis

Blotting of separated DNA fragment into synthetic nylon or nitrocellulose membrane.

Hybridisation using labelled VNTR (Variable Number of Tandem Repeats) probe.

Detection of hybridised DNA fragment by autoradiography.

Applications of DNA Fingerprinting

- Used as forensic tool to solve paternity, rape, murder cases etc.
- For the diagnosis of genetic diseases.
- It can be used for studying population and genetic diversities.
- In studying evolution and speciation.

Chapter - 7

EVOLUTION

ORIGIN OF LIFE

Theory of a biotic origin / Terrestrial origin.

This theory states that life originates by a series of chemical reactions on the earth.

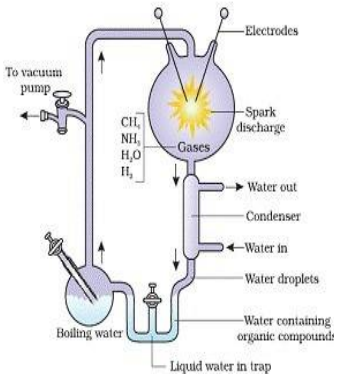
Oparin-Haldane concept.

A. I. Oparin and J.B.S Haldane explain that first living things originated from nonliving things.

That is abiogenesis first but biogenesis ever since.

So this theory is also known as primary biogenesis.

UREY AND MILLER EXPERIMENT



Oparin and Haldane theory of chemical evolution was experimentally proved by **Harold C Urey and Stanley Miller in 1953.**

In their experiment they created a condition similar to the primitive earth.

In their apparatus they circulated a mixture of H_2O (g), CH_4, NH_3, H_2, etc.

The high electric discharge was applied in order to produce lighting.

The mixture was then cooled and analyzed the chemical composition in the precipitate.

The mixture contains the macromolecules like amino acids, fatty acids, urea etc.

EVIDENCES OF EVOLUTION

HOMOLOGOUS ORGAN (Organs with similar structure but different function)

Organs that has similar structure but having different function.

Homology indicates common ancestry.

Homologous organ represents the divergent evolution.

Eg:- In plants – **Tendril in Cucurbits & Thorn in Bougainvillea**

(Both are modified axillary bud)

In animals – **Fore limbs of bats, human, cheetah and whales, Brain of vertebrates & Hearts of vertebrates**.

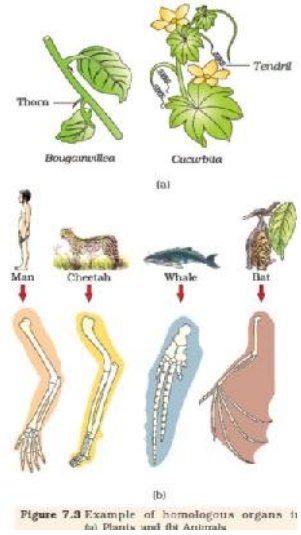


Figure 7.3 Example of homologous organs (a) Plants and (b) Animals

ANALOGOUS ORGANS. (Organs with different structure but same function)

The organs that are having similar function but differ in structure and origins are called analogous organs. The analogous organs are the results of convergent evolution.

Eg:- **1. Eyes of mammals and octopus** **2. Flipper of penguins and dolphin**

3. Wings of birds and insects **4. Tuber of potato and sweet potato**

INDUSTRIAL MELANISM

The diversity of moths in England before and after industrialisation is an **evidence for evolution by natural selection.**

In the early part of the 19th century England had two types of moths one of them was **white-winged** and the other was **dark-winged or melanised.**

Moth diversity in 1850 (Before Industrialisation)

The white-winged moth was abundant before the industrial revolution.

The dark-winged or melanised moth were very rare.

Before industrial revolution, the environment was free of pollution.

The white-winged moth rest on the tree trunk with lichens.

White-winged moth can camouflage with the lichen and escape from the predators.

Moth diversity in 1920 (After Industrialisation)

The white-winged moth can be easily identified by the predators because of the lack of lichens.

During the same period there evolved a new moth variety with dark-winged or melanised body colour.

The dark-winged or melanised moths are escaped from the enemy by camouflaging the black surface produced by the industrial revolution.

The same situation reversed after the replacement of coal by electricity.

HARDY WEINBERG EQUILIBRIUM

The law was proposed by **G. H. Hardy and W. Weinberg.**

The genetic equilibrium of the randomly mating large population is called Hardy - Weinberg Equilibrium.

The law states that, **in a randomly mating large population, the allele frequency of various kinds of genes remains constant generation after generation.**

The gene pool i.e., total genes and their alleles in a population remains constant.

Sum total of all the allelic frequency is 1

Explanation

In a population, if the frequency of the allelic form of gene 'A' is represented by 'p' and allelic form 'a' is represented by 'q' then

The sum total of the allelic frequency is **p+q =1**

In a randomly mating population, the frequency of alleles in the F_2 individual will follow the binomial equation, **i. e., $(p+q)^2 = p^2 + 2pq + q^2$**

p^2 represent frequency of homozygous dominant alleles, 2pq represent frequency of heterozygous alleles and q^2 represent frequency of recessive alleles.

Factors affecting gene frequency - Change in frequency of allele in a population is due to evolutionary changes.

Gene flow or gene migration, genetic drift, mutation, genetic recombination and natural selection are the factors affecting Hardy-Weinberg equilibrium or gene frequency.

Origin and evolution of man

NAME	CHARACTERS
Dryopithecus	• **More ape-like.**
Ramapithecus	• **More man-like.**
Australopithecines	• **Hunted with stone weapons.** • **They ate fruits.**
Homo habilis	• **First hominid (human like).** • **Did not ate meat.**
Homo erectus	• **Fossils discovered in Jawa.** • **They probably ate meat.**
Neanderthal man	• **Lived near east and central Asia.** • **Used hides to protect their body.** • **Buried their dead.**
Homo sapiens	• **They arose in Africa.** • **Pre-historic cave art developed.** • **Human settlement & agriculture started**

Chapter - 8

HUMAN HEALTH AND DISEASE

Common Human Diseases

Human health is defined as the state of complete physical, mental and social well-being of man.

TYPHOID

Caused by the bacterial pathogen ***Salmonella typhi***

Pathogen enter the small intestine through contaminated food and water.

From the intestine pathogen migrate to other organs through blood.

Symptoms

Sustained high fever, weakness, stomach pain, constipation, headache and loss of appetite.

Intestinal perforation and death may occur in severe cases.

Widal Test – Typhoid fever could be confirmed by widal test.

MALARIA

Caused by the protozoan pathogen different species of ***Plasmodium.***

Different species are ***Plasmodium vivax, Plasmodium malaria & Plasmodium falciparum***.

Plasmodium falciparum causes malignant malaria that may even lead to death.

Life cycle of Plasmodium

Plasmodium is **digenetic parasite** ie., it require two host to complete life cycle.

Female Anopheles mosquito is the vector for transmitting the pathogen.

The spindle shaped sporozoites are the infectious stage of plasmodium on human body.

When the female mosquito bites it transmit the sporozoites into the human blood.

The parasite initially multiply within the liver cells and later attack the blood cells.

Haemozoin :- The parasite infected RBC rupture and releases the toxin called haemozoin.

Release of haemozoin is responsible for the chill and high fever.

When mosquito bits an infected person the parasite enter the mosquito body.

The parasite multiply within the mosquito to form sporozoites, that are stored in the salivary gland.

IMMUNITY

Immunity is the innate ability of the body to resist diseases.

Human immunity is classified into two types

1. Innate Immunity or Nonspecific Immunity

The innate immunity is inborn or that is present at the time of birth.

The innate immunity has following barriers to act

Physical Barriers – It includes the anatomical barriers like skin and mucous coating of the gastro intestinal tract, genital tract and respiratory tract.

Physiological Barrier – It include body temperature, PH, secretions with lytic enzyme like lysozymes.

Cellular Barriers – Certain phagocytic cells in our body can act against the invading pathogen.

Eg: - **Polymorpho-nuclear leucocytes (PMNL-neutrophils), Monocytes and natural killer type lymphocytes in blood and macrophages in tissue are phagocytic.**

Cytokine Barriers – Virus infected cells secrete protein called interferons which protect the non-infected cells.

2. ACQUIRED IMMUNITY (Pathogen Specific Immunity)

Acquired immunity is specific to pathogen.

This immunity is characterized by memory.

This type of immunity act when a pathogen enter inside the body.

Acquired immunity response have two stage of response,

Primary Response – Low intensity response during first encounter by pathogen.

Secondary Response or Anamnestic Response – Highly intensified response with memory during subsequent encounter by pathogen.

Acquired immune response are produced by two special types of lymphocytes in blood.

B- Lymphocytes – These cells produce proteins called antibody to act against pathogen.

T- Lymphocytes – These cells help B- lymphocytes to produce antibodies.

There are two types of acquired immunity,

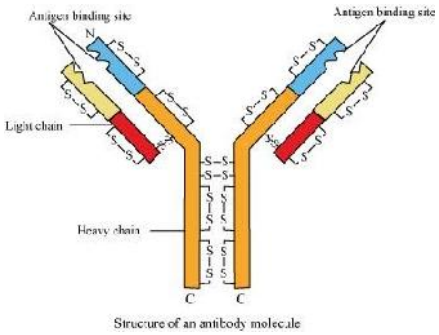
1. HUMORAL IMMUNITY

The immunity mediated by antibody is called humoral immunity.

2. CELL-MEDIATED IMMUNITY

In cell mediated immunity T-lymphocytes are involved.

Cell mediated immunity is also responsible for the graft rejection.



Structure of an antibody molecule

ANTIBODY MOLECULES

An antibody consists of 4 polypeptide chains,

Two small light chains (L_2) and Two longer heavy chains (H_2).

An antibody is represented by H_2L_2.

There are four types of antibodies namely IgA, IgM, IgE and IgG.

AIDS (Acquired Immuno Deficiency Syndrome)

Caused by Human Immuno deficiency Virus (HIV), a retrovirus having RNA Genome.

Mode of Transmission

Sexual contact with infected person.

Through transfusion of infected blood.

By sharing needles as in case of intravenous drug use.

Reusing syringes contaminated with HIV.

Infected mother to her child through placenta.

Persons with multiple sexual partner & drug addicts are more prone to this disease.

Diagnosis :- ELISA Test . ELISA -Enzyme Linked Immuno-Sorbent Assay.

Stages in the infection of HIV

HIV enters body and infect into Macrophages

RNA genome replicates to form viral DNA by **Reverse transcriptase**.

Viral DNA incorporates into host cell's DNA.

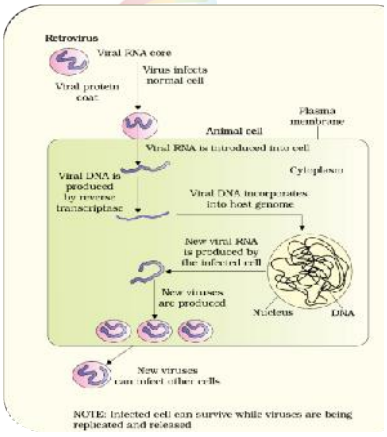
Infected cells produce more and more viral particles.

Enters Helper T Lymphocytes (TH).

Replicates and produce progeny virus.

Attack other T cells so that T cells count decreases.

Immunity weakens.



Prevention of AIDS

- Promoting widespread awareness about HIV and AIDS education through NACO **NACO– National Aids Control Organisation.**
- Use disposable syringe and needles.
- Proper monitoring of blood before blood transfusion.
- Condomise, which means using male or female condoms consistently and correctly.
- Control drug abuse.
- Avoid intercourse with unknown partner.

CANCER

Cancer is dreaded disease in which there is the uncontrolled proliferate division of the body's cells causing the formation of undifferentiated tissue called tumor.

Cancerous cells doesn't show the property of contact inhibition

Contact Inhibition - The growth of the cells stop when they contact with other cells there by inhibit the uncontrolled growth.

Types of Tumor

Benign Tumors

The cancer, which are localized to a particular tissue, are called benign tumor.

They are non-invasive and cause little damage.

Malignant Tumors

Malignant tumors consist of mass of proliferative cells.

The cells can invade to other tissues.

Malignant tumor cells show **metastasis (Cells separate and move to distant site through blood).**

Treatment of Cancer

Surgery :- It is the surgical removal of tumor from the body.

Radiation Therapy :- In radiotherapy, tumor cells are destroyed on exposure to radiations.

Chemotherapy :- The treatment of cancer with anti-cancer drug is called chemotherapy.

Immunotherapy :- In this method using α**–interferon** the immune system is activated to act against the cancerous cells.

EFFECT OF DRUG / ALCOHOL ABUSE

Depending on the actual compound, drug misuse including alcohol may lead to health problems, social problems, injuries, unprotected sex, violence, deaths, motor vehicle accidents, homicides, suicides, mortality, physical dependence or psychological addiction.

- Causes heart failure and hypertension.
- Use of alcohol causes stomach ulcer and pancreatitis.
- Causes lack of interest in personal hygiene, isolation, depression, aggressiveness etc.
- Causes deteriorating relationship with family and friends change in eating and sleeping habit etc.
- The excess usage of alcohol causes liver cirrhosis and damage to nervous system.
- Use of drugs and alcohol during pregnancy adversely affect the foetus.
- Drug users are prone to blood related diseases like AIDS, hepatitis B etc.
- Drug and alcohol users finally may turn to criminals.

Side effects of anabolic steroids in Female.

- Causes masculinization (Features like male).
- Causes increased aggressiveness, mood swing and depression.
- It results in abnormal menstrual cycle, excessive hair growth on face and body.
- Cause enlargement of clitoris and deepening of voice.

Side effects of anabolic steroids in Male.

- Causes increased aggressiveness, mood swing and depression.
- Causes reduction in size of the testicles and decreased sperm production.
- Causes breast enlargement, premature baldness and enlargement of prostate gland.

Chapter - 10

MICROBES IN HUMAN WELFARE

MICROORGANISM & COMMON NAME	GROUP	PRODUCT	USES
MICROBES IN HOUSEHOLD PRODUCTS			
Lactobacillus **LAB - Lactic acid bacteria**	Bacteria		• **Help in formation of curd** • **Produce Vitamin B_{12} in curd** • **Partially digest milk protein** • **Check the growth of disease causing microbes in stomach.**
Saccharomyces cerevisiae **Baker's yeast**	Fungi		• **Used in the fermentation of dough**
Propionibacterium sharmanii	Bacteria		• **Used in the preparation of Swiss cheese**
CHEMICALS, ENZYMES AND BIOACTIVE COMPOUNDS			
Aspergillus niger	Fungi	**Citric acid**	
Acetobacter aceti	Bacteria	**Acetic acid**	
Clostridium butylicum	Bacteria	**Butyric acid**	
Lactobacillus	Bacteria	**Lactic acid**	
Saccharomyces cerevisiae	Fungi	**Ethanol**	
Streptococcus	Bacteria	**Streptokinase**	• **Used as clot buster (Removing the clot)**
Trichoderma polysporum	Fungi	**Cyclosporin A**	• **Used as Immunosuppressive agent**
Monascus purpureus	Fungi	**Statins**	• **Blood cholesterol lowering agents.**

MICROORGANISM & COMMON NAME	GROUP	PRODUCT	USES
MICROBES AS BIOCONTROL AGENTS			
Bacillus thuringiensis	Bacteria		• **Used as a biocontrol agent against pests** • **Used to control butterfly caterpillars**
Trichoderma	Fungi		• **Free living fungi in the root environment.** • **Used as a biocontrol agent against plant pathogens**
Baculoviruses (Mostly belong to genus ***Nucleopolyhedrovirus***)	Virus		• **Used as a biocontrol agent against insect pests and other arthropods**

Biocontrol

It refers to the use of biological methods for controlling plant pathogens and pests.

Advantages of biocontrol

Biocontrol method reduce the use of toxic insecticides and pesticides.

It reduce environmental pollution.

Chapter - 15

BIODIVERSITY AND CONSERVATION

Sum total of diversity that exists at all levels of biological organization is called biodiversity.
The term biodiversity was popularized by the sociobiologist Edward Wilson.

SPECIES-AREA RELATIONSHIP

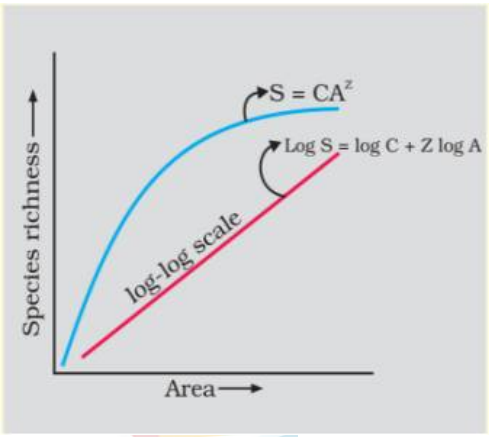
Alexander von Humboldt, a German naturalist based on his studies explain that within a region species richness increases with increasing explored area but only up to a limit.

The relationship shows a rectangular hyperbola

$$S = CA^Z$$

It is linear on a logarithmic scale described by the equation

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



Where,

S = Species richness, A = Area

Z = slope of the line (regression coefficient)

C = Y- intercept.

Z value has a great significance in order to find a species area relationship.

- The value of **Z lies in the range between 0.1 and 0.2** regardless of the taxonomic group or region.
- In **larger areas like the entire continents, the Z value is** much steeper and the value ranges between **0.6 and 1.2**.
- For **frugivorous birds and mammals In the tropical forest** the **Z value is 1.15**.

IMPORTANCE OF BIODIVERSITY TO ECOSYSTEM

According to **David Tilman "Increased species diversity contributed to higher productivity".**
Species richness and diversity increases stability of ecosystem

RIVET POPPER HYPOTHESIS

The hypothesis was proposed by Stanford ecologist **Paul Ehrlich.**
This hypothesis explain the importance of species richness in an ecosystem.
He compared the species in an ecosystem with the rivets in an airplane.
In an airplane (ecosystem) all parts are joined together by thousands of rivets (species).
If passengers remove more and more rivet (species) from airplane (Ecosystem) it may affect the flight safety (proper functioning of the ecosystem).
If key species (Rivet from the wings) are removed more serious damage to ecosystem (threat to flight).

LOSS OF BIODIVERSITY

The IUCN Red List (2004) documents the extinction of 784 species in the last 500 years.
Recent extinctions are,

1. **Steller's Sea Cow (Russia)**
2. **Dodo (Mauritius)**
3. **Quagga (Africa)**
4. **Thylacine (Australia)**
5. **Bali, Javan and Caspian subspecies of Tigers**

CAUSES OF BIODIVERSITY LOSS

THE EVIL QUARTET :-

The four major reasons for the accelerated rates for species extinction is called "evil quartet".
They are,

1. HABITAT LOSS AND FRAGMENTATION.

This is an important reason for biodiversity loss.

It is **due to land encroachment, cutting down trees, filling of wetlands, burning of forest** etc.

These factors change the natural habitat thereby destructing the biodiversity.

2. OVER-EXPLOITATION.

Overexploitation of natural resources has serious effects on biodiversity.

Besides reducing the number of species, it also diminishes diversity within the genetic pool.

Overexploitation is due to human attitude of need turns to greed.

Eg :- **Extinction of Steller's sea cow & Passenger pigeon.**

3. ALIEN SPECIES INVASION.

New species introducing into a geographical region is called exotic species or alien species.

Introduction of exotic species into new habitat by man adversely affect the native species.

Eg :- **Nile Perch introduced into Lake Victoria in East Africa lead to extinction of Cichlid fish in the lake.**

Introduction exotic fishes like African Cat fish (*Clarias gariepinus*) causes threat to indigenous catfishes in our rivers.

Invasive weeds like Lantana, Carrot grass (*Parthenium*) & Water hyacinth (*Eicchornia*) causes environmental damage and threat to native species.

4. CO-EXTINCTIONS.

When a species become extinct the plant and animal associated with it also face the threat of extinction, this is called co-extinction.

It is the loss of one species upon the extinction of another.

Eg:- **Death of host organism lead to death of parasite associated with it.**

Death of Plants and their pollinators.

CONSERVATION OF BIODIVERSITY

***IN SITU* CONSERVATION**	***EX SITU* CONSERVATION**
On-site conservation or Inside the natural habitat	Off-site conservation or Outside the natural habitat
Examples for In situ conservation	**Examples for Ex situ conservation**
1. Biosphere Reserves **2. National Park** **3. Sanctuaries** **4. Sacred Groves etc.**	**1. Botanical Gardens** **2. Zoological Park** **3. Seed bank** **4. Cryopreservation** **5. wild life safari Park** **6. IVF** **7. Tissue Culture**

Biodiversity Hotspots

Regions with very high level of species richness and high degree of endemism are called biodiversity hotspots.

Endemism refer to the species that are confined to a particular region and are not found anywhere else.

Western Ghats and Sri Lanka, **Indo-Burma** and **Himalaya** are the three hotspot area covering our country's biodiversity regions.

The EARTH SUMMIT

The Convention on Biological Diversity (The Earth Summit) was held in Rio de Janeiro in 1992.

It demands all nations to take appropriate measures for conservation of biodiversity and sustainable utilization.