BIOLOGY

SUPPORT MATERIAL

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CLASS XII

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CONTENTS

Chapter – 1: - REPRODUCTION IN ORGANISMS

- **REPRODUCTION IN ORGANISMS**
- **Life Span**
- Period from birth till natural death.

Every organism live only for a certain period of time.

- Reproduction –Producing young-ones of their kind, generation after generation.
- **Types of reproduction**:
- **Asexual reproduction** :single parent capable of producing offspring.
- **Sexual reproduction :** two parents are invovled in producing offspring.

Modes of asexual reproduction

- **Binary fission**: parent body divides into two halves, genetically identical to parent.

Amoeba: It is simple or irregular. Paramoecium: Transverse binary fission.

- **Multiple fission**: parent body divides into many daughter organisms : Plasmodium.
- **Budding**: daughter organisms grow from small buds arising in parent body.

Exogenous budding: out side the body eg. Hydra, Yeast.

Budding in Yeast Endogenous budding : inside the body eg. Gemmule in sponge.

- **Conidia:** non-motile, exogenous spores in chains eg. Fungi.
- **Zoospore**s: microscopic motile structures eg. Algae. **In plants** : term vegetative reproduction frequently used instead of asexual reproduction, units of vegetative propagation called **vegetative propagules**.
- All organisms show remarkable similarity. Vast difference in their reproductive structure. Similar pattern or phases in their life cycles.
- **Juvenile phase:** The phase of growth before reproductive maturity.
- **Reproductive phase:** Reproductive maturity.
- **Senescent phase:** Phase between reproductive maturity and death.

➢ **The main events of sexual cycle are:**

i. Prefertilisation events:

a.Gametogenesis :

- The process of formation of male and female gametes by meiosis (cell-division).

❖ Homogamete(Isogamete): - gametes similar eg. Algae

❖ Heterogamete(an-isogamete): - morphologically dissimilar gamete ,male gamete (antherozoid or sperm) ,female gamete (egg or ovum) eg. Human.

❖ **Sexuality in organisms** : **In plants Bisexual term is used for Homothallic and Monoecious plants**
Both male and female reproductive structures in same plant eg. Higher plants, cucurbits and coconut.

❖ **Unisexual term used for Heterothallic and Dioecious plants**
Male and female reproductive-structure on different plants.
Flowering plants – male flower–**staminate flower** and female flower–**pistillate flower** eg. papaya and date-palm.

- **Animals** – **Bisexual term is used for Hermaphrodite animals-**eg. Earth-worm, Tape-worm, Leech, Sponge.
- **Unisexual animals have male & female sexes in separate individuals**-e.g. insects, frogs, human beings

Cell division during gamete formation:

Haploid-parent (n) produces haploid gametes (n) by mitotic division, eg. Monera,fungi, algae and bryophytes.
Diploid parent (2n) produces haploid gametes(n) by meiosis division (possess only one set of chromosomes)and such **specialized parent cell is** called **meiocyte or gamete mother cell.**

- Example-

Name of organism	Meiocyte(2n)	gamete (n)
Human	46	23
Housefly	12	6
Ophioglossum (fern)	1260	630
Potato	48	24

b) Gamete transfer:- to facilitate fusion.

- ❖ Male gametes mostly motile and female non-motile, exception few fungi and in algae both gametes are motile in some cases
- ❖ Water medium for gamete transfer- in lower plants. Large number of male gametes produced to compensate loss
- ❖ Higher plants, pollen-grains are transferred by pollination.
- ❖ **Fertilization**: Fusion of male and female gametes diploid zygote.
- ❖ **Parthenogenesis.-**development into new organism without fertilisation eg**.** Rotifers, honey-bees, some lizard, bird(turkey).

Fertilization

Two types- external and internal .

- **External fertilisation-** outside the body of organism in external- medium (water) eg. majority of algae, fishes, amphibians**.**
- **Advantage-** show great synchrony between the sexes **–**
  1. Release of large number of gametes into surrounding medium
  2. Large number of offsprings produced.
- **Disadvantage**- offspring vulnerable to predators, natural disasters.
- **Internal fertilisation**- fusion occurs inside female body eg. majority of plants and animals. Egg non-motile and formed inside female body. Male gamete motile, produced in large numbers to reach egg and fuse with it. In seed plants, non- motile male gamete carried to female gamete by pollen-tube.

Post -fertilisation events- formation of zygote.

a. **Zygote**. One celled , diploid, vital link between two generations.

- **External fertilization** –zygote formed in external medium water eg. Frog,
- **Internal fertilization** –zygote formed inside the body eg. Human beings. Development of zygote depends on type of **life cycle and environment**. Some develop thick wall (prevent damage and desiccation) & undergo period of rest eg. Algae, fungi.
- **Haplontic life cycle**- zygote (2n) divides by meiosis to form haploid (n) spores.
- **Diplontic life-cycle**- zygote (2n) divides mitotically, develops into embryo (2n).
- **Oviparous animals** lay eggs out-side the female body. Eggs can be fertilized/ unfertilized. Fertilized eggs covered which hard calcareous shell, laid in safe place in the environment. Unfertilised eggs laid in water. Example- fishes, frogs, reptiles, birds
- **Viviparous animals** bear and rear the embryo inside female body, give birth to young-ones. Advantage- proper embryonic care, protection, survival chances of young-ones greater. Example- cows, whales, human beings
- **Embryogenesis**: development of embryo from zygote by cell division (mitosis) and cell differentiation.
- **Cell- division** increases the number of cells in the developing embryo

  Cell differentiation - groups of cells undergo certain modifications for the formation of different kinds of tissues and organs.
- **In flowering plants**- zygote formed inside ovule

❖ Changes occur in flowering plants:

Sepal	Fall off
Petal	Fall off
Stamen	Fall off
Zygote	Embryo
Primary endosperm nucleus	Endosperm (3 N)
Synergid	Disintegrate
Antipodals	Disintegrate
Ovary	Fruit
Ovule	Seed
Ovary wall	Pericarp (epicarp + mesocarp + endocarp)
Integument	Seed coat (testa + tegmen)

- **Parthenogenesis**: Female gamete develops into new organism.
- **Seedless fruits** formed by **parthenogenesis**
- **Clone**: A group of individuals of the same species that are morphologically and genetically similar to each other & their parents

Question & Answer
Very short answer type(1 mark)

1- What is meiocyte?
Ans: Specialized cells in diploid organism, i.e., gamete mother cell which undergo meiosis.

2- Name the kind of reproduction in bees by which drones are produced?
Ans: Parthenogenesis.

3- What is special in flowering bamboo?
Ans: Bamboo species flower only once in their life-times generally after 50-100 years.

4- What is meant by homothallic?
Ans: The term homothallic refers to bisexual or hermaphrodite condition.

5- Why are the date palms referred to as dioecious ?
Ans: In date-palms, the male and female flowers are present in different plants.

6- If the meiocyte of an onion plant contains 32 chromosomes, work out the number of chromosome in the endosperm and embryo?
Ans: Hint: endosperm is triploid.

7- Name two acellular organisms which reproduces sexually.
Ans: Paramoecium, Plasmodium

8- Give the scientific terms for the following
Ans: a. Morphologically and genetically similar individual derived through asexual reproduction. Ans- Clone
b. Cyclical changes shown by seasonal breeders. Ans- Oetrous cycle

Short answer type (2 marks)

9- Name the structure which gets transformed into seeds at maturity.
Ans: ovule

10- Name any one animal in which self-fertilization occurs.
Ans: *Taenia* (tapeworm)

CHAPTER 2 – SEXUAL REPRODUCTION INFLOWERING PLANTS

FLOWERS

- Site of sexual Reproduction.
- Male and female reproductive organs are borne on flowers.

PARTS OF A FLOWER:

Four WHORLS – CALYX (sepals), COROLLA (petals), ANDROECIUM (Male reproductive organ), GYNOECIUM (Female reproductive organs).

Male Reproductive Organ

- Androecium consists of Stamens.
- Stamen consists of anther, filament & connective (when anther is bilobed)
- Anther bilobed has 4 Microsporangia.

Refer fig. 2.1 of NCERT (L.S. OF A FLOWER WITH DIFFERENT PARTS)

MICROSPOROGENESIS:

Microspore mother cell (2n)
↓ Meiosis
Microspore (n)
↓ Mitosis
Pollen grains (n)

Pollen grains have two outer walls; i) Exine ii) Intine

- Exine is made of sporopollenin (HARDEST NATURAL SUBSTANCE)
- Mature pollen grains have two cells - big vegetative cell & small generative cell.
- Generative cell forms two male gametes by mitotic division.
- Pollen grains shed in 2-celled/3celled stage2

GYNOECIUM / CARPEL (THE FEMALE REPRODUUCTIVE ORGAN)

Refer fig 2.7 of text book (Structure of anatropous ovule)

- Each Carpel consists of ovary, style & stigma.
- Ovules are attached to ovary by placenta.
- The funicle – stalk of ovule
- Hilum, a region where funicle is attached
- Integuments - cover embryo sac.
- Micropyle - a pore for entry of pollen tube & to imbibe water

MEGASPOROGENESIS

Megaspore mother cell (2n)
↓ Meiosis
4 Megaspores (n)
(3 megaspores degenerate, 1 remains functional)
↓
Funtional Megaspore (n) (Divides 3 times by mitosis)
↓
8 Nucleated Embryo Sac formed
↓ 3 cells group at micropylar end -the egg cell(n) & 2 synergids(n)
↓ 3 cells at chalazal end called antipodals(n)
↓ 2 polar nuclei at center(n each)

Ref fig 2.7 and 2.8 of text book

POLLINATION– transfer of pollen from anther to stigma. Agents of pollination –air, water, insect. bat, bird, man.

Transfer of pollen to stigma
→ Self pollination (Autogamy)
  → Auto gamy (Same flower)
  → Geitenogamy: Different flowers same plant
→ Cross pollination (Hetrogamy)
  → Xenogamy (different flowers on different plants of the same species)

Double fertilization

- Pollen grains germinate on stigma & pollen tube grows through style.
- Pollen tube reaches micropyle & releases two male gametes into embryo-sac.
- Fertilisation is the process of fusion of male & female gametes (n+n) to form a diploid(2n) zygote.

SYNGAMY: Fusion of one male gamete(n) with egg (n) ⟶ Zygote(2n)Produced
First Fusion ⟶ Fusion of two Polar Nuclei(n+n=2n) ⟶ Second fusion. ⟶
Male Gamete(n) Fuses with the fusion product of the two polar nuclei(3n)
Third Fusion ⟶ fusion of male gamete with egg cell.

- **DOUBLE FERTILIZATION**: i)Fusion of male gamete with egg – First fertilisation,
ii)Fusion of fusion product of polar nuclei with male gamete – Second fertilisation.

Refer fig 2.13 in NCERT

POST FERTILISATION CHANGES:

STAGES OF EMBRYO DEVELOPMENT AFTER FERTILISATION

1. Zygote divides by mitosis into suspensor & embryo cells
2. Suspensor cell forms a globular basal cell which remains embedded in the endosperm & a multicellular suspensor bearing the embryo
3. Globular embryo becomes heart-shaped & then mature embryo with radicle, plumule & Cotyledons

- Primary endosperm nucleus divides repeatedly to form endosperm, food for the embryo.
- Mature ovary becomes fruit.
- Mature ovule becomes seed.
- **True Fruit** develops only from the **ovary**, e.g. mango, tomato
- **False Fruit** develops from parts of the flower **other than the ovary** e.g. apple, peach etc.

Seeds two types: i) Albuminous (with Endosperm)
ii) Non albuminous(without Endosperm)
Special mechanism of **reproduction**:-
I) **Apomixis**- Production of seeds without fertilisation e.g. species of Astereceae and grasses.
ii) **Polyembryony**- Occurrence of more than one embryo in a seed e.g.Orange.

OUTBREEDING DEVICES:

Continued self-pollination result in **breeding depression**. Flowering plants have developed many devices to discourage self-pollination & encourage cross-pollination such as
Bearing unisexual flowers
Anther & stigma mature at different times
Anther & stigma placed at different positions
Self-incompatibility where pollen grains of a flower donot germinate on the stigma of the same flower

ARTIFICIAL HYBRIDISATION:

Types of cross-pollination performed by man for crop improvement. Achieved by
i) Emasculation i.e. removal of anthers from the flower bud of a bisexual flower before the anther dehisces using a pair of forceps and
ii) Bagging i.e. covering the emasculated flowers with a bag of suitable size to protect them from contamination with unwanted pollen
If flower is unisexual, emasculation is not needed. Flower bud bagged & when the stigma becomes receptive, pollination is done using desired pollen & the flower is rebagged

Questions

Short Answer Type Questions (3 marks.)

1. Explain the phenomenon of double fertilization in angiospermic plants.
2. Trace the development of the mature ovule from a megaspore mother cell.
3. Enumerate the steps in artificial hybridisation.
4. Differentiate between monoecious and dioecious plants, with an example for each.
5. How is pollination effected in Vallisneria?

Long Answer Type Questions (5 marks).

1. Represent diagrammatically the formation of an embryo sac from a megaspore mother cell.
2. Draw a well-labelled diagram of the L.S of embryo of grasses. How does it differ from that of bean.

Chapter-3 HUMAN REPRODUCTION

Ref.: Concept map: Page-C1 & C2

The Male reproductive system

1. **Penis**
    a. Urination
    b. Sexual intercourse
        1. Corpus cavernosum- spongy tissue that fills with blood to make penis erect
        2. Glans- the head, end of penis
        3. Foreskin
            i. Covers glans,
            ii. May be removed surgically in an operation (circumcision)

2. Scrotum
    a. Located behind penis
    b. Contains two testes
    c. Temperature sensitive (Sperm must be made in cooler conditions i.e, 2-3° C lower than body temperature)

3. Testes
    a. Sperm is produced by the seminiferous tubules due to FSH
    b. Testosterone is produced by Leydig cells due to LH
        1. Causes the development of the male sex organs at ~8 weeks after conception.
        2. Responsible for facial, armpit, and pubic hair, bone growth and muscular development.
    c. Testes formed in the abdomen before birth. Descend through the "inguinal canal" during fetal or post-natal life. Sometimes it may take months/years to reach right place. Possible site for hernia.

4. Epididymis: Stores sperm until they have matured.

5. Vas deferens: Tube that leads from the epididymis to the urethra. Many sperm cells are stored here too.

6. Prostate gland: Provides an alkaline fluid that can protect sperm from harsh vaginal acids.

7. Seminal Vesicles: Produce food for sperm. Food "Fructose"

8. Cowper's gland: Produces clear lubricating fluid

The Female Reproductive System

Ovary:

i) Each ovary contains immature ova (eggs) in follicles.

ii) Females born with lifetime supply of eggs(250,000-400,000 in each ovary)

iii) Ovaries release ovum -. Almost all ova degenerate between birth and puberty.

iv) Approx. 400 eggs will be ovulated over woman's life.

v) Egg is the largest human cell.

vi) Ovaries are located lower abdomen. 1 left and 1 on the right.

Fallopian tubes

i) Two thin tubes attached to the upper sides of uterus

ii) Tubes terminate near the ovaries but are not attached

iii) "Fimbriae" are finger-like structures on the end of each tube

iv) Tubes conduct egg to uterus by use of small hairs called "cilia"

v) **Fertilization** of ovum takes place in the **ampullary-isthmic junction of the fallopian tubes**. Egg viable for only 24-48 hours after ovulation.

Uterus:

i) **Pear-shaped** organ located in lower abdomen

ii) **Muscles** (myometrium) stretch to allow baby to develop. Oxytocin starts labor contractions.

iii) **Lining of uterus** (endometrium) thickens with blood-rich tissue due to progesterone

iv) **Endometrium** supports embryo/fetus during growth

v) **Placenta** It is the interface between baby and mother. If not pregnant, lining breaks down and is discharged from *body* through vagina. This is **menstruation** (period)

vi)**Cervix connects uterus to vagina**. Like a door that opens during ovulation. Cervical mucous closes the door at all other times.

Vagina:

Birth canal:

i)**Menstrual** blood leaves the body
ii) Organ of intercourse
iii) Muscular stretches to allow a baby to grow

iv)Vaginal opening partly remains closed by thin membrane of tissue called **hymen.** May be stretched or torn during any physical activity

Cervix:

i)Located at inner end of vagina
ii)Opening of uterus into vagina
iii) Mucous prevents bacteria and viruses from entering uterus
iv)Lets sperm into uterus after ovulation
v) Where baby also passes through during vaginal birth

Labia:

2 layers of skin, which fold over the opening to vagina and urethra
ii) Inner labia **(labia minora)**
iii)Outer labia **(labia majora)**
1.Two folds of skin, surround vaginal area
2. Pubic hair grows on outer labia

Clitoris:

i) Small organ, 5 to 10 millimeters long
ii) Located at junction of inner labia near front of body
iii) Contains erectile tissue & sexually sensitive

Mons pubis : Cushion like fatty tissue covered by skin and pubic hair

GAMETOGENESIS & ITS HORMONAL REGULATION :

Ref: Concept Map Page C 3

Differentiate between: **Spermatogenesis and oogenesis :**

Spermatogenesis	Oogenesis
Produces male gametes (sperm)	produces female gametes (oocytes)
–occurs in the seminiferous tubules (in testes)	–occurs in the ovaries
–involves meiosis –occurs throughout life after puberty	– involves meiosis occurs after puberty until menopause
may produce 400,000,000 per day	–humans normally produce one oocyte during each ovarian cycle
Primary spermatocyte divide equally to form two similar secondary spermatocytes	Primary otocyte divide unequally to form one large secondary oocyte and a small polar body
One spermatogonium produces 4 functional spermatozoa	An oogonium produces one functional ovum and 3 non functional polar bodies

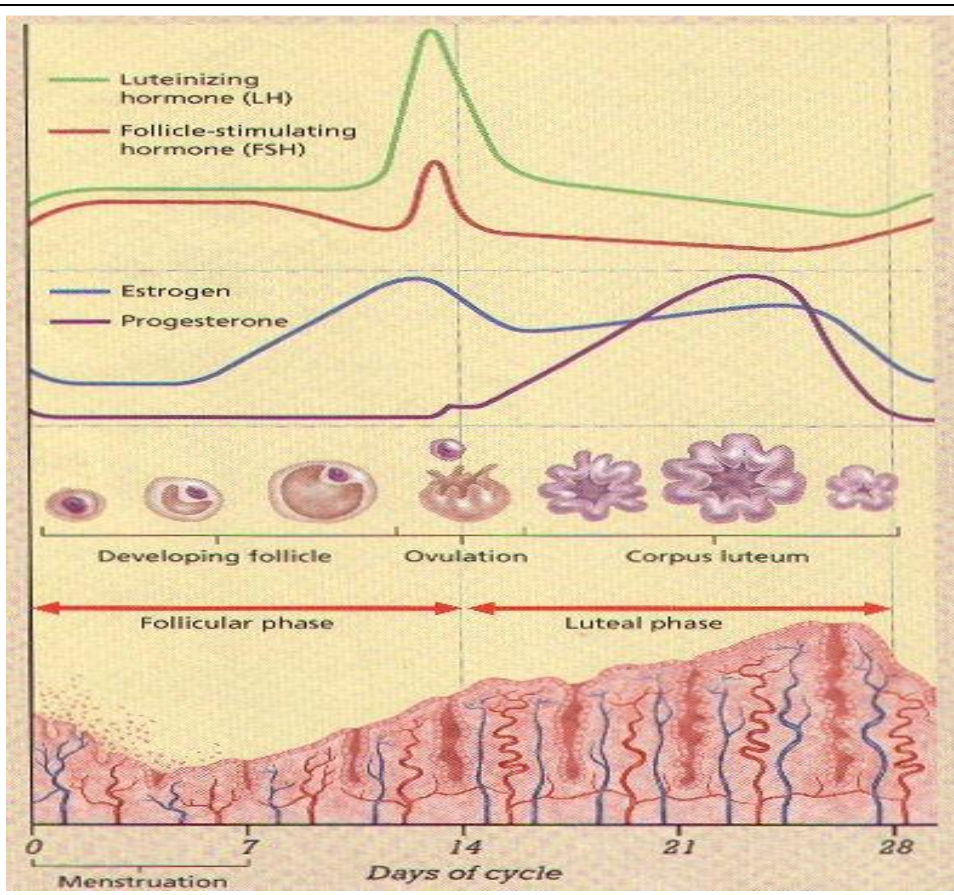
2)Follicular phase (Proliferative phase) and Luteal phase (Secretory Phase)

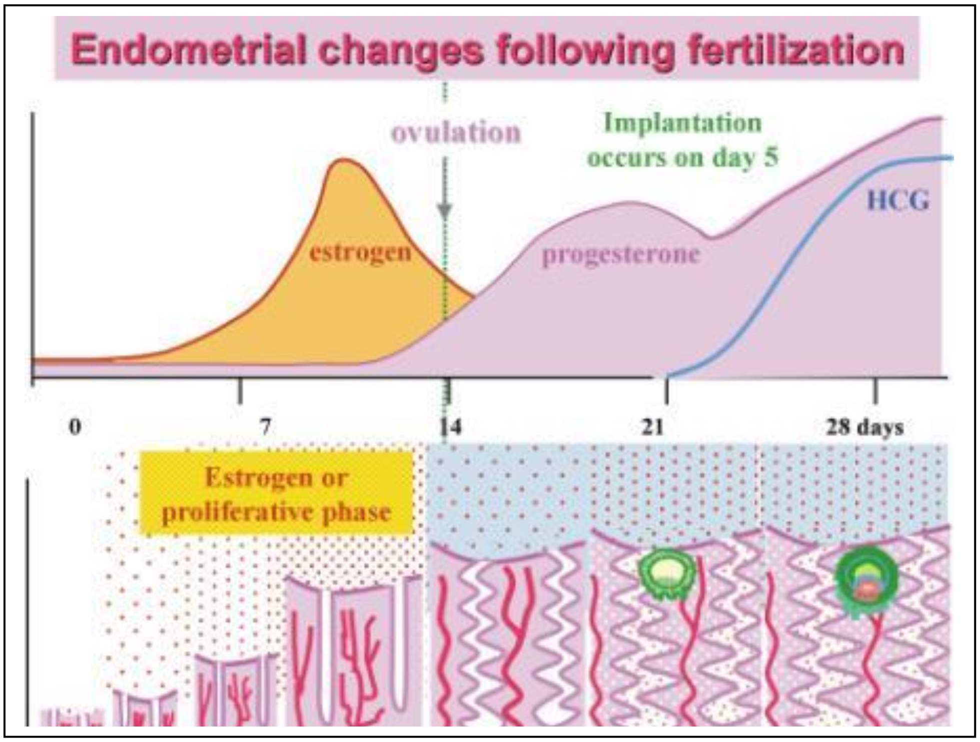
Proliferative phase	Secretory Phase
Follicular phase	***Luteal phase***
Stage of repair and proliferation	Prepares endometrium for implantation
It extends from the end of menstruation to ovulation	It extends after ovulation to menstruation
LH and FSH increases	LH is high (LH surge)
Estrogen level increases	Progesterone level increases
Estrogen is secreted by Graffian follicle	Progesterone secreted by corpus luteum

Menstrual Cycle

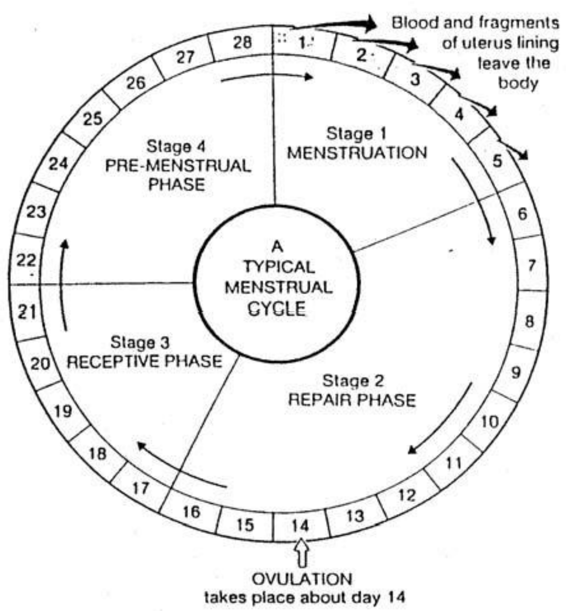
Menstruation→	Repair of the endometrium→	Ovulation→	Thickening of the endometrium→	Breaking down→
Follicular Phase FSH/Estrogen		Due to LH	Luteal Phase LH/Progesterone	

MENSTRUAL CYCLE: **Ref. Concept Map Page C 4**



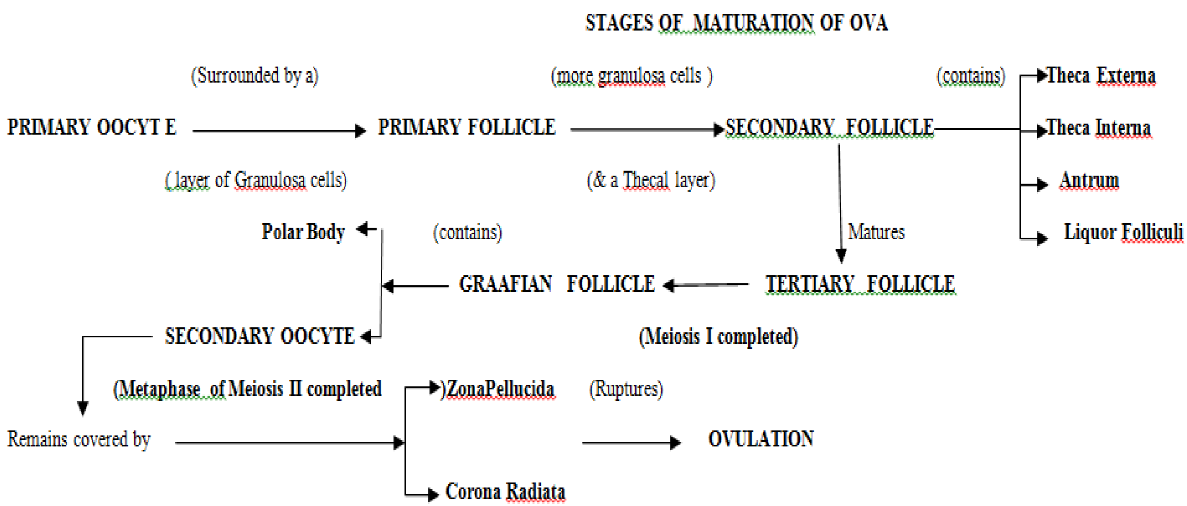


THE MENSTRUAL CYCLE



. **A typical menstrual cycle.** It is usual to regard the first day of the cycle as the day when bleeding begins.

FSH and LH from the pituitary:	FUNCTION / PRODUCTION	
Hormone	**In Females**	**In Males**
FSH Controls →	Eggs + Estrogen	Spermatogenesis
LH Controls →	Ovulation + Corpus Luteum	Testosterone

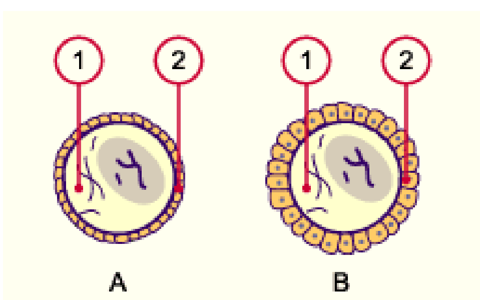


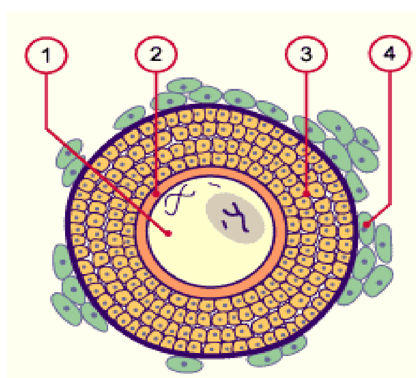
From Primordial Follicle to Tertiary Follicle

Primordial follicle: The surviving primary oocytes, at birth, are surrounded by **thin, single layers cells** of so-called follicular epithelial cells.

Primary follicle

The primordial follicles while developing into primary follicles the follicular epithelium that surrounds the oocyte becomes **iso**- to highly **prismatic**





A Primordial follicle
B Primary follicle
1 Oocyte
2 Follicular epithelium

1 Oocyte
2 Pellucid zone
3 Stratum granulosum
4 Theca folliculi cells

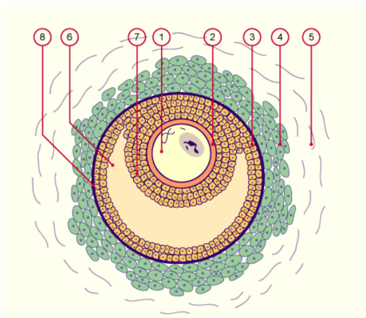
Secondary follicle

Secondary follicles with follicular epitheliums encompassing **multiple rows** are formed called the **stratum granulosum**. **Pellucid zone**, between the oocyte and follicular epithelium becomes visible.

Tertiary follicle

A well-developed net of capillaries in the theca internal.
Antrum – a fluid filled cavity develops
The **theca** layer organized in to Theca internal & Theca external

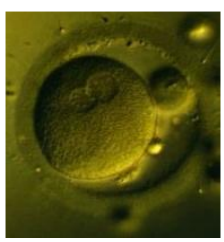
Tertiary follicle

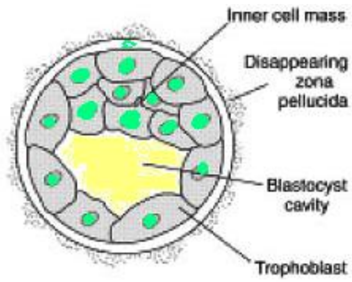


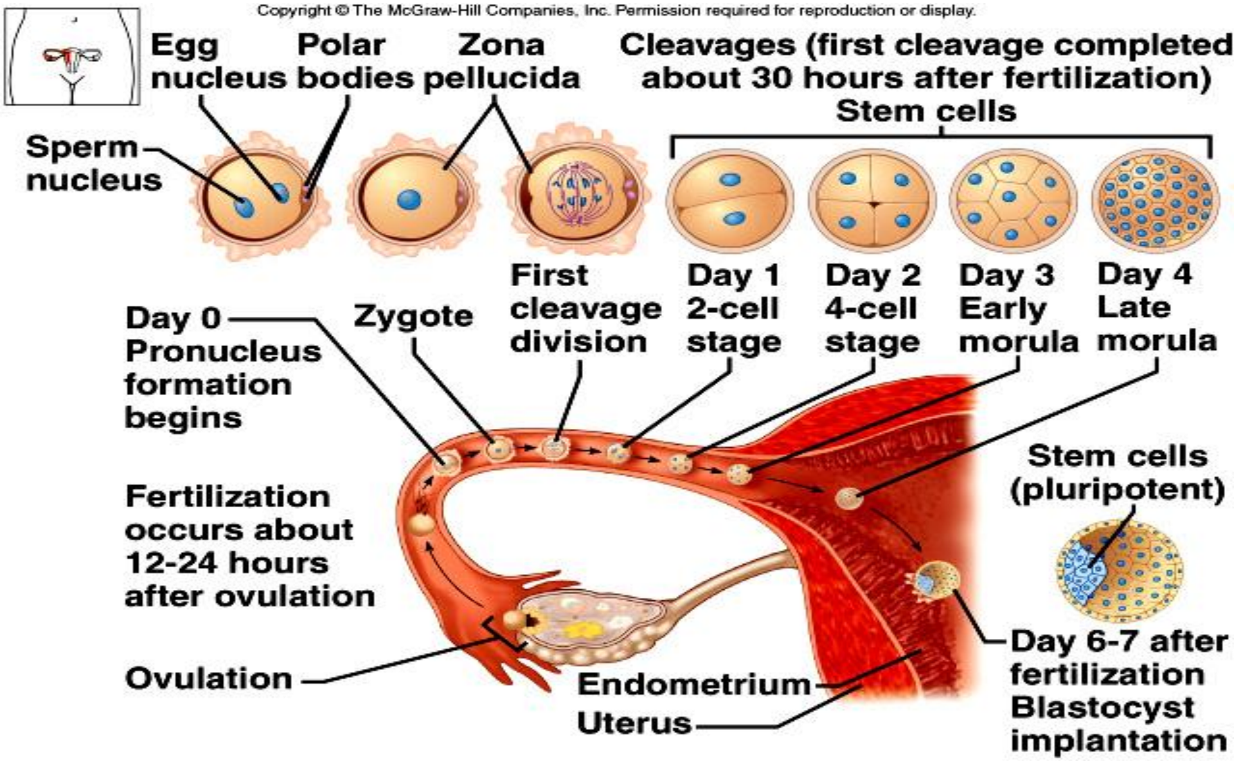
1 Oocyte
2 Pellucid zone
3 Stratum granulosum
4 Theca internal
5 Theca external
6 Antral follicle
7 Cumulus oophorus (Granulosa cells, together with the oocyte)
8 Basal lamina between theca and stratum granulosum

Conception to Birth

The following shows some of the many stages of human development:

Zygote		The single cell that results from fertilization of an ovum by a sperm.
Morula		*The morula (little mulberry)l • Solid ball (16 →64 cells). • Morula arises from mitotic (cleavage) divisions.

Blastocyst		The blastocyst is a liquid-filled ball of cells. Occurs around 5 – 8 days after conception. Implantation in the endometrium occurs at this stage.
Embryo		Human considered an embryo from implantation until about 8 weeks after conception.
Foetus		8 weeks after conception until birth.



Fate of three germ layers

Ectoderm	Mesoderm	Endoderm
Nervous system	Skeleton	Digestive tract
Epidermis of skin	Muscles	Respiratory system
	Circulatory system	Liver, pancreas
	Gonads	Bladder

Mnemonics

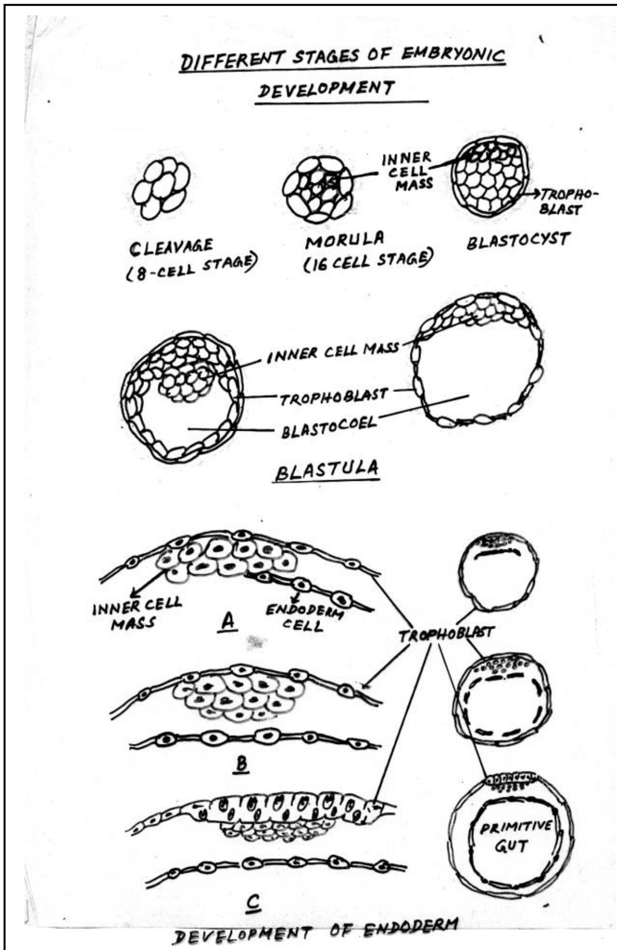
Tubules in male reproductive system
“SEVEN UP”

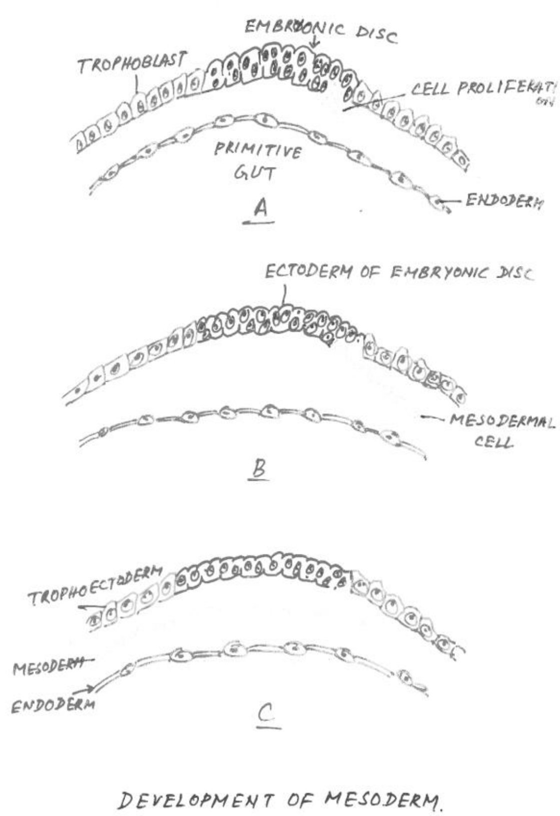
Seminiferous tubules
Epididymis
Vas deferens,
Ejaculatory duct
(Nothing)
Urethra
Penis

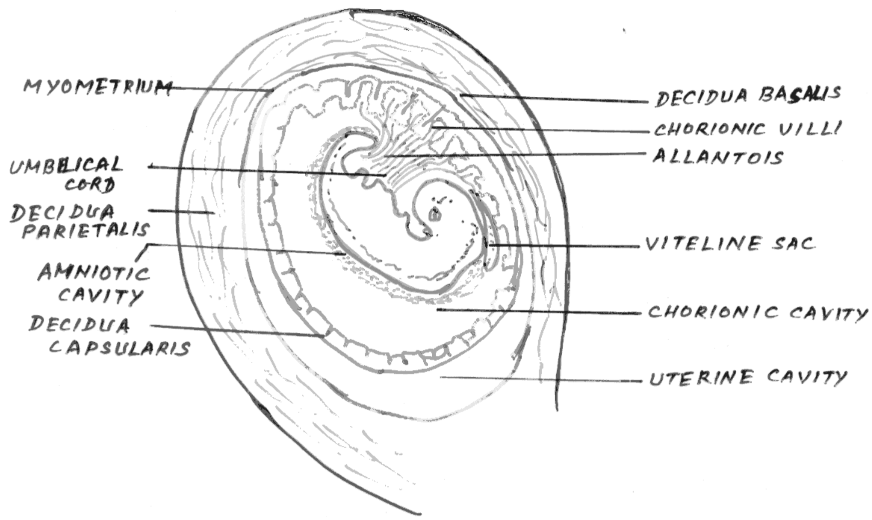
Menstrual Cycle
“FOL(d) M(a)PS”

Ovarian cycle:
Follicular phase
Ovulatory phase
Luteal phase

Menstrual cycle:
Menstrual flow,
Proliferative phase
Secretory phase







EMBRYONIC DEVELOPMENT IN MAN. (EXTRA EMBRYONIC MEMBRANE)

TERMS TO REMEMBER

Acrosome- the part of a sperm cell that contains an enzyme – (This enables a sperm cell to penetrate an egg.)

Afterbirth-placenta and fetal membrane expelled from the uterus after the birth of a baby

Amniotic sac-fluid-filled membrane or sac that surrounds the developing embryo while in the uterus.(protects baby from hard shocks, keeps it at a constant temperature.)

Birth-the process of being born. process by which baby moves from the uterus into the outside world. **Parturition**

Blastocyst = blastula = early stage of an embryo; a liquid-filled sphere whose wall is composed of a single layer of cells; during this stage (about eight days after fertilization) implantation in the wall of the uterus occurs.

Cervix- lower part, or neck, of uterus. (Opening to the uterus.)
Clitoris-small, sensitive organ in front of the vagina
Coitus-synonym for sexual intercourse
Conception-fertilization of an egg cell by a sperm cell
Corpus Luteum - After ovulation, this crater-like structure produces progesterone and estrogen. The corpus luteum is the old RUPTURED GRAFFIAN follicle. It means “yellow body”.
Cowper's glands - 2 glands that secrete an oily liquid, which cleans and lubricates the urethra of the male
Egg cell-a female sex cell (female gamete or ovum or **secondary oocyte**)
Ejaculation-the discharge of semen from the penis
Embryo-the unborn child developing in the uterus between the second and eighth weeks of life
Endometrium - the lining for the uterus – site for blastocyst implants and develops.

Epididymis-the tightly coiled tube at the back at each testis that holds newly created sperm – (each epididymis is like a nursery where sperm mature and learn to swim.)
Erection- condition of penis when it fills with blood and becomes firm, enlarged, and erect.
Fallopian tubes -tubes leading from each ovary to the uterus. Tubes carry the egg from ovary to the uterus. Fertilization occurs here. (Also known as the **oviducts**.)
Fimbria - A **fimbria** (plural **fimbriae**) Latin word, literally means "fringe." a fringe of tissue near the ovary leading to the fallopian tube
Fertile- able to conceive a child
Fertilization union of sperm and egg. Conception.
Fertilized egg- egg after sperm has united with it. Zygote
Fetus-unborn child developing in the uterus <u>after</u> the first eight weeks of life
Follicle - In ovaries. Each holds and nourishes an egg until ovulation. Nest. Becomes corpus luteum after ovulation.
Foreskin – A sheath of skin that surrounds the penis.
Follicle Stimulating Hormone - secreted from pituitary gland in both men and women. In women, FSH promotes the development of eggs and estrogen. In men, FSH promotes the development of sperm cells.
Fraternal twins-babies that develop from two eggs, each fertilized by a sperm cell; may or may not be of the same sex
Gamete – a sex cell. Sperm cells and egg cells are gametes.
Genitals-the reproductive or sex organs, especially the external organs
Germ Cell- egg or sperm cell. Gamete. In humans, germ cell contains 23 chromosomes
Hormones-chemical substances produced by the endocrine glands; they act in other parts of the body and affect maturation, growth, and behavior; LH, FSH, GH, Testosterone, Estrogen, Progesterone are all hormones.
Hymen-a thin bit of tissue, or membrane that may partially cover the opening of the vagina
Identical twins-babies that develop from a single fertilized egg that separates into two halves; identical twins are always of the same sex
Labia-two folds of skin surrounding the entrance of vagina
Labor-the muscular contractions that expel a baby from uterus during childbirth
Leydig Cells – when prompted by LH, Leydig cells create testosterone.
LH - Luteinizing Hormone - Secreted from pituitary gland, causes ovulation and formation of corpus Luteum in women. In men, LH causes Leydig cells to produce testosterone.
Menstrual cycle - periodic building up and sloughing off of lining of uterus approximately every twenty-eight days
Menstruation-the periodic discharge of blood and waste material (unfertilized secondary oocyte / ova and the degenerating endometrium lining) from the uterus
Miscarriage- expulsion from the uterus of a fetus before it is developed sufficiently to live Also called spontaneous abortion
Myometrium – muscles of the uterus that stretch to accommodate the growth of the baby. These muscles contract during labor and push baby out…
Orgasm-the peak of sexual excitement when the male ejaculates semen,
Ovary- female sex glands; they produce egg cells, estrogen and progesterone.
Ovulation-the discharge, or release, of an egg cell / secondary oocyte from the ovary
Ovum-scientific name for an egg cell / secondary oocyte
Oxytocin - hormone, released from the pituitary gland , stimulates <u>contraction</u> <u>of the myometrium</u> of the uterus during labor and facilitates <u>ejection of milk</u> from the breast during nursing.

Penis-the male sex organ through which sperm cells leave the body; it also discharges urine
Placenta- network of blood vessels and other tissues by which the unborn child is attached to the wall of the uterus. grows out of the endometrium The umbilical cord is attached to it. It is the interface between mother and developing fetus.
Pregnancy-the process in a woman from conception to birth
Pregnant-the condition of a woman with an embryo or fetus in her uterus
Progesterone – pregnancy hormone, which is first produced by the corpus luteum and then by the placenta.

* increases lining of endometrium.
* maintains pregnancy
* helps develop mammary glands.

Prostate gland- surrounds the upper end of male urethra and produces part of the fluid that mixes with the sperm to form semen. Prostate fluid alkaline ,helps to protect sperm from vaginal acids.
Scrotum- pouch of loose skin containing the testes. Houses and air-conditions the testicles by moving and sweating.
Semen-the mixture of sperm and fluids released during ejaculation. Semen comprised of sperm, fructose, prostate fluid and oil from Cowper's gland.
Seminal vesicles-small saclike organs opening into each vas deferens near the upper end of the urethra; produce part of the fluid that mixes with the sperm to form semen; provide food (fructose) for the sperm.
Seminiferous tubules - tubes in testes that produce sperm
Sexual intercourse- entry of penis into vagina and subsequent release of semen; also called coitus
Sperm-the male sex cell (male gamete or spermatozoon), which contains 23 chromosomes in human.
Spermatozoon-scientific name for sperm
Spontaneous abortion--synonym for miscarriage
Testes- male sex glands; produce sperm cells and testosterone;
Testicles-synonym for testes
Testosterone – male hormone that regulates development of penis, muscles, body hair, etc…
Umbilical cord- ropelike structure connecting embryo or fetus to placenta within the uterus.
Urethra-the tube through which urine is expelled from the bladder in both males and females and through which semen leaves the male body
Uterus = **womb** - the hollow pear-shaped organ in which a baby develops before it is born;
Vagina- passage from the uterus to the outside of the body , accepts the penis during intercourse. It is the birth canal & menstrual fluids leave through it
Vas deferens- tube extending from each epididymis to the urethra in males
Womb-synonym for uterus
Yolk sac-a structure that develops for the nutrition of embryo during early embryonic life and then ceases to function
Zygote - The cell formed by the union of two gametes. [fertilized ovum before cleavage.]

IMPORTANT NOTES

- An adult male produces over 10^{12} to 10^{13} sperms each day
- Human female oogonial development by mitosis is completed by 25 weeks of foetus and no oogonia are formed after birth
- Sperm entry into the ovum stimulates MPF (M phase promoting factor) & APC (Anaphase promoting complex) for completion of Meiosis II
- During Spermatogenesis, spermatogonium produces four sperms while in oogenesis, oogonium produces one ovum and two polar bodies.
- Human Sperm contains Clupein proteins.
- Yolk nucleus: A mass of mitochondria and golgi bodies near nucleus is called as yolk nucleus and controls vitellogenesis.
- Maximum level of estrogen – 12^{th} day, LH-13th day, Progestrone – 21st day, Corpous luteum formation – 19^{th} day of menstrual cycle.
- Menstrual cycle is absent during pregnancy, lactation periods and permanently during menopose.
- Two ovaries alternate in ovulation
- 13 mature eggs are released per year, so about 416 eggs (13x32 years) are ovulated during whole reproductive period of human female.
- Menstruation is also called "Weeping of uterus for the lost ovum" or" Funeral of unfertilized eggs".
- In human embryo, yolk sac degenerates since eggs is microlecithal, which shows evolutionary significance.
- Placenta acts as a physiological barriers and an ultra-filter between foetal and maternal blood.
- Progesterone is also called pregnancy hormone since its secretions controls pregnancy
- Teratogens are physical, chemical, biological agents which may cause malformation in developing embryo
- Period between fertilization and parturition is called gestation periods. Varies between 266 days up to 280 days (49 weeks)

Chapter-4: REPRODUCTIVE HEALTH

Reproductive Health:

Human reproductive health and sexuality involve great many *components* and *interrelationships.*

A *total view of human reproductive health is basic to personal well-being* as well as to interpersonal relationships.

Every individual is *a unique sexual being*.

Adolescents are *vibrant, fragile and prone to experimentation and risk taking,* as a result they are the most v*ulnerable population* as far as *delinquent behavior* and attitude is concerned.

Every *decision* has its own *consequence*. Any wrong decision can lead to *disastrous consequence*, which in turn can ruin one's life.

Sexual adjustment is part of total personality adjustment. Self-esteem is the key to sexual maturity.

Broad based community and institutional support for reproductive health is essential.

Adolescence Reproductive and Sexual Health (ARSH) topics are to be taken care of to dispel the myths and misconception about this important aspect with focus on:

- reducing risky behavior
- theories which explain what influences people's sexual choices and behaviour
- reinforced message about sexual behaviour and risk reduction
- Providing accurate information about, the risks associated with sexual activity, about contraception birth control, methods of avoiding or deferring intercourse
- Dealing with peer and other social pressures on young people; providing opportunities to practice communication, negotiation and assertion skills
- Uses a variety of approaches to teaching and learning that involve and engage young people and help them to personalise the information
- Uses approaches to teaching and learning which are appropriate to young people's age, experience and cultural background

Methods of birth control

CONCEPT MAP Ref: CH-4 (Page-3)

- **Behavioural methods:** Behavioural methods depend on a good knowledge of the menstrual cycle as well as adequate self control by the couple.
    - **Coitus Interruptus:** Coitus interruptus means 'interrupted sex". In this birth control method, the penis is withdrawn from the vagina just before ejaculation.
      The main advantage is that this method does not require the use of any drug, does not interfere with normal body functions, and the couple can plan for pregnancy at any time

they want. The main disadvantage is that it is dependent almost wholly on the man's self-control. The failure rate is high at 15 - 18%.

  - **Rhythm method or Safe Period:** This method requires a good knowledge of the female partner's menstrual cycle to identify the days on which sexual intercourse is possible without the risk of pregnancy.

- **Avoiding vaginal Intercourse:** Anal sex, oral sex or sex without penetrating the vagina
- **Barrier methods:** In barrier methods of birth control, a barrier is placed between the penis and the vagina during intercourse so that the sperm cannot meet the ovum for fertilization.
  - **Male Condoms:**, usually made of latex that covers the erect penis during penetration of the vagina.
  - **Female Condoms:** made of polyurethrane, loose sheath with two rings on either side. can be inserted about 8 hours prior to sexual intercourse and can be kept in for about another 12 hours after intercourse. Can be used more than once during this period.
  - ***Condoms protect against pregnancy as well as sexually transmitted diseases (STDs), including HIV/AIDS.***
  - **Diaphragm:** vaginal is a small saucer shaped rubber sheath with a metal coil in its rim which is fitted across the mouth of the uterus (cervix).
  - **Cervical Cap:** The cervical cap is a small dome-shaped rubber device fitted on the cervix. It is uncomfortable to apply and is rarely used nowadays.
  - **Vaginal Sponge:** The sponge is a small polyurethrane round device which needs to be placed inside the vagina before sexual intercourse. It releases spermicide which makes sperm inactive. It should be left in place for 8 hours after use and can be used more than once during this time.

    The sponge also acts as a barrier contraceptive to some extent since it swells up to fit across the cervix once it is inside the vagina.

- **Hormonal Methods:** Drugs are used to either prevent ovulation or to prevent implantation of the embryo after fertilization.
- Combined oral contraceptives contains two hormones similar to the natural hormones in a woman's body---an estrogen and a progestin.

How the Birth Control Pill works

Mainly work by preventing ovulation. In a normal menstrual cycle, the pituitary gland secretes the hormones FSH and LH to stimulate the ovary to release an egg ('ovulation").

Progesterone in pills make the cervical mucus hostile to the sperm.

- Causes changes that make the endometrium unreceptive to a fertilized ovum if ovulation and fertilization do take place
  - **Oral Contraceptive pills:** Combined oral contraceptive pills or birth control pills contain two hormones - estrogen and progesterone. They have two functions. The main one is to prevent ovulation. The second function is to disrupt the normal growth of the internal uterine lining (endometrium) so that the embryo cannot implant in it.

- **Centchroman:** This is a non-hormonal non steroidal contraceptive. The main function is to cause a slowing down in the growth rate of the internal uterine lining as well as to speed up the movement of the embryo so that implantation cannot occur.
- **The Patch:** The patch (Ortho Evra). This is a thin band-aid like patch containing estrogen and progesterone should be applied over the skin. Releases the hormones slowly into the skin through which they are absorbed.
- **Depo-provera:** This birth control method consists of injecting a high dose of the hormone progesterone every three months. It acts mainly by preventing ovulation. The main disadvantage is that there may be irregular bleeding throughout the three months.
- **Nuvaring:** This is a thin silastic ring which should be inserted into the vagina once every month. It releases the hormones estrogen and progesterone and prevents ovulation during the menstrual cycle.

Subdermal Implants

The Norplant (a registered trademark of The Population Council for levonorgestrel subdermal implants) Implant system set of six small plastic capsules. Capsules placed under the skin of a woman's upper arm.

Norplant capsules contain aprogestin, similar to natural hormone that a woman's body makes. It is released very slowly from all six capsules. Thus the capsules supply a steady, very low dose. Norplant implants contain no estrogen.

Norplant capsules thicken cervical mucus making it difficult for sperm to pass through. It stops ovulation (release of eggs from ovaries) in about half of the menstrual cycles after the first year of use.

Emergency Oral Contraception

After unprotected sex, emergency oral contraception can prevent pregnancy. Sometimes called postcoital or 'morning after' contraception.

Mainly stops ovulation

Regular use of emergency contraceptives has serious health hazards.

Vaginal Pessaries, Tablets, Creams or Foams:

These contain spermicides which are toxic to the sperm and should be inserted into the vagina just before coitus. Their advantages are that they are easy to apply, do not interfere with coitus and act as lubricants. Disadvantage is that they are not very effective always.

Intra-Uterine Contraceptive Devices (IUCD):

IUCDs or IUDs are contraceptive devices which are placed inside the uterus. Small, flexible plastic frame. Has copper wire or copper sleeves on it. Inserted into a woman's uterus through her vagina. Have two strings, or threads, tied to them. Strings hang through the opening of the cervix into the vagina. A provider can remove the IUD by pulling gently on the strings with forceps.

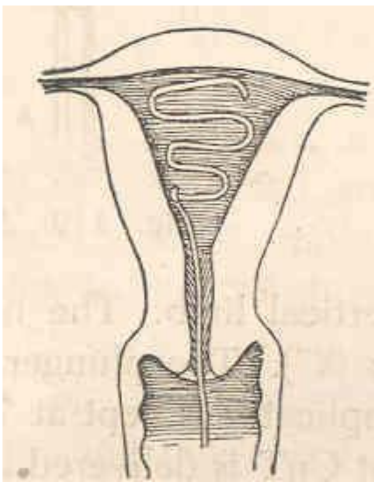
Preventing sperm and egg from meeting. Perhaps the IUD makes it hard for sperm to move through the woman's reproductive tract, and it reduces the ability of sperm to fertilize the egg. Prevent the egg from implanting itself in the wall of the uterus.

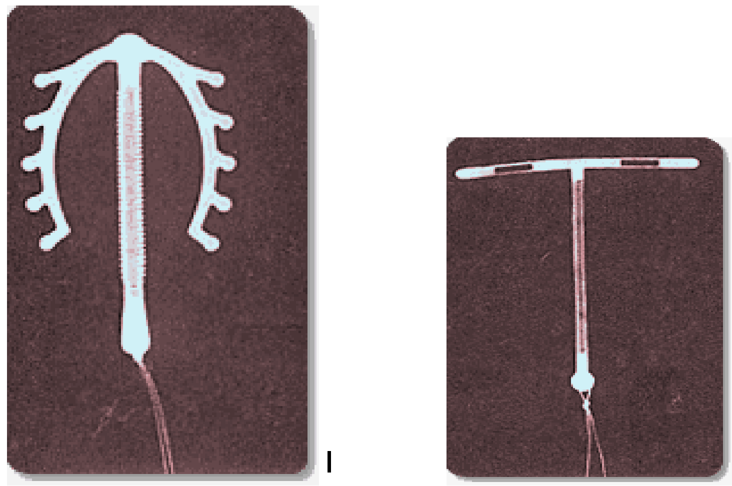
IUCDs prevent pregnancy by making the endometrium unreceptive to the fertilized ovum. It stimulates the endometrium to release leukocytes (WBCs) and prostaglandins making it hostile to the sperm. It also causes bizarre and irregular growth of the endometrium. This prevents implantation of

a fertilized ovum.
IUDs like Copper-Ts also come wrapped in copper. Copper is toxic to sperms and is a method of enhancing the contraceptive effect of the IUDs.

The IUCDs can come in various shapes and sizes.

- **Lippes Loop:** The Lippes loop consists of a thin plastic (or polyethylene)wire bent in a series of S-shapes.





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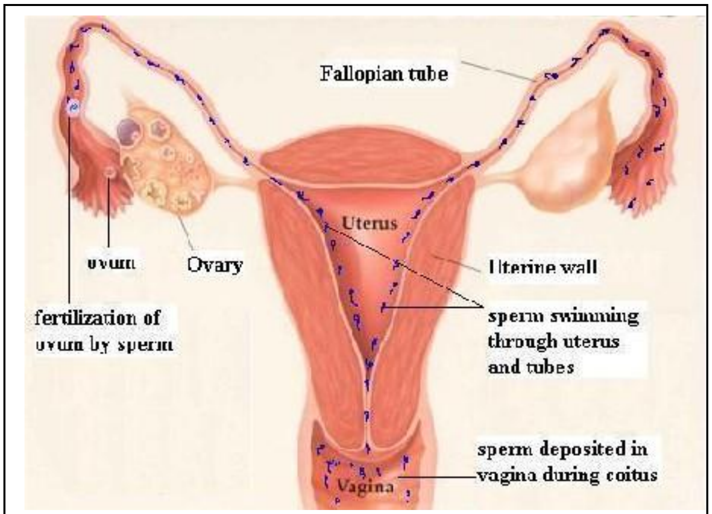
Lippes loop **Copper-Ts**

- **Copper T:** T-shaped structure which stays inside the uterus with the long arm of the T along the uterine cavity (endometrium) and the shorter arms transversely across the upper part of the endometrium.
- **Mirena:** Releases a progesterone called levonorgestrel. It works by affecting ovulation, affecting the normal growth of the endometrium and by affecting the cervical mucus so that the movement of sperm is obstructed. In the United Kingdom, hormone based IUDs are known as Intra-uterine Systems (IUS).

- **Surgical Methods:** These are more or less permanent methods of contraception.
    - **Tubal Ligation:** Both the female tubes are tied off and usually cut during tubal ligation to prevent the sperm from reaching the ovum during intercourse.
    - **Vasectomy:** The two tubes which carry sperm from the testes to the penis are the vas deferens. Tying them

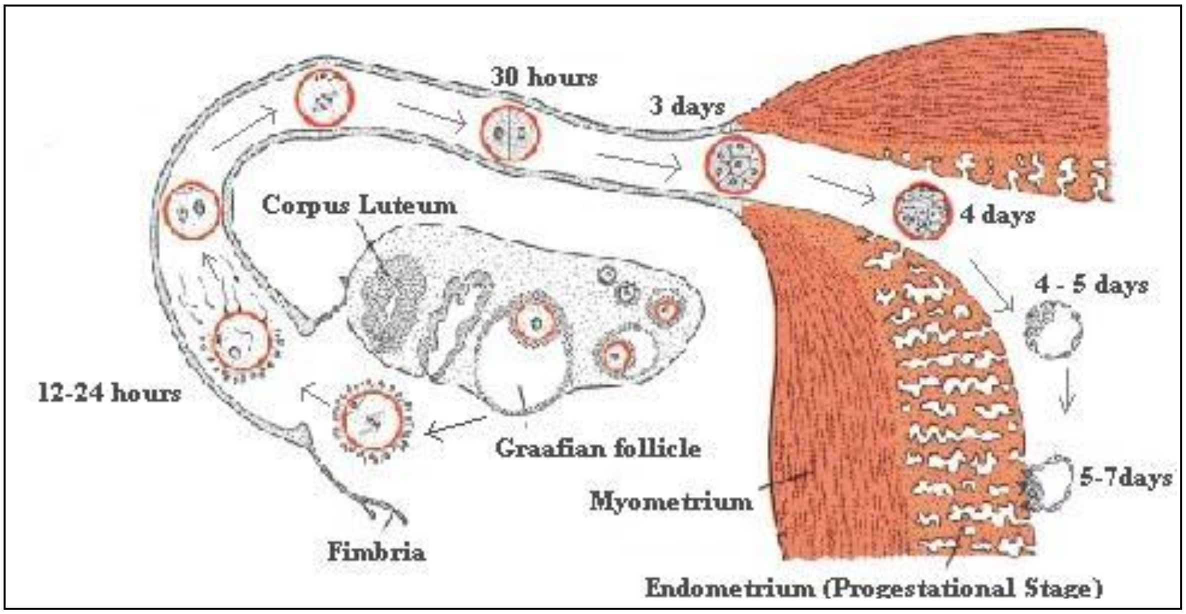


off and cut.

- **Essure:** Essure is a method in which small micro-inserts are placed at the mouth of the fallopian tubes to cause scarring and block them. This prevents sperm from reaching the ovum for fertilization.

HOW PREGNANCY OCCURS

Occurs when a sperm with an ovum.
Ovum round about 100 microns in diameter, The ovum is picked up by the fallopian tube on the same side. The tubes have long fingerlike projections called fimbria which it uses, rather like hands to pick up the ovum. Ovum then moves through the tube, propelled along by long hairs growing from cells in the tubes. Like grass bending before the wind, the hairs bend towards the uterus in waves, pushing the ovum slowly towards the uterus. The egg remains viable, (alive) for about 72 hours, but is capable of being fertilized for only about 12 - 24 hours. If it remains unfertilized during this period, it disintegrates in the tube without leaving any trace. Its end products (mainly proteins) are absorbed into the bloodstream and excreted through the urine or stool.



Fertilization, Implantation and Pregnancy

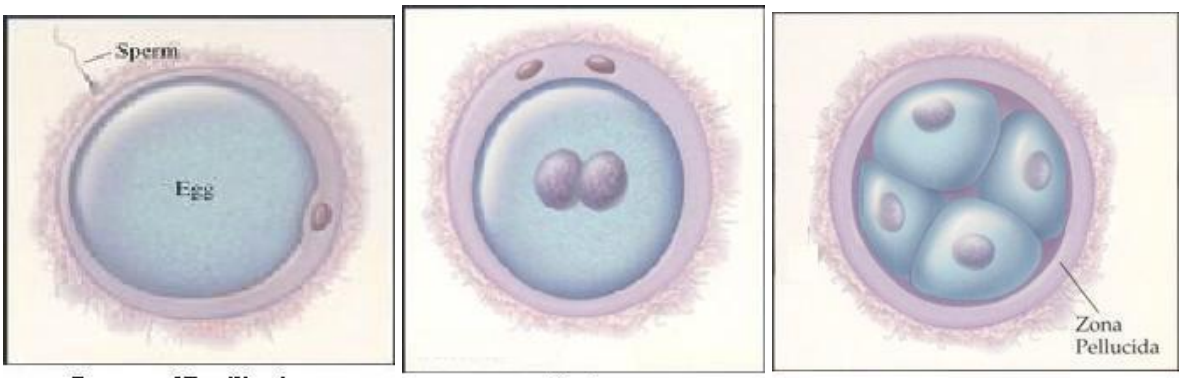
The sperm viable for a longer period, found in uterus 5 – 7 days after coitus. But capable of fertilizing an ovum for only 48 - 72 hours after being ejaculated. Time taken by sperm to reach tubes is between 6 – 12 hours but many authorities say it can be as early as 1 hour.

Intercourse has to take place within this narrow time frame (1-2 days before ovulation or immediately after ovulation), for a pregnancy to occur. At every intercourse normal man deposits 2 – 5 mililitre of semen in the upper part of the vagina (see diagram). Each mililitre of semen normally contains about 50 – 200 million of sperms.

Sperms swim rapidly upwards into the uterus and from there into the two tubes on either side at the rate of 3mm per hour. Takes an average of 10 hours for sperm to reach tubes.

All the sperms deposited in the vagina cannot swim into the uterus. Only about 1 % of the total number of sperms deposited in the vagina make the journey.

Hundreds of sperm (estimated to be around 300) surround the ovum in the tube. They press against the membrane of the ovum attempting to penetrate it and fertilize the ovum. Finally one sperm succeeds. At once a chemical reaction is triggered off in the wall of the ovum, making it impenetrable to any other sperm. No other sperm can enter the ovum now.



Process of Fertilisation **Zygote** **4-celled embryo**

Unsuccessful sperms slowly degenerate, break down and become indistinguishable from any other protein end product in the female partner's body (sperm made up mainly of protein). These get absorbed into the blood stream, are carried away to be expelled from the body in the stool or the urine.

Sperm that manages to penetrate the ovum fuses with it to form a single cell called a zygote. Zygote starts to divide as it is propelled towards the uterus – dividing first into 2 cells, then into 4, then 8 and so on. Dividing zygote called an embryo.

When the process of in-vitro fertilization (IVF) is carried out, the ovum and the sperm is allowed to fertilize in a laboratory dish (petri dish). The embryo is usually transferred into the mother's uterus at the 4 – 8 celled stage, usually on the third day after fertilization.

By the time the zygote reaches the uterus at about the 6th to 9th day after ovulation, it is a 16-celled cluster of cells called a morula. The morula looks rather like a bunch of grapes. Each of its cells is identical to each other.

Theoretically, it is from the 2-celled to the 16-celled stages that the cells can be separated from each other and allowed to develop into clones of each other (identical twins). In nature, separation occurs spontaneously – usually at the 2-celled stage – to form identical twins. Separation at later stages can lead to the potentially fatal condition of conjoint twins or Siamese twins.

When it reaches the uterus, the morula sticks to the inner lining of the uterus (called the 'endometrium'). By this time, the hormone progesterone released by the ovaries finishes preparing the endometrium to receive the morula.

The morula burrows deep into the endometrium and by the 9th - 12th day after ovulation, is fully buried in it. Burrowing can cause a little bleeding called ‘implantation bleeding’. Buried embryo begins to develop, Its cells increasing in number and gradually becoming different from each other in the way they function.

The development of the embryo continues until at the end of 9th month of pregnancy (40 weeks or 280 days), a fully formed baby, capable of leading a life independent from its mother is ready to be born.

INFERTILITY AND ITS TREATMENT

‘Infertility’ when a couple fails to conceive after one year of sexual life without contraception. 80% of all women desiring children, conceive within 1 year of marriage and another 10% within the second year.

According to the World Health Organisation, incidence of infertility is about 10 % worldwide. Another 10-12% of all the other couples have only one child and wish to have more. The incidence of infertility is gradually increasing all over the world.

For many people going through infertility treatment, the level of distress and tension can be very high. Mutual trust and faith in the doctor can help the couples to enquire about different modalities of treatment for both the male as well as the female partner, and make informed decisions of their reproductive status azoospermia (complete absence of sperm). In these cases, sperm has been aspirated from the testes directly.

- **Intra-Uterine Insemination (IUI):** This method is used in men with moderately low sperm count. the semen is collected by masturbation, washed and centrifuged to increase the sperm density. This high density sperm sample is now injected into the uterus, bypassing the vagina. The chances of hostile cervical mucus is thus eliminated. Since the sperm is injected into the uterine cavity, chances of pregnancy is increased. The procedure should be done within 2 hours of collecting the semen.
  - **Insemination with Husband's Semen (AIH)** This is done in cases of impenetrable cervical mucous or when disease or deformity of the cervix makes it impossible for the sperm to enter the uterus. It is also carried out in cases of impotence or premature ejaculation.
  - **Insemination with Donor Semen (AID)** AID is usually carried out in couples where the husband suffers from azoospermia.

InVitro Fertilisation (IVF) process by which egg cells are fertilised by sperm (usually 100,000 sperm / ml) outside the womb, *in vitro*. IVF is a major treatment in infertility when other methods of assisted reproductive technology have failed. The process involves hormonally controlling the ovulatory process, removing ova (eggs) from the woman's ovaries and letting sperm fertilise them in a fluid medium. The fertilised egg (zygote) is then transferred to the patient's uterus with the intent to establish a successful pregnancy. The first successful birth of a "test tube baby", Louise Brown, occurred in 1978. Prior to that, there was a transient biochemical pregnancy reported by Australian Foxton School researchers in 1973 and an ectopic pregnancy reported by Steptoe and Edwards in 1976.

In vitro, (Latin) meaning *within the glass*, biological experiments involving cultivation of tissues outside the living organism were carried out in glass containers such as *beakers, test tubes, or petri dishes.* Term *in vitro* used to refer to any biological procedure that is performed outside the organism. In vivo procedure, tissue remains inside the living organism within which it is normally found. A colloquial term for babies conceived as the result of IVF, ***test tube babies***, However, *in vitro* fertilisation usually performed in shallow containers called Petri dishes. (made of glass or plastic resins.)

Zygote intrafallopian transfer (**ZIFT**) infertility treatment where blockage in the fallopian tubes prevents the normal binding of sperm to the egg. Egg cells removed from woman's ovaries, and in vitro fertilised. Resulting zygote placed into the fallopian tube by laparoscopy. The procedure spin-off of the gamete intrafallopian transfer (GIFT) procedure. ZIFT has a success rate of 64.8% in all cases.
Takes an average five weeks to complete a cycle of ZIFT. First, the woman must take a fertility medication to stimulate egg production in the ovaries. The doctor will monitor growth of ovarian follicles, once they are mature, woman will be injected with human chorionic gonadotropins (hCG). Eggs will be harvested approximately 36 hours later, usually by transvaginal ovum retrieval. After fertilization in laboratory resulting early embryos or zygotes are placed into the woman's fallopian tubes using laparoscope.

Gamete intrafallopian transfer (**GIFT**) assisted reproductive technology against infertility. Eggs removed from a woman's ovaries, placed in one of the Fallopian tubes, along with the man's sperm. The technique, which was pioneered by endocrinologist Ricardo Asch, allows fertilization to take place inside the woman's body.
Takes, an average of four to six weeks to complete a cycle of GIFT. First, the woman must take a fertility drug to stimulate egg production in the ovaries. The doctor will monitor growth of ovarian follicles, once they mature, woman will be injected with Human chorionic gonadotropin (hCG). The eggs will be harvested approximately 36 hours later, mixed with the man's sperm, and placed back into the woman's Fallopian tubes using laparoscope.

Intracytoplasmic Sperm Injection (ICSI): technique in which a single sperm injected into the centre of the egg, in order to achieve fertilization. Sperm is collected from the male partner by masturbation. Single healthy sperm then injected into the prepared ovum.
The advantage of this method is that only a single sperm is needed - even men with a very low sperm count can become fathers with this treatment. Men found to be azoospermic, that is with no sperm at all in the semen, sperm can be suctioned out of the vas deferens (male tubes). Sperm can also be liberated from the testes itself by careful testicular biopsy and culture by a method called MESA - Microepididymal sperm aspiration.

Prevention of Male Infertility : Undescended testes should be treated at the earliest during infancy before testicular function is damaged. Infections by mumps and other viruses should be managed by keeping a watchful eye on complications in the testes.

General Facts About STDs

Sexually transmitted diseases (also called STDs, or STIs for sexually transmitted infections): Infections transferred from one person to another through sexual contact. According to the Centers for Disease Control and Prevention, there are over 15 million STD cases reported annually in the United States.

More than 25 diseases that are transmitted through sexual activity. Other than HIV, the most common STDs in the United States are chlamydia, gonorrhea, syphilis, genital herpes, human papillomavirus, hepatitis B, trichomoniasis, and bacterial vaginosis. Adolescents and young adults are the age groups at greatest risk for acquiring an STD. Approximately 19 million new infections occur each year, almost half of them among people ages 15 to 24.

Some STDs can have severe consequences, especially in women, if not treated, which is why it is so important to go for STD testing. Some STDs can lead to pelvic inflammatory disease, which can cause infertility, while others may even be fatal. STDs can be prevented by refraining from sexual activity, and to a certain extent, some contraceptive devices, such as condoms.

Specific STDs: An Overview

Human Papilloma Virus: Thought to be one of the main causes of cervical cancer. Has been linked with other types of cancers of female reproductive system. HPV can be treated to reduce signs and symptoms. Currently no cure for this virus. HPV vaccine recently developed to prevent HPV infection.

Herpes Virus: STD that presently with no cure. Treatment available. Home remedies & natural treatment available. Herpes symptoms include blisters or sores that periodically break out on the genitals. Refer FAQs.

Hepatitis: To cure for those already infected, a Hepatitis B (HBV) vaccine available to prevent spread of this infection. Many are asymptomatic, however those who do suffer from Hepatitis B symptoms may have many unpleasant discomforts. Infection may clear up on its own. Some people may suffer from chronic infections for many years. Treatment available for chronic sufferers. Other types of hepatitis infections that can be passed through sexual contact include Hepatitis A and Hepatitis C.

HIV/AIDS: Most dreaded STD. New ways of treating this infection significantly prolongs an infected person's life. For many this infection eventually progresses to AIDS and, ulitmately, death. More than 40 million people worldwide are infected with the HIV virus; women account for 50% of those infected.

Syphilis: Throughout history, cases of syphilis have been recorded. Can easily be treated and cured. Without treatment, syphilis symptoms can progress and affect the nervous system and brain leading to dementia and even death.

Trichomoniasis: most common, curable STDs. However, symptoms may be mistaken for a yeast infection causing women to use wrong type of treatment for her vaginal discharge.

Common Infections: Chlamydia and gonorrhea often infect a person at the same time. Although the symptoms of chlamydia are different from gonorrhea not unusual for person to be asymptomatic. If testing for chlamydia, good idea to test for gonorrhea. Both STDs can be cured but can damage reproductive system if left untreated.

Pubic Lice: Crabs are very similar to head lice. Itchy symptoms can be hard to miss. Treatment for pubic lice can easily take care of the discomfort these pests can cause.

Rare Infections: Granuloma inguinale and chancroid,. Other lesser-talked about STDs include nongonococcal urethritis and molluscum contagiosum,

KNOW THE SYMPTOMS OF STDs

Men

- Swelling or tenderness in genital area.
- Blisters ,sores or bumps around the mouth or genitals.
- Fever,chills and aches.
- Unusual itching.
- Burning sensation when you pass urine or move your bowels.
- White,watery or yellow disharge from the penis.

Women

- Have fewer symptoms than men, often none at all. STDs can lead to cancer. Women should watch for-
- Bleeding that is not part of their period.
- Pelvic or vaginal pain.
- Discharge from the vagina.
- Painful urination.
- Unusual rash, sore or growth in the genital area.

DON'T LET STDs TAKE YOU BY SURPRISE

Pelvic Inflammatory Disease Overview

Pelvic inflammatory disease (PID) is infection of a woman's reproductive organs. Infection spreads upward from the cervix to the uterus, Fallopian tubes, ovaries, and surrounding structures

Pelvic Inflammatory Disease (PID) Symptoms

If a woman has PID, she may have any of these symptoms:

- Abdominal pain (especially lower abdominal pain) or tenderness
- Back pain
- Abnormal uterine bleeding
- Unusual or heavy vaginal discharge
- Painful urination
- Painful sexual intercourse
- Symptoms not related to the female reproductive organs include fever, nausea, and vomiting.

PID symptoms may be worse at the end of a menstrual period and during the first several days following a period.

Ectopic Pregnancy Overview

Pregnancy that develops outside a woman's uterus (womb). When the fertilized egg from ovary does not implant itself normally in the uterus. Egg develops somewhere else in the abdomen. Such conceptions are abnormal and cannot develop into a fetus.

- Common ectopic pregnancy in fallopian tubes (so-called tubal pregnancy). Also found on the outside of the uterus, on the ovaries, or attached to the bowel.
- Complication of ectopic pregnancy is intra-abdominal hemorrhage (severe bleeding). Eg. tubal pregnancy the products of conception continues to grow in the fallopian tube, tube expands and eventually ruptures. This can be very dangerous because a large artery runs on the outside of each fallopian tube. If the artery ruptures, you can bleed severely.

- Ectopic pregnancy usually found in the first 5-10 weeks of pregnancy.

INFERTILITY IN HUMAN: Causes & Consequences :-

IN MALES	IN FEMALES
Oligospermia: Low sperm count	Anovulation: Absence of ovulation.
Azospermia: Absence of sperm.	Oligoovulation: Deficient ovulation.
Asthenozoospermia: Low sperm motility.	Hyperprolactinemia: Ovum remain trapped inside the follicle.
Teratozoospermia: Defective sperm morphology.	Idiopathic Infertility: Failure or abnormal fertilization.
Cryptorchidism:Failure of Testes to descend in the scrotal sac.	Tubal Infertility: Damaged/ligated fallopian tube

COMMON SEXUALLY TRANSMITTED DISEASES (STDs)

SL. NO.	STD	CAUSAL AGENT	SYMPTOMS	EFFECT ON FOETUS	EFFECT ON PERSON AFFECTED
1	CHLAMYDIOSIS	*Chlamydia trachomatis*	Painful urination & intercourse Mucus discharge from penis/vagina	Premature birth,blindness, Pneumonia	Pelvic inflammatory disease, Infertility,Ectopic pregnancy
2	GONORRHOEA	*Nisseria gonorrhea*	Painful urination in men	Still birth, Blindness	Pelvic inflammatory disease, Infertility,Rash,Death
3	TRICHOMONIASIS	*Tricomonas vaginalis*	Inflammation, Itching& vaginal white discharge (Leucorrhoea)	Not known	Valvar erythema, Burning dysuria
4	GENITAL HERPES	*Herpes simplex virus*	Genital sores, Fever	Still birth, Brain damage	Cervical cancer.
5	SYPHILIS	*Trepanema pallidum*	Initially sores in genitalia & mouth, Rashes	Premature birth, Miscarriage, Still birth	Death
6	GENITAL WART	*Human papilloma virus*	Warts on genitalia	Not known	Cervical cancer
7	HEPATITIS-B	*Hepatitis –B virus*	Fatigue, Fever, Jaundice, Rash, Abdominal pain	Low birth weight	Liver cirrhosis, Liver cancer
8	AIDS	*HIV*	Fever, Prone to infection, Inflammation	AIDS affected	Dementia, Death

IMPORTANT NOTES

- Indian population is identified as 'Young population' whereas population of USA, England ,Germany etc. are identified as 'Ageing population'.
- In India, Kerala has lowest Birth rate & U.P. highest.
- Deficiency of Manganese causes infertility & Vitamin E is considered as Antisterility Vitamin.
- 11th July celebrated as World Population Day.
- Every 16th person in the world is an Indian.
- Main objectives of National Population Policy, 2000 are : population stabilization, compulsory school education, reduce infant mortality rate, decrease fertility rate, promote delayed marriage, incentive for sterilization, restrain child marriage etc.
- Kerala declared as the ' First baby friendly state of the world' by first Human Development Report 2002.
- I-pills or Intelligent pills are Emergency Contraceptive pills that should be used in emergency only.Frequent use of it may bring ovarian damage & Menstrual problem.
- Contraceptive Corn: Scientists have produced a genetically modified corn crop which produces antisperm antibodies &suggest that a plant based jelly may be prepared which will prevent pregnancy & spread of STDs simultaneously.

IMPORTANT TERMS TO REMEMBER

AMNIOCENTESIS: Foetal test based on chromosomal pattern in amniotic fluid surrounding the developing embryo. can be used for sex determination.

LACTATIONAL AMENORIA: Absence of menstruation due to disruption of ovulation during the period of intense lactation following parturition.

INTRA UTERINE DEVICES(IUDs): A medical device of insertion of artificial barrier in the uterus through vagina for obstructing sperm entry.

STERILISATION: Surgical intervention for stopping pregnancy by blocking gamete transport pathway in male/female.

ASSISTED REPRODUCTIVE TECHNOLOGIES(ART): Artificial technological devices to enable couples to have children when fail they to get child due to any reproductive disorder.

ARTIFICIAL INSEMINATION: Medical technological devices by which semen collected from a healthy donor is artificially introduced into the vagina or uterus of female.

ETIOLOGY: Study of causes of diseases.

PROPHYLAXIS: Prevention of diseases.

EPIDEMIOLOGY: Mode of transmission of diseases.

RECANALISATION: Attachment of cut Vasa deferentia with plastic tubes during Vasectomy.

CASTRATION: Surgical removal of Testes.

POPULATION CRASH: Rapid decline in the population.

POPULATION EXPLOSION: Rapid increase in the population.

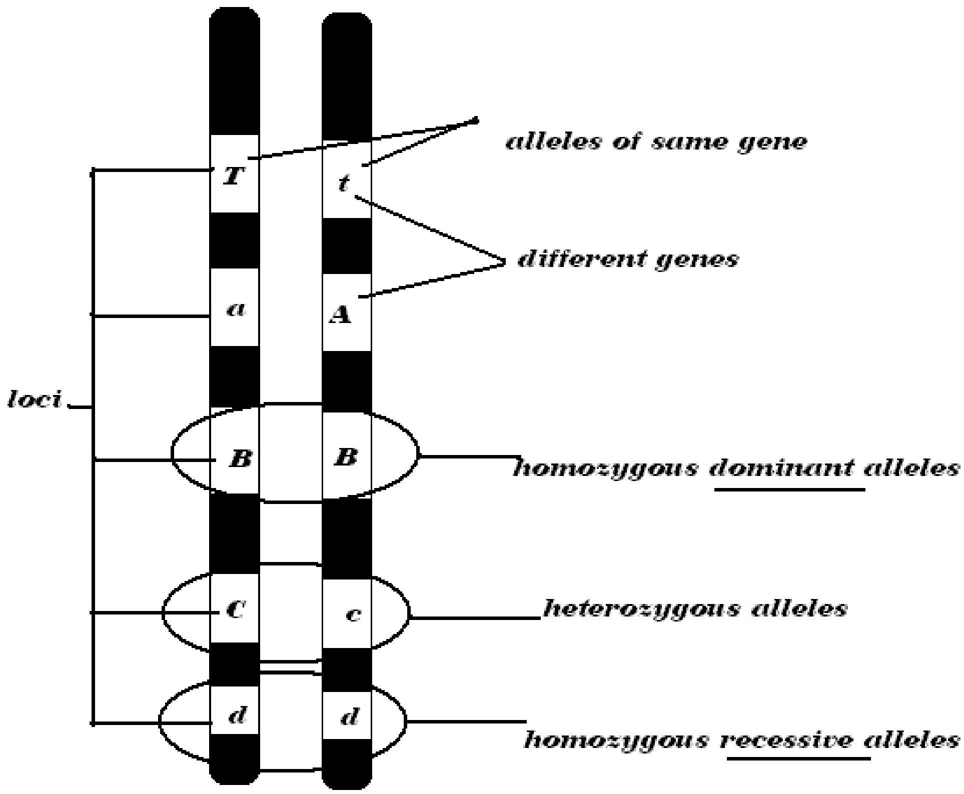
AGE COMPOSITION: Relative abundance of the organisms of different ages in the population.

IN-VITRO FERTILISATION: Artificial technique of fusion of gametes outside the body in laboratory condition, in almost similar conditions as that of the body.

INFERTILITY: Inability of a couple to produce children in spite of unprotected sexual cohabitation.

Chapter 5 : Genetics

Relationship between genes and chromosome of diploid organism and the terms used to describe them



Know the terms

Terms	Meaning	Example
Locus	Address/ location of a gene in a chromosome	T,A.b,d etc
Allele	Allelomorphs= alternative form of a gene	T and t OR A and a etc
Homozygous	Both alleles of a gene at a locus similar	AA or aa
Heterozygous	Both alleles of a gene at a locus dissimilar	Aa or Tt etc
Homozygous Dominant	Both alleles of a gene at a locus similar & dominant	AA
Homozygous recessive	Both alleles of a gene at a locus similar & recessive	aa

Mendel's first law (Law of dominance)characters are controlled by discrete units called genes (allele) which occur in pair. In heterozygous condition only one gene that is dominant can express itself. (Can be explained by monohybrid cross)

Mendel's second law (Law of segregation): The two alleles received, one from each parent, segregate independently in gamete formation, so that each gamete receives one or the other with equal probability. (Can be explained by monohybrid cross)

Mendel's third law (Law of recombination): Two characters determined by two unlinked genes are recombined at random in gametic formation, so that they segregate independently of each other, each according to the first law (note that recombination here is not used to mean crossing-over in meiosis). (Can be explained by dihybrid cross)

This is what Mendel said (*summary) :*

1) **Dominant** alleles overpower recessive alleles. Dominant traits overpower recessive traits.
2) Rule of **segregation (Separation):** Gametes (sex cells) only receive one allele from the original gene.
3) Rule of **Independent assortment**: One trait will not determine the random selection of another.

Incomplete dominance: When one allele of a gene is not completely dominant over the other and the F1 hybrids are intermediate between two parents. The phenotypic and genotypic ratio is same.1:2:1 in F2 generation. E.g. Snapdragon or *Antirrhinum majus*

Co dominance: Two alleles of a gene are equally expressive and dominant in a generation eg Human blood group

(**Note :** *Human blood group is also an example for multiple allelisim i,e when a gene exists* ***in more than two allelic*** *forms)*

Basic outline of Mendels cross

1. **Pure breeding parents for a pair of contrasting character (allelic Pair) is taken**
   e.g, Tall pure-bred pea plants (TT) & short pure-bred pea plants (tt)
   ↓
2. ***Gamete formation (Meiosis)***
   ↓
3. **Hybridization (crossing is done)**
   ↓
4. **F1 generation - the product of the above cross (are called hybrids)**
   ↓
5. **Selfing (allowed to self fertilize / self breeding)**
   ↓
6. ***Gamete formation (Meiosis)***
   ↓
7. **F2 generation - the product of the above selfing**
   ↓
8. **Analysis of result (Phenotype and Genotype)**

Linkage

Tendency of genes on same chromosome to remain together

Such genes are called – linked genes.

Linked genes present only parental types

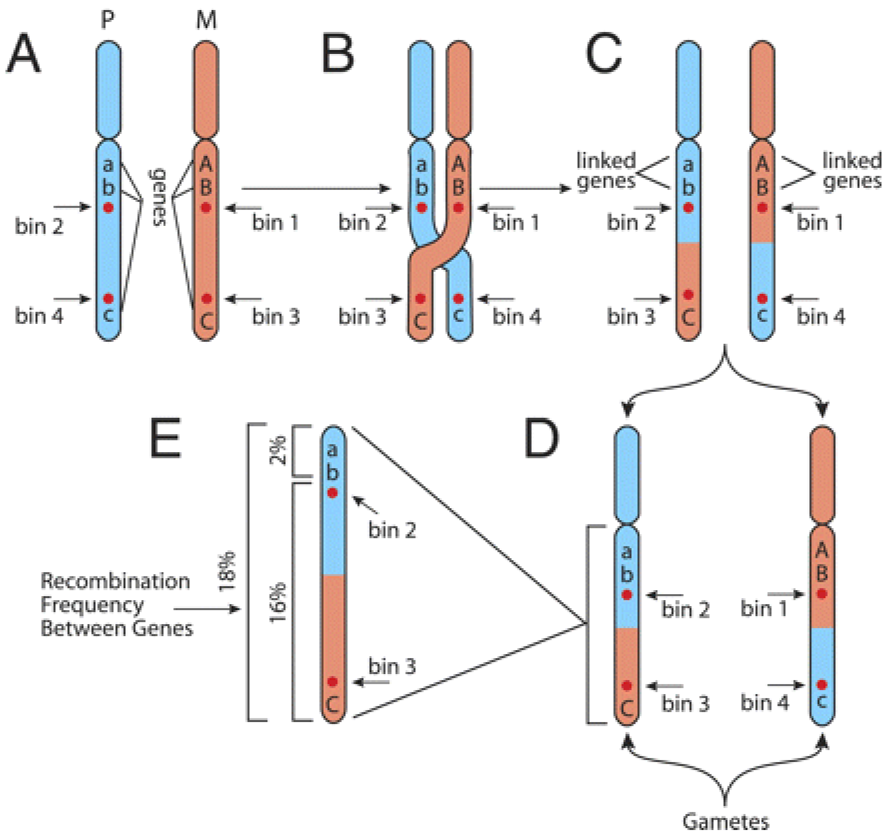


Figure Schematic of Genetic Linkage and Recombination

- **(A)** Two homologous chromosomes: **blue** (paternal) and **orange** (maternal). Three genes with separate alleles and linkage " noted (A,a; B,b; C,c;).
- **(B)** Crossing over during meiosis. **(**
- **(C)** Two alleles and their linked genes have switched locations via recombination. Four additional alleles and their associated (A,a; B,b;) have not switched and are considered linked.
- **(D)** Recombined haploid chromosomes segregate separately during meiosis as gametes before fertilization.
- **(E)** Sample recombination frequencies between genes demonstrating higher rates of recombination for genes further apart.

Cross	Result of F2 generation	
	Phenotypic ratio	**Genotypic ratio**
Monohybrid Tt X Tt	3:1	1:2:1
Dihybrid cross YyRr X YyRr	9:3:3:1	1:2:1:2:4:2:1:2:1
Incomplete dominance Rr X Rr	1:2:1	1:2:1

Co Dominance and multiple allelisim

Blood group	Possible genotype
A	I^AI^A OR I^Ai
B	I^BI^B OR I^Bi
AB	I^AI^B
O	ii

Crosses of blood group (CO DOMINANCE)

Blood group	Possible genotype	Possible phenotype
A X A	I^AI^A X I^AI^A	A
	I^AI^A X I^Ai	A
	I^Ai X I^Ai	A ; O
B X B	I^BI^B X I^BI^B	B
	I^BI^B X I^Bi	B
	I^Bi X I^Bi	B; O
AB X AB	I^AI^B X I^AI^B	AB: A; B
O X O	ii X ii	O

POSSIBLE BLOOD GROUP OF PROGENY WITH RESPECT TO THE BLOOD GROUP OF PARENTS

Parent	Progeny			
	A	**B**	**AB**	**O**
A X A	+	-	-	+
A X O	+	-	-	+
A X B	+	+	+	+
B X B	-	+	-	+
B X O	-	+	-	+
AB X A	+	+	+	-
AB X B	+	+	+	-
AB X O	+	+		-
AB X AB	+	+	+	-
O X O	-	-	-	+
KEY	**+** = POSSIBLE		**-** = NOT POSSIBLE	

Sex determination and sex chromosome

Organism	Male	Female
Human beings	XY	XX
Birds	ZZ	ZW
Insects	XO	XX

Pedigree Analysis

Pedigree is a chart of graphic representation of record of inheritance of a trait through several generations in a family

Symbols used:- refer NCERT Text Book

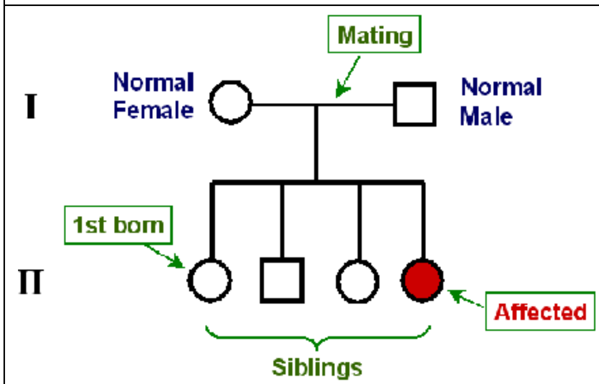
Four patterns of inheritance

AUTOSOMAL DOMINANT

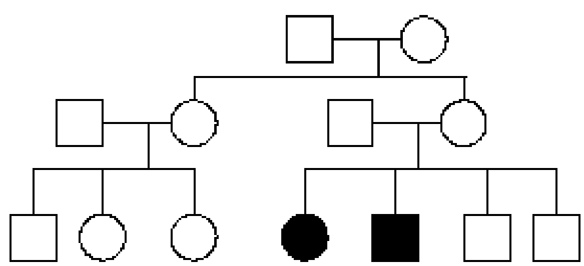
1. Traits are controlled by dominant genes
2. Both males and females are equally affected
3. traits do not skip generations
4. e.g. polydactyly, tongue rolling ability etc

AUTOSOMAL RECESSIVE

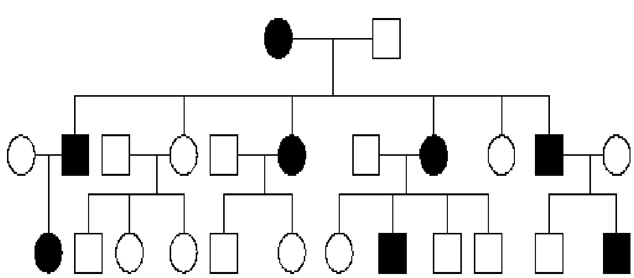
1. Traits controlled by recessive genes and appear only when homozygous
2. Both male and female equally affected
3. Traits may skip generations
4. 3:1 ratio between normal and affected.
5. Appearance of affected children from normal parents (heterozygous)
6. All children of affected parents are also affected.
7. e.g.- Albinism, sickle cell anaemia etc



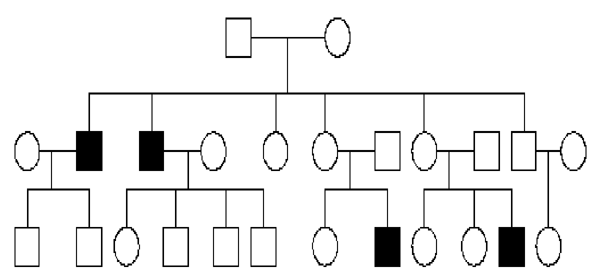
a model of pedigree chart



Autosomal recessive pedigree



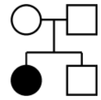
A 'typical' autosomal dominant pedigree



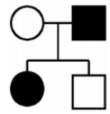
x-chromosome linked pedigree

Now try to answer

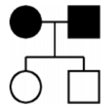
1. Is it possible that this pedigree is for an autosomal dominant trait?



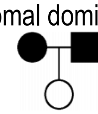
2. Can two individuals that have an autosomal dominant trait have unaffected children?



3. Is it possible that this pedigree is for an autosomal dominant trait?



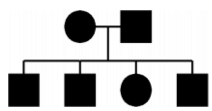
4. Is it possible that this pedigree is for an autosomal dominant trait?



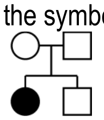
5. Is it possible that the pedigree above is for an autosomal recessive trait?
6. Assuming that the trait is recessive, write the genotype of each individual next to the symbol

   A = normal

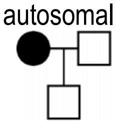
   a = the trait (a genetic disease or abnormality)



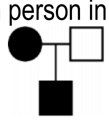
7. Is it possible that the pedigree above is for an autosomal recessive trait?
8. Write the genotype of each individual next to the symbol



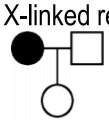
9. Is it possible that the pedigree above is for an autosomal recessive trait?



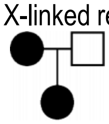
10. Is it possible that the pedigree above is for an X-linked recessive trait?
11. Write the genotype next to the symbol for each person in the pedigree



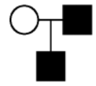
12. Is it possible that the pedigree above is for an X-linked recessive trait?



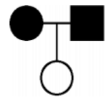
13. Is it possible that the pedigree above is for an X-linked recessive trait?



14. Is it possible that the pedigree above is for an X-linked recessive trait?



15. Is it possible that the pedigree above is for an X-linked recessive trait?



16. Is it possible that the pedigree above is for an X-linked recessive trait?

Clues

	Affected	**Unaffected**
Autosomal Dominant	AA Aa	aa
Autosomal Recessive	aa	AA Aa
X- chromosome linked recessive	$X^- X^-$ $X^- Y$	XX $X X^-$ XY

TERMINOLOGIES

Allele = A factor or letter that makes up a gene. 2 alleles make up one gene. Alternative forms of a genetic locus; a single allele for each locus is inherited separately from each parent (e.g., at a locus for eye color the allele might result in blue or brown eyes).

Alleles = "B" and "b" are different alleles.

Autosomal = refers to genes that are not found on the sex chromosomes. Autosomal chromosomes are ones that **are not** XX and XY. A chromosome not involved in sex determination. The diploid human genome consists of 46 chromosomes, 22 pairs of autosomes, and 1 pair of sex chromosomes (the X and Y chromosomes).

Carrier = a person who has a defective gene and a Dominant normal gene and therefore, is normal**. (Nn)**

Centimorgan (cM): A unit of measure of recombination frequency. One centimorgan is equal to a 1% chance that a marker at one genetic locus will be separated from a marker at a second locus due to crossing over in a single generation. In human beings, 1 centimorgan is equivalent, on average, to 1 million base pairs

Chromosomes = 46 are found in human cells. Genes are carried among chromosomes.

Clones: A group of cells derived from a single ancestor.

Cystic Fibrosis = Autosomal recessive. Mucous in lungs... Death in the 20s.

Dominance = This is one of Johann Gregor Mendel's principles. In his studies with pea plants Mendel notices that pure tall plants bred to pure short plants resulted in tall hybrid plants. Tallness was dominant over shortness.

Dominant = an allele that overpowers another is dominant.

Down's Syndrome = due to an extra chromosome. (21st pair).

Gamete = sperm or egg. Germ Cell. In humans, germ cell contains 23 chromosomes.

Genetics: The study of the patterns of inheritance of specific traits

Gene = Every trait is controlled by a gene. A human has 20,000 genes. Genes are controlled by 2 factors called "alleles". Each allele comes from a parent.

Genotype = All the genes of a beastie equal the genotype of the beastie. (Genes an organism possesses)

Genome: All the genetic material in the chromosomes of a particular organism; size generally given as its total number of base pairs.

Germ Cell- An egg or sperm cell. A gamete. In humans, a germ cell contains 23 chromosomes.

Haploid= A single set of chromosomes (half the full set of genetic material), present in the egg and sperm cells of animals and in the egg and pollen cells of plants. Human beings have 23 chromosomes in their reproductive cells.
Hemophilia = sex-linked recessive. Males get it most often.
Heterozygous = means alleles of a gene are "different".
Heterozygosity=The presence of different alleles at one or more loci on homologous chromosomes.
Homozygous = alleles of a gene are "the same"
Homologous chromosomes: A pair of chromosomes containing the same linear gene sequences, each derived from one parent
Huntington's Chorea = Autosomal Dominant. People die at 40 +... Jerky muscular motions
Hybrid = alleles of a gene are "different" (Hh) See heterozygous.
Independent Assortment: This is Johann Gregor Mendel's 2nd principle. States that alleles of one gene separate independently from alleles of another gene. In other words, eye color does not affect a person's ability to roll his or her tongue.
In vitro: Outside a living organism.
Karyotype: Photomicrograph of an individuals chromosomes arranged in a standard format showing the number, size, and shape of each chromosome type;
Linkage: Proximity of two or more genes on a chromosome; the closer together the genes, the lower the probability that they will be separated during meiosis and hence the greater the probability that they will be inherited together.
Linkage map: A map of the relative positions of genetic loci on a chromosome, determined on the basis of how often the loci are inherited together. Distance is measured in centimorgans (cM).
Locus (pl. loci): The position on a chromosome of a gene or other chromosome marker; also, the DNA at that position. The use of locus is sometimes restricted to mean regions of DNA that are expressed.
Meiosis = the kind of cell division that produces sperm and egg. Meiosis cuts the number of chromosomes in half. In humans, for instance, the nuclei of body cells contain 46 chromosomes. Due to meiosis, sex cells carry only 23 chromosomes – one chromosome from each original homologous pair.
Mendel, Johann Gregor = The father of genetics (said that traits are controlled by 2 factors etc...)
Mutation = Change in the DNA instructions. Change in DNA sequence. Change can be beneficial, detrimental or neutral. Ultimately results in change in protein. For instance, random genetic mutation gave rise to the dark phenotype of the peppered moth.
Non-Disjunction: When homologous chromosomes fail to segregate properly during meiosis. Down syndrome, Turner syndrome and Klinefelter syndrome result from non-disjunction.
Phenotype = the way an organism looks.(EXTERNAL CHARACTERISTICS)
Recessive = A small, weaker allele is recessive. (CANNOT EXPRESS ITSELF IN HETEROZYGOUS CONDITION)
Segregation = One of Mendel's principles. Mendel said all genes are comprised of 2 factors, one from each parent. Chromosomes segregate during meiosis. These factors (alleles) of a gene separate during the formation of gametes (sperm and egg). This ensures that each parent contributes 50% of their genetic information.
Sex chromosomes = chromosomes that determine sex (XY and XX)
Somatic Cell = Body cell that contains 46 chromosomes in humans.
Tay Sachs = Autosomal recessive. Children die young. Head enlarges....
Trait = is a feature of an organism.

Questions

1 Mark Questions

Q1. Mendel's work was rediscovered by three scientists independently. Name any two of them.

Q2. How do we predict the frequency of crossing over between any two linked genes ?

Q3. Why did Mendel select pea plant for his experiment?

Q4. In a monohybrid cross the genotypic and phenotypic ratio is 1:2:1. What type of Inheritance is it example of? Give one example

Q5. If a human zygote has XXY sex chromosomes along with 22 pairs of autosomes. What sex will the individual be? Name the syndrome

Q6. Which of the following is a dominant & recessive trait in garden pea-
Tall stem, constricted pod.

2 Mark Questions

Q7. A mother with blood group 'B' has a fetus with blood group 'A' father is 'A'. Explain the situations?

Q8. The genes for hemophilia are located on sex chromosome of humans. It is normally impossible for a hemophilic father to pass the gene to his son. Why?

Q9. Justify the situation that in human beings sex of the child is determined by father and not by mother?

Q10. What is trisomy? Give one example.

3 Marks Questions

Q11. A man with AB blood group marries a woman with AB blood group.

(i) Work out all possible genotypes & phenotypes of the progeny.

(ii) Discuss the kind of domination in the Parents & progeny.

Domination in Father – Co dominance
Domination in progeny - Dominance

Q12. Enumerate points to establish parallelism between chromosomes & genes.

Ans12. Refer Pg 82 NCERT Book (3)

Q13. What is 'Pedigree Analysis' ? What are the symbols generally used in it?

Ans13. Refer Pg87,88 of NCERT Book (3)

5 Marks Questions

Q14. A dihybrid heterozygous round, yellow seeded garden pea was crossed with a double recessive plant.

(i) What type of cross is this ?

(ii) Work out the genotype & phenotype of the progeny.

(iii) What principle of Mendel is illustrated by it ?

Ans14. Test Cross (1)
Working out (3)
Principle of segregation (1)

Q15. Describe the nature of inheritance of the ABO blood group in humans. In which ways does this inheritance differ from that of height of the plant in garden pea?

Ans15. Refer Pg 77 NCERT Book (3)
Dominance & multiple allelism where as height shows dominance (2)

Chapter 6. MOLECULAR BASIS OF INHERITANCE

DNA largest macromolecule made of helically twisted, two, antiparallel polydeoxyribonucleotide chains held together by hydrogen bonds.

- ➔ X-ray diffraction pattern of DNA by Rosalind Franklin showed DNA a helix.
- ➔ Components of DNA are (i) deoxyribose sugar, (ii) a phosphate, and (iii) nitrogen containing organic bases.
- ➔ DNA contains four different bases called adenine (A), guanine (G) cytosine (C), and thymine (T).
- ➔ These are grouped into two classes on the basis of their chemical structure: (i) Purines (with a double ring structure) and (ii) Pyrimidines (with a single ring structure)
- ➔ 1953.James Watson and Francis Crick proposed three dimensional structure of DNA
- ➔ DNA double helix with sugar phosphate back bone on outside and paired bases inside.
- ➔ Planes of the bases perpendicular to helix axis.
- ➔ Each turn has ten base pairs.(34 A^0)
- ➔ Diameter of helix 20 $A^{0.}$
- ➔ Two strands of DNA antiparallel.
- ➔ DNA found both in nucleus and cytoplasm.
- ➔ Extranuclear DNA found in mitochondria and chloroplasts.
- ➔ Two chains complementary
- ➔ Two chains held together by hydrogen bond.
- ➔ Adenine-Thymine pair has two hydrogen bonds.
- ➔ Guanine-Cytosine pair has three hydrogen bonds.
- ➔ Upon heating at temperature above 80-90 degree two strands uncoil and separate (Denaturation)
- ➔ On cooling two strands join together (renaturation /annealing)
- ➔ DNA is mostly right handed and B form.
- ➔ Bacterial nucleoid consists of a single circular DNA molecule .

PACKAGING OF DNA HELIX

DNA of eukaryotes is wrapped around positively charged histone proteins to form nucleosome.

Nucleosome contains 200 base pairs of DNA helix.

Histone octamer =2(H2a+H2b+H3+H4)

Linker DNA bears H1 protein

Chromatin fibres formed by repeated units of nucleosomes.

Non histone proteins required for packaging.

Regions of chromatin, loosely packed and stains lightly called euchromatin.

Regions of chromatin, densely packed and stains darkly is called heterochromatin.

DNA AS THE GENETIC MATERIAL

 Transformation experiment or Griffith effect.

- Griffith performed his experiments on Mice using *Diplococcus pneumoniae*.
- Two strains of bacteria are S-type and R-type cells.
- Experiments

 Living S-strain Injected into mice ⟶Mice killed

 Living R-strain Injected into mice ⟶ Mice lived

 Heat Killed S-strain Injected into mice ⟶ Mice lived

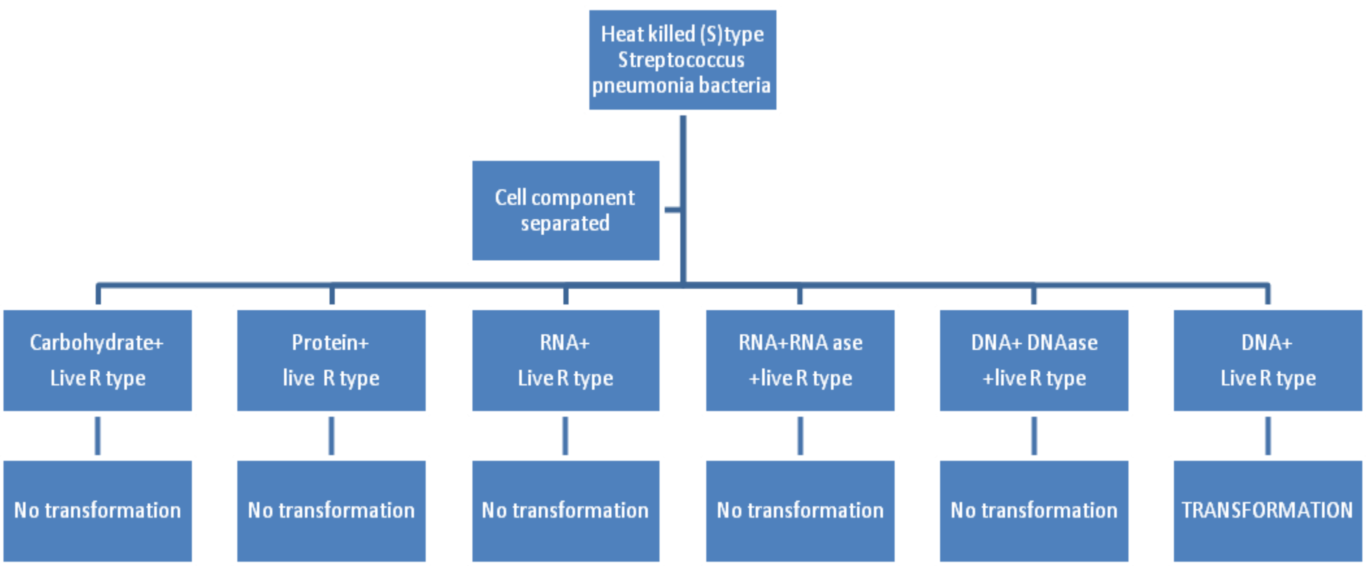
 Living R-strain + Heat Killed S-strain Injected into mice⟶ Mice killed

Grffith concluded that R type bacteria is transformed into virulent form.

Transformation is the change in the genetic constitution of an organism by picking up genes present in the remains of its relatives.

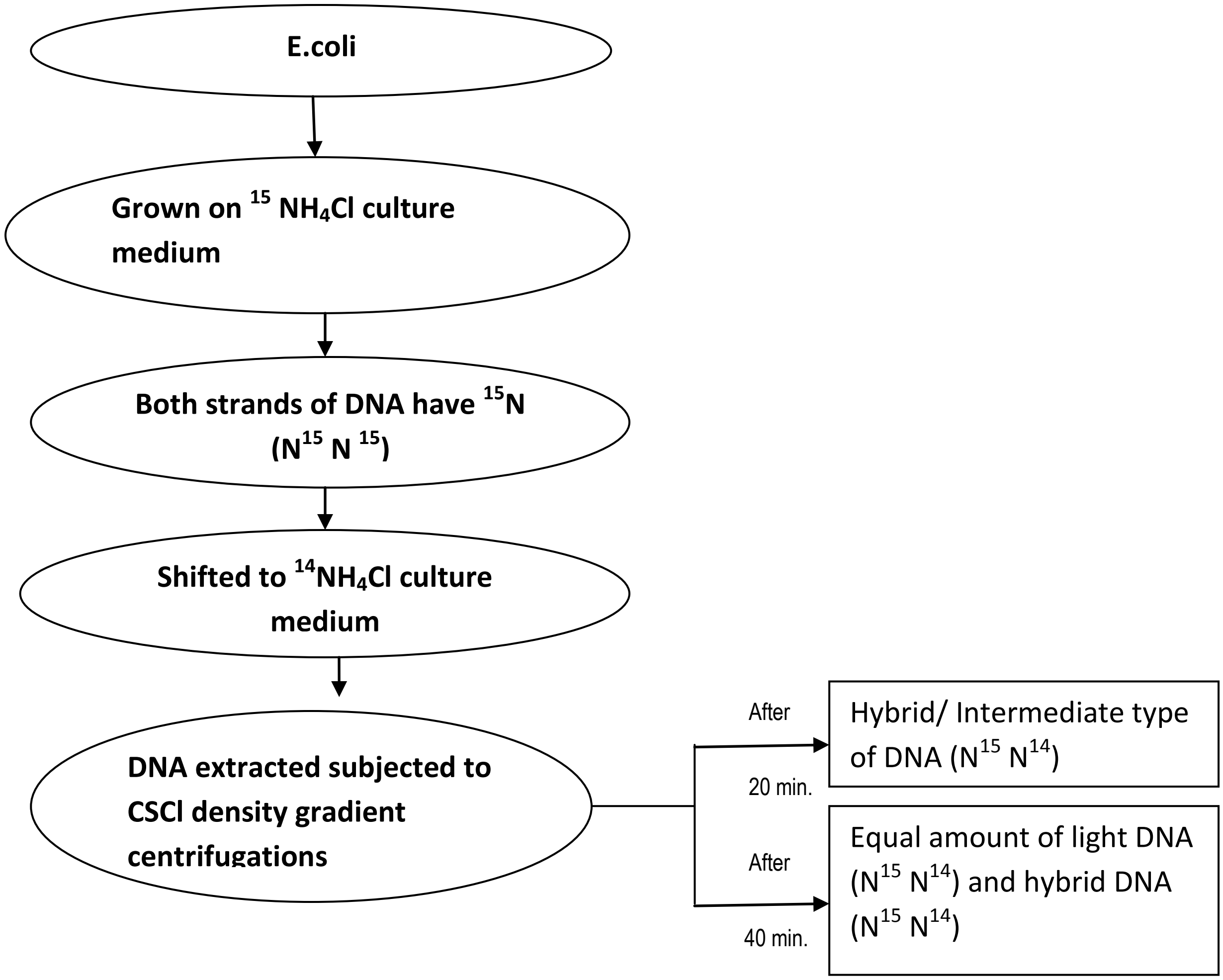
BIOCHEMICAL CHARACTERISATION OF TRANSFORMING PRINCIPLE

Proved by Oswarld Avery, Colin Macleod, Maclyn Mc Carty



From this we conclude that DNA is the genetic material.

Semi conservative nature of DNA Mathew Messelson and Franklin start.



8. 3 Replication of DNA In Eukaryotes Definition: "Process by which DNA produces daughter DNA molecules which are exact copies of the original DNA." In eukaryotes, DNA is double stranded. The two strands are complementary to each other because of their base sequences. **Semi-conservative method of DNA replication** Important points:

(i) Most common method of DNA replication.
(ii) Takes place in the nucleus where the DNA is present in the chromosomes.
(iii) Replication takes place in the S-phase (synthesis phase) of the interphase nucleus.
(iv) Deoxyribose nucleotides needed for formation of new DNA strands are present in nucleoplasm. At the time of replication, the two strands of DNA first separate. Each strand then acts as a **template** for the formation of a new strand. A new strand is constructed on each old strand, and two exactly identical double stranded DNA molecules are formed. In each new DNA molecule, **one strand is old** (original) while the **other is newly formed**. Hence, Watson and Crick described this method as **semi-conservative replication**. (A) An overall process of DNA replication showing replication fork and formation of new strands template and lagging template.

The various steps involved in this process are summarized as follows:

i. Mechanism of replication starts at a specific point of the DNA molecule, called **origin**.

ii. At origin, DNA strand breaks because of an **incision** (nick). This is made by an enzyme called **incision enzyme** (endonuclease).

iii. The hydrogen bonds joining the two strands are broken by the enzyme.

iv. The two strands start **unwinding**. This takes place with the help of a **DNA unwinding enzyme Helicases.** Two polynucleotide strands are thus separated.

v. The point where the two strands separate appears like a fork or a **Y-shape**. This is described as a **replicating fork**.

vi. A new strand is constructed on each old strand. This takes place with the help of a small **RNA primer** molecule which is complimentary to the DNA at that point.

vii. Each old DNA strand acts as a **template** (site) for the construction of new strand. The RNA primer attaches itself to the old strand and attracts the enzymes(**DNA polymerase III**) which add new nucleotides through ***base complementation***. The deoxyribose nucleotides are present in the surrounding nucleoplasm. New DNA strand is thus constructed opposite to each old strand

viii. Formation of new complementary strand always begins at the 3' end of the template strand (original strand) and progresses towards the 5' end (i.e in 3' **-** 5' direction). Since the new strand is ***antiparalle***l to the template strand, it is obvious that the new strand itself is always developed in the, 5'-3' direction. For this reason when the two original strands separate (then with respect to the origin of separation), one acts as 3'-5' template while the other acts as 5'-3' template.

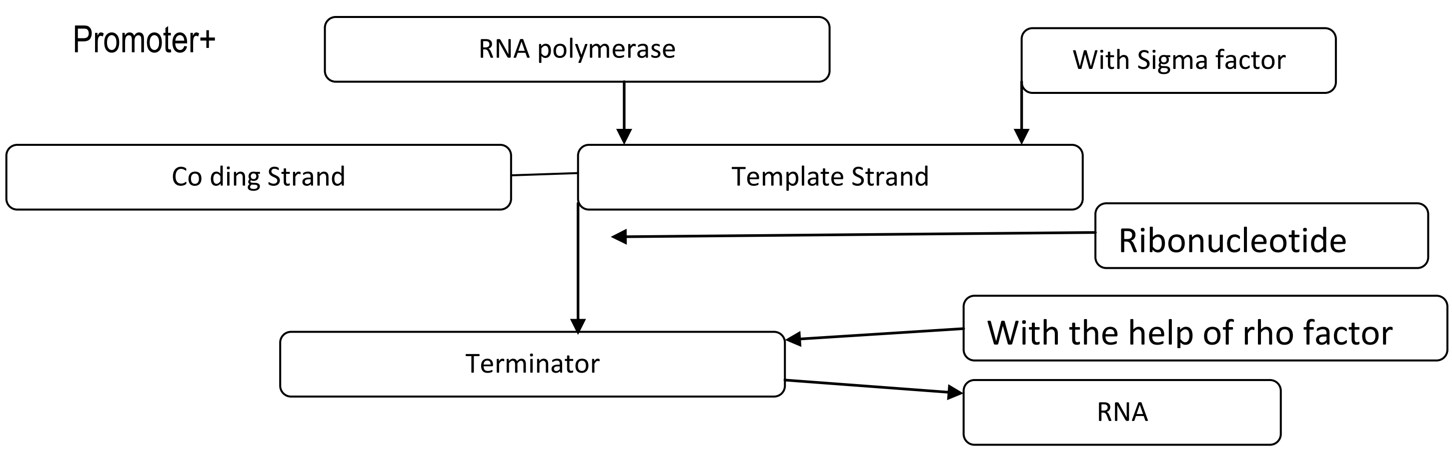
ix. Of the two, the replication of 3'-5' template begins first. Hence the new strand formed on it is called the **leading strand**. The other template (5'-3') must begin replication at the fork and progress back toward the previously transcribed fragment. The new strand formed on it is called the **lagging strand**.

x. Replication of the lagging strand takes place in small fragments called **Okazaki fragments**. These are then connected together by the enzyme **ligase.**

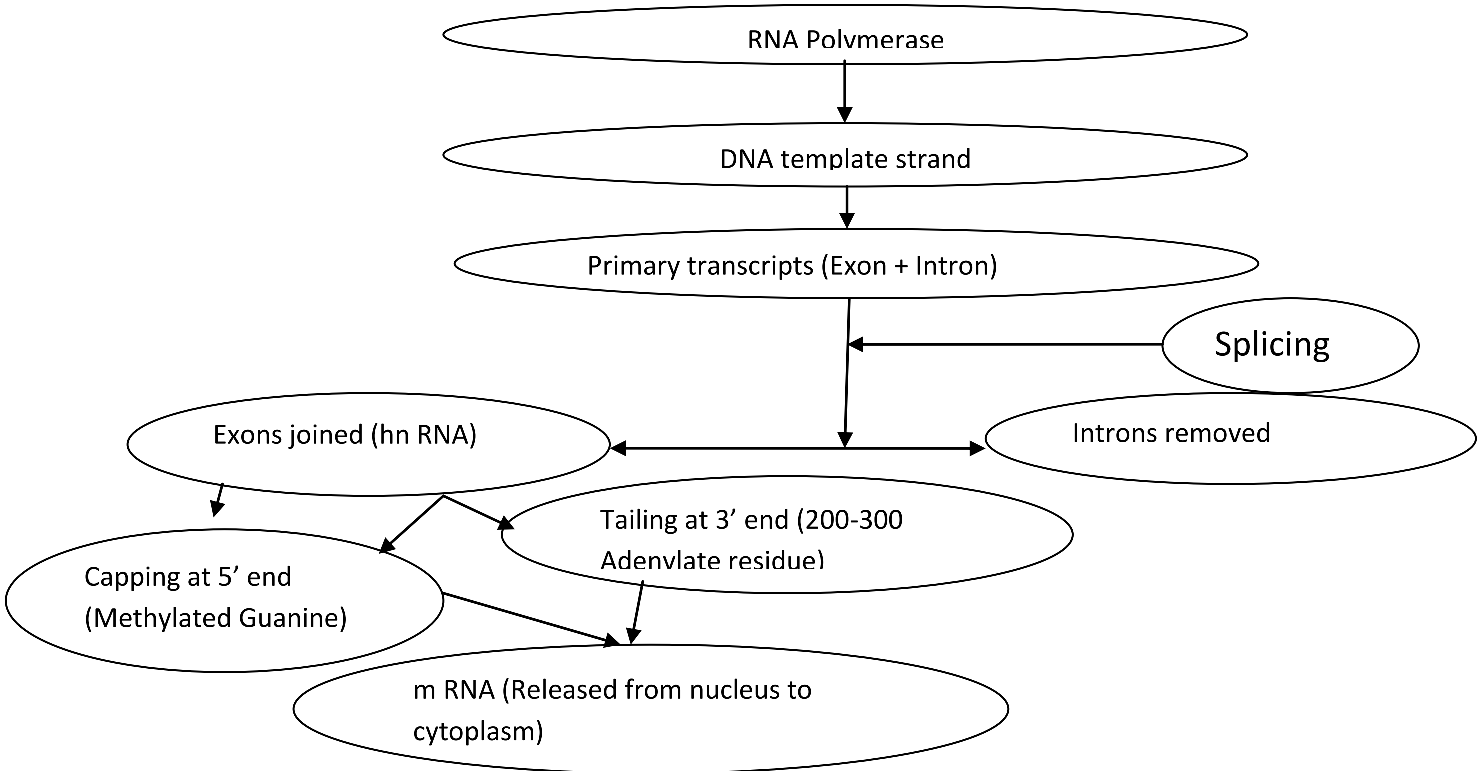
xi. Replication may take place in only one direction on the DNA helix (unidirectional) or in two directions (bidirectional).

xii. At the end of the process, two double stranded DNA molecules are formed from the original DNA molecule.

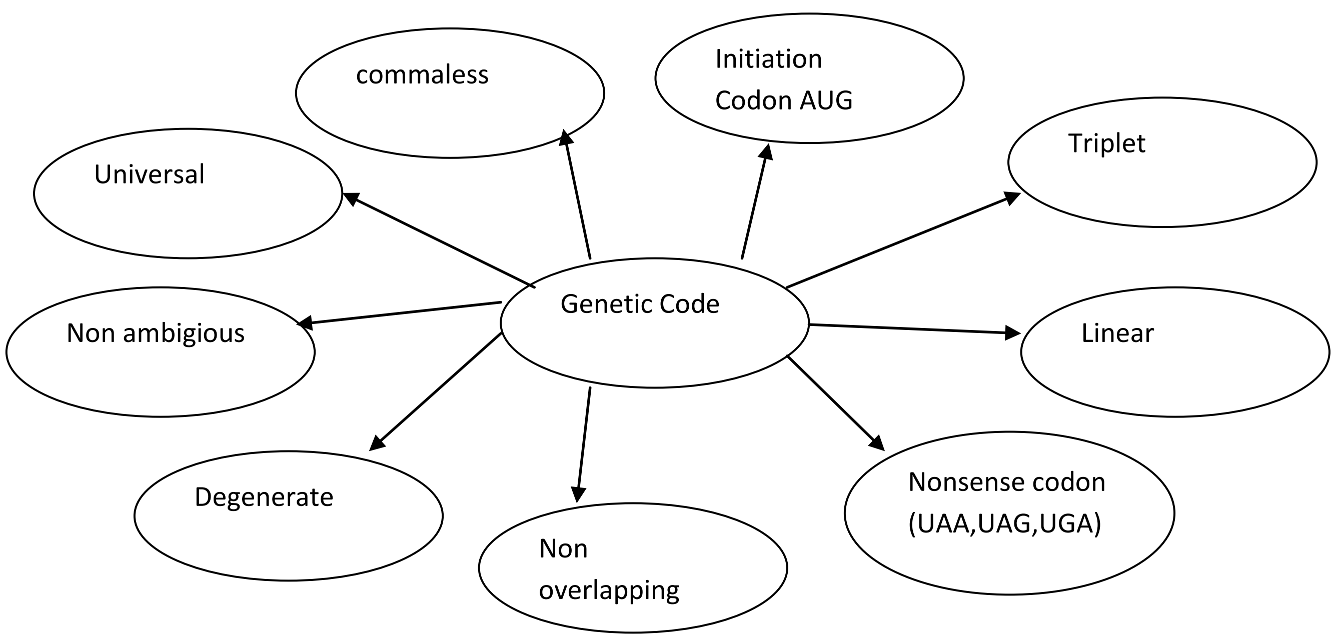
Transcription in Prokaryotes



Transcription in Eukaryotes



GENETIC CODE



Nonambiguous—Particular codon will always code for same amino acid.
Degenerate—Number of codons can code for one amino acid.
Universal—Specific codon codes for same amino acid in all organisms.

Translation:-

❖ Process of joining of amino acids by peptide bond to form a polypeptide.

1. Activation of amino acids
   - $AA+ATP+E \xrightarrow{Mg^{+2}} AA\text{-}AMP\text{-}E+ PPi$
   - $AA\text{-}AMP\text{-}E+tRNA \rightarrow AA\text{-}tRNA+AMP+E$

2. Initiation
   - Small subunit (40s) of ribosome binds with mRNA.
   - Charged t RNA specific for initiation codon reaches P site
   - Larger subunit (60s) of ribosome now combines with 40s-m RNA—t RNA ^{met} complex in the presence of Mg^{+2}

3. Elongation
   - Second t-RNA charged with amino acid occupies A site of ribosome.
   - Peptide bond formation between methionine and second amino acids with the help of enzyme peptide transferase.
   - Ribosomes moves over m RNA in 5'→3'

4. Terminator
   - Translation stops when non sense codons (Stop codons) reached.
   - No t RNA for stop codons (UAA,UAG,UGA)
   - Synthesized polypeptide is released with the help of release factor.

* AA—Amino acid
*ATP—Adenosine Triphosphate
*E—Pyrophosphate
AA—AMP-E-Amino acid adenylate enzyme complex
AA—t RNA—Amino acyl-t RNA complex

LAC OPERON

*Discovered by Jacob and Manod.
*Experimented on E.coli.
Refer to figure number 6.14 of page 117 of text Book

SWITCH OFF CONDITION

i-gene

↓

Repressor Protein + Operator gene

↓

RNA polymerase can not access the structural gene due to repressor –operator complex (ROC)

↓

No transcription of the structural gene

↓

No enzyme or protein formation

SWITCH ON CONDITION

i-gene

↓

Repressor Protein+ Inducer (Lactose)

↓

Repressor Inducer complex (RIC)

↓

Structural gene accessed by RNA polymerase (no blockage at operator)

↓

Transcription of Structural gene

↓

Enzyme/ protein formed

Methodologies of Human Genome Project

Sequence annotation (Sequence the whole set of genome)

Expressed sequence Tags (EST) (Identifying all the genes Expressed as RNA)

-Isolation of total DNA from the cell

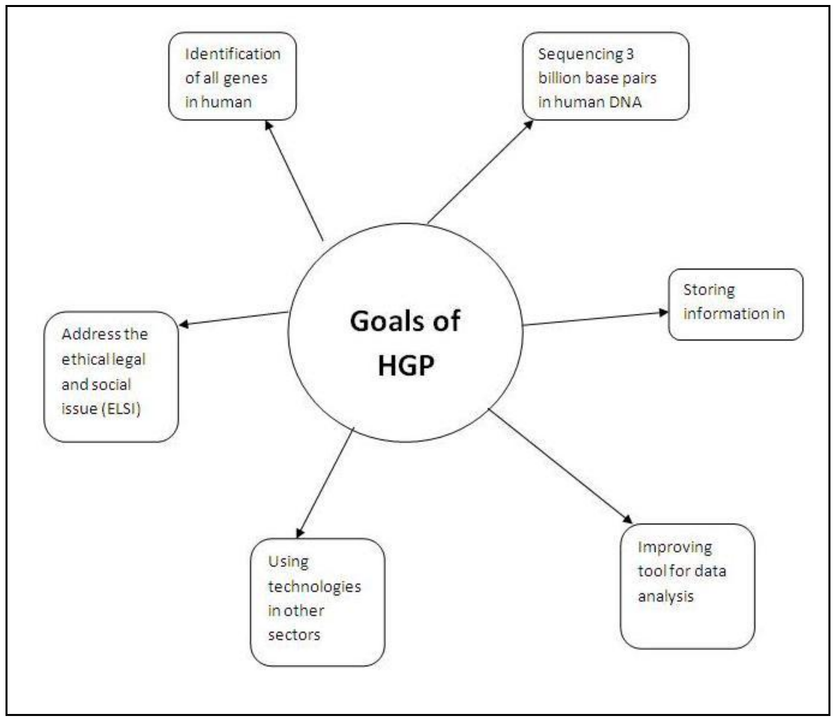
-Fragmentation by restriction endonuclease

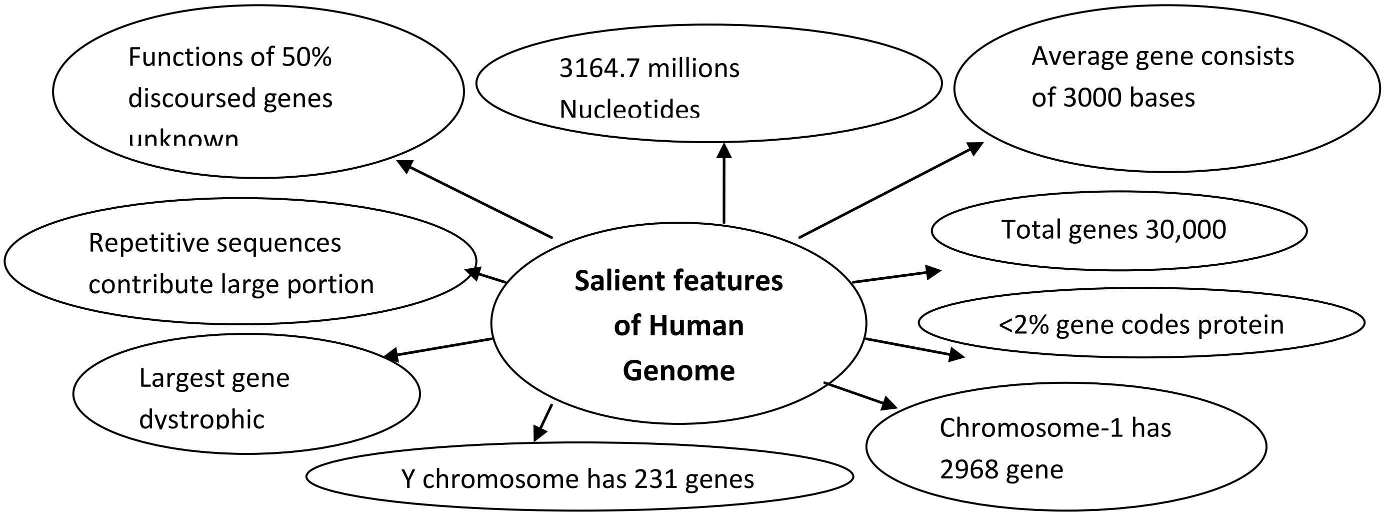
Fragments cloned in suitable host BAC/YAC

Fragments sequenced using automated DNA sequences.

Sequences arranged on the basis of overlapping regions.

Alignment of the sequences by specialized computer based programmes





Application of Human genome project

-: Identification of defective genes.
-: Opportunity to offer early treatment.
-: Identification of genes that confer susceptibility to certain disease.
-: Prediction of protein that the genes produce.
-: Drug designing to enhance or inhibit the activities of the proteins.

TECHNIQUE FOR DNA FINGER PRINTING

- Technique developed by Dr.Alec Jeffreys.
- Process is also known as DNA typing/DNA profiling.

DNA extraction from the cells in high speed refrigerated centrifuge
↓
Amplification of DNA content by PCR (Polymerase chain reactions)
↓
DNA fragmentation by Restriction endonuclease
↓
Gel electrophoresis
↓
Double stranded DNA split into single stranded
↓
Southern blotting (Transferring separated DNA to nylon or nitrocellulose sheet)
↓
Nylon sheet immerse in a bath having probes/marker* (Hybridisation)
↓
Nylon membrane pressed on X-ray film (Autoradiography)
↓
Dark band develops at probe site

*Probes/ Markers are radioactive synthetic DNA complementary to VNTR

QUESTIONS

ONE MARK QUESTION

1.Name the genetic material in TMV.

2.Write the scientific name of the plant on which Taylor et al performed their experiment.

3.What would be the proportion of light and hybrid density DNA molecules after 80 minutes of a single cell of E. coli growth?

4.When does DNA replicate in the cell cycle ?

5.Name the amino acids having only one codon.

TWO MARK QUESTION

1.What is meant by semiconservative nature of DNA replication?

2. What are the functions of DNA polymerase?

3. What is frame shift mutation ?Name the type of mutation that does not affect protein synthesis .

4.What are the untranslated regions (UTRs) ?

5.Briefly describe polymorphism.

THREE MARK QUESTIONS

1.Describe the discontinuous synthesis of DNA.

2. How is Lac operon “switched on” in an E.coli cell ?

3.Name the three RNA Polymerases found in eukaryotes and mention their functions.

4.Explain the two major approaches involved in the sequencing of genomes.

FIVE MARKS QUESTIONS

1.Describe the salient features of the double helical model of DNA.

2. Bring out the salient features of genetic code .

3.Describe in detail the steps in the technique of DNA finger printing.

4.Describe the process of replication of DNA.

5. What is satellite DNA ?Name their types. Mention their basis for the classification of satellite DNA.

CHAPTER-7: EVOLUTION

Evolution: Process that results in heritable changes in a population spread over many generations (change in allele frequencies over time) leading to diversity of organisms on earth. It is the genetic change in a population or species over generations(Genes mutate, individuals are selected, and populations evolve).

Evidences of evolution:

From comparative anatomy: Comparison of body structures amongst different species comes under comparative anatomy. Certain anatomical similarities among species bear witness to evolutionary history. e.g. the same skeletal elements make up the forelimbs of man, horse, whale and bat, but each of them performing different function. However, structural similarities in all mammals descended from a common ancestory with prototype forelimbs are common suggesting homology. Comparative anatomy confirms that evolution is a remodeling process. Ancestral structures that originally functioned in one capacity become modified as they take on new functions-'***descent with modification'.***

Homologous organs	**Analogous organs**
Same basic structural plan and origin but different function	Different structure and origin but same function
It **suggests common ancestry**	It **do not suggests common** ancestry
Indicates Divergent evolution	***Indicates Convergent evolution***
Thorn of *Bougainvillea* Tendril of *Cucurbits*	Thorn of citrus and spine of *Opuntia* Tendril of cucumbers and tendril of pea
Flipper of seal, wing of bat, cats paw, human hand	Wing of insect and wing of bird

Vestigial organs: functionless homologous organs that have no apparent function in certain organism. (supposed to be remnants of organs that had been well developed and functional in their ancestral state but had become modified during evolution)

E.g. 1. Vermiform appendix in man,2. Pelvic girdle in python,3. Nictitating membrane,4. Coccyx or tail vertebrae in man.

Divergent evolution	Convergent evolution
Origin of a variety of species from a common ancestral form Divergent evolution is the process of two or more related species becoming more and more dissimilar. As they adapted to different environments, the appearance of the two species diverged	Independent development of similar forms and features by unrelated organisms to adapt to a similar environment Unrelated species become more and more similar in appearance as they adapt to the same kind of environment
Homologous organs supports it	Analogous organs supports it

Divergent Evolution: Evolutionary pattern in which two species gradually become increasingly different. This type of evolution often occurs when closely related species diversify to new habitats. On a large scale, divergent evolution is responsible for the creation of the current diversity of life on earth from the first living cells. On a smaller scale, it is responsible for the evolution of humans and apes from a common primate ancestor. ***Adaptive radiation is one example of divergent evolution.***

Adaptive radiation: Diversification, over evolutionary time, of a species or group of species into several different species or subspecies that are typically adapted to different ecological Group of organisms diversify greatly and take on new ecological roles. (for example, **Darwin's finches in the Galapagos Island and Marsupials in Australia**).

Convergent Evolution :Convergent evolution takes place when species of different ancestry begin to share analogous traits because of a shared environment or other selection pressure. For example, whales and fish have some similar characteristics since both had to evolve methods of moving through the same medium: water.

Parallel Evolution :Parallel evolution occurs when two species evolve independently of each other, maintaining the same level of similarity. Parallel evolution usually occurs between unrelated species that do not occupy the same or similar niches in a given habitat.

Biological Evolution:

In the early 1800s French naturalist Jean Baptiste Lamarck suggested that evolution is a process of adaptation , the refinement of charecteristics that equip organisms to perform successfully in their environment.However, unfortunately we remember Lamarck for his erroneous view of how adaptation evolve (the inheritance of acquired characters).

Branching descent and natural selection are the two key concepts of Darwinian Theory of evolution. According to him all the species inhabiting earth today descended from ancestral species (descent with modification)and natural selection is the mechanism for such descent with modification. Natural Selection states that a population of organisms can change over the generations if individuals having certain heritable traits leave more offspring than other individuals, resulting in a change in the populations genetic composition over time.

Stabilizing selection favors the norm, the common, average traits in a population .In nature, natural selection is most commonly stabilizing. The average members of the population, with intermediate body sizes, have higher fitness than the extremes. Stabilizing selection culls extreme variants from the populations.

Directional selection shifts the overall makeup of the population by favoring variants of one extreme within a population. Natural selection may be directional: it may favor, for example, smaller individuals and will, if the character is inherited, produce a decrease in average body size. Directional selection could, of course, also produce an evolutionary increase in body size if larger individuals had higher fitness.

Disruptive selection, like directional selection, favors the variants of opposite extremes over intermediate individuals. Disruptive selection differs in that sudden changes in the environment creates a sudden force favoring that In nature, sexual dimorphism is probably a common example.

Founder Effect: A cause of genetic drift attributable to colonization by a limited number of individuals from a parent population. When few individuals colonize a new habitat, genetic drift will more than likely occur. The founder population is small and again the alleles present in this small population will not be representative of the original population. Saltation (from Latin, saltus, "leap") is a sudden change from one generation to the next, that is large, or very large, in comparison with the usual variation of an organism. The term is used for occasionally hypothesized, nongradual changes (especially single-step speciation) that are atypical of, or violate, standard concepts involved in neo-Darwinian evolution.

Natural Selection: states that a population of organisms can change over the generations if individuals having certain heritable traits leave more offspring than other individuals,resulting in a change in the populations genetic composition over time.

Artificial selection: Process by which humans breed animals and cultivate crops to ensure that future generations have specific desirable characteristics.(In artificial selection, breeders select the most desirable variants in a plant or animal population and selectively breed them with other desirable individuals).

Big bang theory: States that the universe began in a state of compression to infinite density, and that in one instant all matter and energy began expanding and have continued expanding ever since.

Genetic drift: Changes in the frequencies of alleles in a population that occur by chance, rather than because of natural selection.

Gene flow: movement of genes into or through a population by interbreeding or by migration.

Gene frequency: The frequency in the population of a particular gene relative to other genes at its locus. Expressed as a proportion (between 0 and 1) or percentage (between 0 and 100 percent).
Gene pool: All the genes in a population at a particular time.

Hardy-Weinberg principle: ***In population genetics, the idea that if a population experienced no selection, no mutation, no migration, no genetic drift, and are random mating,then the frequency of each allele and the frequencies of genotype in the population would remain the same (constant) from one generation to the next generation.***

p2 + 2pq + q2 = 1 or, (p + q)2 = 1

Calculation of allele frequencies

Recessive traits: If the frequency of a recessive trait such as cystic fibrosis or PKU is known, it is possible to calculate allele frequencies and genotype frequencies using the Hardy Weinberg equation and its assumptions are as follows:

i. say 1 in 1, 2500 Indian newborns have cystic fibrosis which means that the frequency of homozygotes for this recessive trait is

$q^2 = 1/2,500 = 0.0004$

ii. The square root of the frequency of recessives is equal to the allele frequency of the cystic fibrosis allele

q = (0.0004)0.5 = 0.02

iii. The frequency of the normal allele is equal to 1 - the frequency of the cystic fibrosis allele

p = 1- q = 1 - 0.02 = 0.98105

iv. The frequency of carriers (heterozygotes) for the cystic fibrosis allele is

2pq = 2 (0.98)(0.02) = 0.04 or 1/25

v. The frequency of homozygotes for the normal allele is

$p^2 = (0.98)^2 = 0.96$vi.

Thus the population is composed of three genotypes at the calculated frequencies of homozygous normal = 0.96, heterozygous carriers = 0.04, homozygous affected = 0.0004

Time period	**Name**	**Brain capacity**	**Remarks**
10-15 Mya	*Dryopithecus (ape like)*		East Africa, Asia; closely related to chimpanzee
	Ramapithecus (man like)		Shivalik Hills; erect posture, small canine
2 mya	Australopithecines (cave dwellers)	500cc	African Ape Man ; height 1.5mts
	Homo habilis	700cc	Tool Maker, Community Life
1.2 mya	*Homo erectus*	800cc to 1300cc	Knew how to use fire, larger teeth
100,000-40,000 mya	Neanderthal man	1450cc	East and central Asia
25000mya	*Homo sapiens*	1650cc	Modern man ; height1.5 to 1.8 mts; flat face

Synopsis of Human evolution Major Events during Geological Periods(Time scale):

PERIOD	EVENTS
Precambrian:	Origin of life, Oxygen evolution through photosynthesis
Cambrian	Flourishing of the invertebrates, increase in algal diversity, appearance of vertebrates.
Ordovician	Plants begin to colonize land.
Silurian	Increase in diversity of fish.
Devonian	Amphibians appear
Carboniferous	Extensive forest,dominance of amphibians,increase in diversity of insects,first reptiles appear.
Permian	Age of reptiles begin
Triassic	Dinosaurs evolve and spread, first mammal appear
Jurassic	First bird and first flowering plant appear.
Cretaceous	Dominance of flowering plants.
Tertiary	Age of mammals begin
Quarternary	Evolution of human, Large mammals and birds become extinct.

Organic Evolution Study Questions

1. Biological evolution is the cumulative changes that occur in a ____________________ over time.
2. The principle source of change (genetic variation) is due to this type of chromosomal event. _____________________
3. Charles Darwin published his landmark book entitled ____ in 1859.
4. In his book, Darwin states that the origin of all life forms is due to random
._______________
5. Darwin premise that all humans, animals, and bacteria share a common distant ancestor is explained with the concept of __________________ with
._________________________
6. Similarities of the structures of between dissimilar species (ex: arm bones) are called ________________ structures.
7. Darwinian Theory tells us that
_________________ + ________________ = new species
8. Neo-Darwinian Theory tells us that beneficial genetic mutations concentrated in a population over time can result in the formation of new ____________________.
9. List three characteristics that always provide a selective advantage.

Evolution Study Questions KEY

1. population.
2. Mutation
3. “The Origin of Species”
4. chance.
5. descent modification.
6. homologous.
7. mutability + natural selection = new species
8. species.
9. i. self defense ii. reproductive success iii. food gathering ability

Probable questions:

Short Answer Questions

1. Define evolution.
2. Explain the origin of the earth and atmosphere.
3 . Who conducted simulation experiments? What is the significance of this experiment? Explain the simulation experiment conducted to explain the origin of complex organic molecules from simple molecules.

Long Answer Questions

1. What are homologous organs? What is homology? What do the homologous organs explain as an evidence of organic evolution?
2. What are analogous organs? What is analogy?What do analogous organs explain as an evidence of organic evolution?
3. What are vestigial organs? How do they support the organic evolution? Name any four vestigial organs in human being.
4. Briefly explain the idea of natural selection taking **industrial melanism** or antibiotic resistance in bacteria as example.

Ans. Prior to industrialization, the number and frequency of white peppered moth far exceeded that of dark coloured peppered moth in Liverpool , England since the white moth got selective advantage over dark variety to avoid predation by concealing in the lichen infested grey tree trunk. However, after the industrialization, due to disappearance of lichen in a polluted ambience the dark peppered moth got selective advantage over white moth to avoid predation in the black tree trunk and hence got reproductive success due to directional selection. A reduction in air pollution due to clean air legislation again lead to reproductive success of the white variety. (industrial melanism)

5. What is geological time scale? How do you infer the evidence of evolution from it?
6. Discuss the evidences from morphology and comparative anatomy in support of organic evolution.
7. Comparative embryology gives no less a significant evidence in support of evolution than any other branch of biology. Substantiate.

8. Fossils are the documentary evidences in support of evolution. Discuss.

Ans Fossil record provides clear evidence for the evolution of species over time. It also documents the evolution of major new groups of organisms from previously existing organisms.Fossil records allow the biologist to reconstruct the history of life on earth.

9. Justify the statement" Galapagos islands are the living laboratories of Evolution".

Ans The Galapagos island are home to 13 species of finches which evolved on the Galapagos island in isolation from other finches.New species of finches evolved from the single species that originally colonize the island provide unique example of **adaptive radiation** thus , supporting evolution.

10. What is Hardy-Weinberg equilibrium? Write the Hardy-Weinberg equation.

11. What is genetic drift?

Ans Genetic drift is the effect of chance.

Genetic drift causes random changes in allele frequencies over time. Genetic drift can cause small populations to lose genetic variation.It can cause the fixation of harmful, neutral or beneficial alleles.

12. Define founder effect.

Ans Founder effect is a genetic bottle neck that results when a small group of individuals from a larger source population establishes a new population far from the original population.

13. What is gene flow?

Ans. Gene flow is nothing but exchanging alleles between populations.

Gene flow can introduce new alleles into a population, providing new genetic variation on which evolution can work. Gene flow makes the genetic composition of populations more similar

14.Discuss Darwin's theory of Natural Selection.

Ans. Natural selection is the effect of advantageous allele.

In natural selection(NS) , individuals that possess certain forms of an inherited phenotypic trait tend to survive better and produce more offspring than do individuals that possess other forms of trait. NS is the only evolutionary mechanism that consistently favors alleles that improve the reproductive success of the organism in its environment.

15.Discuss mechanisms of evolution.

Ans. Genetic variation is the raw material of evolution

Individuals within the populations differ in morphological, behavioral and biochemical traits , many of which are under genetic control. Genetic variation provides the raw material on which evolution can work.

Evolution can be summarized as a three step process

1) Mutations and genetic rearrangements caused by recombination occur at random .
2) These random events then generate inherited differences in the characteristics of individuals in populations.
3) Finally, mutation , gene flow , genetic drift and natural selection can cause allele frequencies to change over time.

Of the four mechanisms of evolutionary change, mutation, gene flow and genetic drift are influenced by chance events, while, natural selection is a random process.

CHAPTER 8 : HUMAN HEALTH AND DISEASES

IMPORTANT QUESTION

1.How do saliva and tear help to prevent bacterial infection?
Ans: -saliva and tear contain lysozymes.
-Lysozymes are the enzymes which digest the cell wall of bacteria
-By lysing the cell wall, they kill bacteria and prevent their infection.

2. What is vaccination?How does it help in producing immunity?
Ans:- Vaccination is the process of introducing a preparation of antigenic protein of the pathogens or weakened or killed pathogen into the body.
-The vaccines include quick multiplication of B and T-lymphocytes;some of them are stored as memory cells
-The B-lymphocytes quickly produced antibodies,which neutralize the antigen during infection.

3. Write the full form of ELISA.Give an example of the clinical application of ELISA?
Ans:--Enzyme Linked Immune Sorbent Assay.
-ELISA test is used in the diagnosis of AIDS,hepatitis-B and other STDs

4 .What are the advantages of people being healthy ?
Ans-When people are healthy,
a)They are efficient at work which consequently increases productivity and brings economic prosperity
b)Health increases longevity.
c)It reduces infant and maternal mortality

5 .a) Name the respective forms in which the malarial parasite gains entry into
i) Human body and
ii) Body of female Anopheles
b) Name the hosts where the sexual and the asexual reproduction of malarial parasite occur respectively
c) Name the toxin responsible for the appearance of symptoms of malaria in humans.Why do these symptoms occur periodically ?
Ans-(a) (i)-Sporozoite
(ii)-Gametocyte
(b) -sexual reproduction in mosquito
-asexual reproduction in human body.
(c) Haemozoin
- Haemozoin is released when the RBCs rupture and release the pathogen
-some cells of pathogen enter fresh RBCs and reproduce asexually and repeat the cycle; hence the symptoms appear periodically .

6. Define innate immunity. Name and explain the category of barrier which involves macrophages.
Ans. Innate immunity refers to all those defence elements with which a person is born and are always available to protect the body. **-**Macrophanges form part of the cellular barrier. **-**The cellular barrier includes the following specialized cells; (i) Polymorphonuclear leucocytes. (ii) Monocytes. (iii) Natural killer lymphocytes and (iv) Macrophages. - these cells phagocytose and destroy the invading microbes.

7. What is meant by writing H2L2 for an antibody? Name any four types of antibodies produced in our/human body?

Ans. - Each antibody molecule has four peptide chains. - Of them, two are small and called light chains (L) and two of them are longer and called heavy chains (H); hence written as H2L2. The four types of antibodies are IgA, IgE, IgG and IgM.

8. How do normal cells get transformed into cancerous neoplastic cells? Mention the differences between viral oncogenes and cellular oncogenes.

Ans. The transformation of normal cells into cancerous neoplastic cells is induced by physical, chemical and biological agents collectively called carcinogens; they lose the property of contact inhibition.

Difference:

Viral Oncogenes	Cellular Oncogenes
- These are the genes present in the oncogenic viruses, which effect oncogenic transformation of the cells they infect.	- These are the genes present in normal cells and code for growth factors; when activated under certain conditions, can cause oncogenic transformation of the cell.

9(i) Explain metastasis. Why is it fatal?

(ii) The lymphocytes are of two types B and T-cells. Why are they called so? (iii) A person was injured in a road accident and required an urgent immune response. What should be done?

Ans. (i) Metastasis is the property of tumor cells, which get separated from a tumor, spread to different sites in the body through body fluids and produce secondary tumors wherever they are lodged. Since secondary tumors are formed at several parts of the body, it is difficult to be diagnosed and treated; hence it is fatal.

(ii) Those lymphocytes which undergo maturation in the bone marrow are called B-cells while those which undergo maturation in the thymus are called T-cells.

(iii) Vaccine against Tetanus.

Chapter-9 strategies for enhancement in food production

Animal Breeding-objectives:
1.Improved growth rate.
2.Increased production
3. Improve Desirable Qualities.
4.Improved resistance to diseases
5.Improved resistance to adverse environmental conditions

Methods: i).**Inbreeding**:-Breeding between same breed for 4-6 generations.Eg.- cows, baffaloes, poultry **In breeding depression**- continued in breeding reduces fertility even productivity. A single outcross often helps to overcome inbreeding depression
ii) **Outbreeding**- breeding between unrelated animals Of two types –

1.) **Out crossing-** mating within the same breed but not having ancestors.

2.) **Crossbreeding**- superior males of one breed are mated with superior females of another breed to get better progency.e.g.- cows of inferior breed with superior bull. **Hisardale**- is a new breed of sheep developed in Punjab by crossing Bikaneri Eves and Marano Rams.

3*)* **Interspecific hybridization**- male and female animals of two different species are mated. E.g.- mule is crossbreed of male donkey and female horse.

4) Control breeding- it is done by artificial insemination and multiple ovulation embryo transfer technology (MOET)
(a) Artificial insemination- semen of superior male is collected and injected unto the reproductive tract of selected female. The spread of certain diseases can be controlled by this method.
(b) **MOET-** This is a technique for herd improvement. Hormones(FSH) are given to the cow for inducing follicular maturation and super ovulation. The cow is either mated with best bull or inseminated .It is done in cattle, sheep, rabbits etc.

Steps in Plant breeding:-
1 **Collection of variability**-Collection and preservation of all different wild varieties, species, relatives of cultivated species etc. are also called germplasm collection.
2.**Evaluation and selection of parents**-Germplasm is evaluated to identify plants with desirable traits.
3.**Cross hybridization among the selected parents**-Two plants having two desired characters are hybridized to get new hybrid having two desired characters.
4.**Selection and testing of superior recombinants**-Selection of the plants having desired character combinations.
5.**Testing,release and commercialization of new cultivars**-Newly selected lines are evaluated for their yield, agronomic traits, disease resistance etc. and released into the market.

Green revolution - Crop production.
White revolution - Milk production
Blue revolution - Fish production

Biofortification-Breeding crops with higher levels of proteins, vitamins and minerals e.g.vit C rich bitter gourd,mustard,tomato; protein rich beans lablab etc.

SCP (Single cell protein)-Microbes such as bacteria, yeast, algae are treated in various ways and used as food. Eg-spirulina can be grown in waste water(from potato processing plant)

Tissue culture- cultured with any plant part called **explant.**
Types –
1.**Meristem Culture** –When apical part is taken and cultured.
Uses: a*)*Rapid clonal multiplication
b*)*Production of virus free plants
c)Production of transgenic plants
d)Germplasm collection

2. Protoplast culture and somatic hybridization- The plant cell lacking cell wall is protoplast. Fusion of protoplast is done by Polyethylene glycol. Pomato is somatic hybrid of potato and tomato**.**
3.Micropropagation-Tissue culture technique used for rapid vegetative propagation of ornamental plants and fruit trees
4.**Somaclone**-Plants obtained from single plants by vegetative propagation.

Questions

I MARK

Q1.Name two techniques involved in controlled breeding experiments.
Q2.What is blue and green revolution?
Q3. What is inbreeding depression?
Q4. What is 'Heterosis'or hybrid vigour?
Q5.Name the Indian variety of rice patented by an American company.
Q6.What is Pomato?
Q7 .Name the algae used as protein rich food.
Q8.Expand-MOET and SCP.
Q9.What is quarantine?
Q10.What is cultivar?

2 MARK

Q1. What is Biofortification?
Q2.Which part of the plant is best suited for making virus free plants?
Q3.What is breed? What are the objectives of animal breeding?
Q4.Define out-crossing? Suggest an advantage.
Q5.What is artificial insemination?what is its importance?
Q6. What are the differences between aqua and pisciculture?
Q7. What is animal husbandry?
Q8. What is bird flu?
Q9. Name the most common species of honey bees of India?what are the products from the honey bees?
Q10. What is germplasm?How it is maintained?

3MARKS QUESTIONS

Q1.What does inbreeding mean? Suggest its advantages. What is the danger of inbreeding?

Q2.Name the methods employed in animal breeding. Which method is the best? Why?

Q3. Explain the procedure of MOET technique in cattle.

Q4. What is interspecific hybridization ?Give one example of crop in which it practiced and mention one advantage.

Q5. What is cross-breeding ?what advantages does it have? Give example

5 MARKS QUESTIONS

Q1. Explain the points that have to be considered for successful bee- keeping?

Q2. Write the scientific name of sugarcane grown in north and south India respectively. Mention their characteristic features. Mention the characteristic of the hybrid produced by crossing these two varieties .

Hint :North – Saccharumbarberi. South – Saccharumofficinarum . High yield , thick stems , higher sugar content , ability to grow in both North and South India

Q 3. Describe various steps involved in plant breeding.

Hint: Collection of variability, Evaluation and selection of parents, Cross hybridisation among the selected parents, Selection of testing of superior Recombinants, Testing , release and comercialisation of new cultivars

Chapter – 10: Microbes in Human Welfare

Microbes are present everywhere.

E.g. Thermal vents of geyser (Temp. above 1000c)

- Deep in soil.
- Under snow.
- **Diverse**. Protozoa, Bacteria, Fungi, Virus, Viroids, Prions (Proteinaceous infectious agents)
- **Useful** : Antibiotics.
- **Harmfu**l: cause diseases.

In Household Products:

- Everyday : Lactobacillus (LAB) Lactic acid Bacteria – form curd from milk.
- Increase Vit . B12
- Check disease causing microbes in our stomach.
- Fermentation of dough for dosa, idli (CO_2 produced)
- Making bread –Baker's yeast.***Saccharomyces cerevisiae*.**
- **Toddy** made from sap of palm.
- Cheese making (eg.Swiss cheesse by ***Propionibacterium sharmanii***, Roquefort cheese by fungi.)

In Industrial Products :

- Beverages and antibiotics.
- Fermentors : Large vessels for growing microbes.

Fermented Beverages :

- Beverages like wine, bear, whisky, Brandy, Rum (***Saccharomyces cerevisiae***)

Malted cereals and fruit juices used to produce ethanol, wine and beer produced without distillation. Whisky, brandy, rum produced after distillation.

Antibiotics : (Against life)

- Penicillin produced by Alexander Fleming from ***Penicillium notatum*** while working with *Staphylococci* Earnest Chain and Howard Plorey awarded Nobel Prize in 1945 for establishing Penicillin as an effective antibiotic.
- Uses : Treat diseases like plague, whooping cough, diphtheria, leprosy.

Chemicals: Enymes and other Bioactivities Molecules: Uses:

- ***Aspergillus niger*** for production of Citric Acid.
- **A *cetobacter aceti*** for production of Acetic Acid.
- ***Clostridium butylicum*** for production of Butynic Acid.
- Lactobacillus for production of Lactic acid.

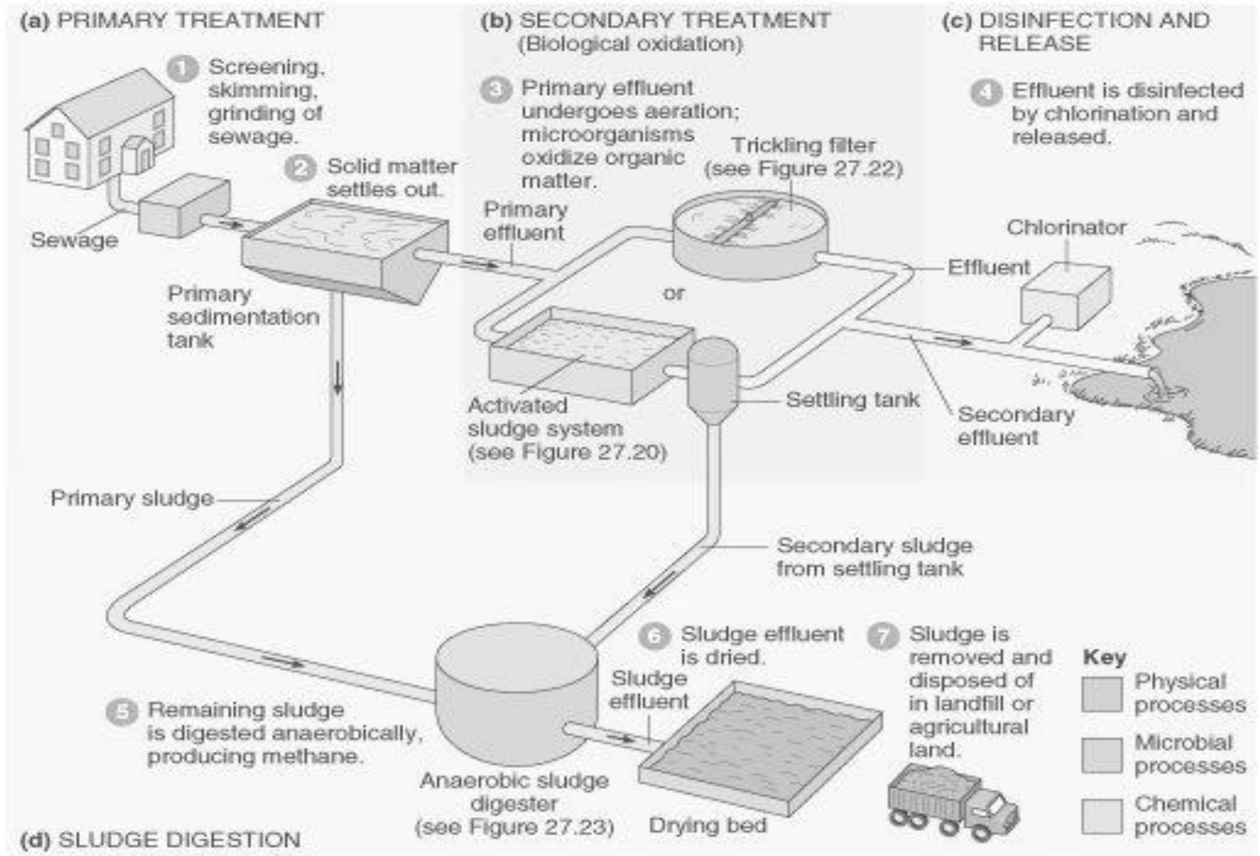
- Lipases used in detergents to remove oil strains from Laundry.
- Pectinases and Proteases to clarify bottled jucies.
- **Streptokinase** (from ***Streptococcus)*** as clot buster in patients with myocardial infraction (heart attack).
- ***Cyclosporin A***– an immunosuppresant used in organ transplant patients (produced by ***Trichoderma polysporum***)
- **Statins** produced by yeast ***Monascu spurpureus*** used as blood, cholesterol lowering agent.

Microbes in sewage Treatment:

- Major component of waste water, human excreta.
- Waste water sewage.
- Cannot be disposed directly into rivers and streams.
- Before disposal sewage treated in sewage treatment plants (STPs)
- Treatment done in two stages.
- Primary : Physical removal of particles large and small by filtration and sedimentation.

Solids – primary sludge.

- Supernatant – effluent.
- Secondary: Primary effluent taken to large aeration tanks.
- Agitated mechanically and air pumped into it.
- Aerobic microbes form masses with fungal filaments flocs.
- Microbes consume organic matter in effluent for growth.
- BOD (Biological oxygen demand) reduced.
- Passed into settling tank.
- Bacterial flocs sedimented (activated sludge)
- Small part of activated sludge used as inoculums in aeration tank.
- Major part pumped into large anaerobic sludge digesters.
- Anaerobic bacteria digest bacteria and fungi.
- Bacteria produce gases such as menthane, hydrogen sulphide and CO2 – Biogas.
- Secondary effluent released into rivers and streams.
- No man made technology available till date.
- Untreated sewage if released into rivers causes pollution.
- Ministry of environment and Forests iniatiated, Ganga Action Plan and Yamuna Action Plan.



- Concrete tank 10- 15 mts deep, & slurry of dung fed.
- Floating cover placed above rises as biogas content rises.
- Connecting pipe for supply of biogas.
- Used for cooking and lighting.
- Development by IARI :- Indian Agriculture Research institute & KVIC:-Khadi and village Industries Commission.

Microbes as BiocontrolAgents :

- Insecticides and Pesticides toxic, harmful & are pollutants.
- Natural predation better method.
- No of pests kept in check, not totally eradicated.
- Food chains not disturbed
- Eg. Ladybird and Dragon flies useful to get rid of aphids and mosquitoes.
- ***Bacill us huringiensis***(Bt) used to control butterfly caterpillar.
- Mode of spores operation.

oAvailable is sachets, mixed with water and sprayed on plants.

oEaten by insect larva

oToxin released in gut kills larvae.

- Now Bt toxin genes introduced into plants – resistant to insect pests.

e.g. Bt cotton.

- ***Tungus trichoderma*** now being developed.
- ***Nucleo polyhedrovirus***– good for narrow spectrum insecticide applications.

Advantages :-

- No negative impacts on plants, mammals, birds, fish or target insects.
- For overall IMP (Intergrated pest Management) programme.
- For ecologically sensitive areas.

As Biofertilizers:

- Chemical fertilizers major pollutant.
- Switch to organic farming and use of biofertilizers need of the time.
- Main sources of biofertilizers. **Bacteria, Fungi & Cyanobacteria.**

Eg Rhizobium present in roots of leguminious plants fix atmospheric nitrogen into usable organic form. **Azospirillium** and **Azotobacter** – free living bacteria – fix atmospheric Nitrogen.

- Symbiotic Associations

Eg.Genus **Glomus sp**. form **mycorrhiza**

- Fungal symbiont absorbs phosphorus from soil and passes it to plant.
- Plants show
  - resistance to root – borne pathogens.
  - Tolerance to salinity and drought
  - Increase in growth and development.
- *Cynobacteria*– autotrophic – fix atmospheric nitrogen
- Imp.biofertilizer.

e.g. ***Anabaena, Nostoc, Oscillatoria*.**

- **Blue green algae** – increase fertility by adding organic matter.
- No. of biofertilizers are commercially available.

Process of sewage treatment in STP

a)Primary treatment(physical)

b)Secondary treatment(biological)

Effluent loaded in large aeration tank, Agitation & rapid growth of aerobic microbes (flocs) ,Consumes organic matter ,reduces BOD, Effluent passed to settling tank, Flocs sediments form – **activated sludge(A.S.),**Poured into sludge digester(small amount of A.S. used as inoculum) Filtration & sedimentation.

Process of sewage treatment in STP

Primary treatment (physical)

↓

Filtration & sedimentation

Secondary treatment (biological)

↓

Filtration &sedimentation

↓

Agitation & rapid growth of aerobic microbes (flocs)

↓

Consumes organic matter, reduces BOD

↓

Effluent passed to settling tank

↓

Flocs sediments form – **activated sludge**

↓

Anaerobic Sludge Digester

Form Biogas

Water released into rivers and streams

<u>Questions</u>

(1 mark)

1. Name two vitamins produced by microbial fermentation.

2. What is the botanical name of baker‘s yeast?

3. Milk starts to coagulate when lactic acid bacteria is added to warm milk as a starter. Mention two benefits LAB provides

(2 marks)

1. State the use of:

- *Trichoderma* with respect to organ transplant
- Nucleopolyhedrovirus with respect to pest management

2. Why should sewage be treated before its disposal?

3. What is primary sludge?

4. Name the pests, lady birds and dragonflies help to get the rid of respectively

5. Give the role of microbes in single cell protein.

6. What is micorhiza? How does it help as biofertilizers?

7. What is BOD? What does it mean if a water sample has more BOD?

8. Name any two cyanobacteria. How do they serve as main source of biofertilizer ?

9. What is the difference between Bt and Bt cotton? Explain the use of Bt as a biological control.

10. Give reason-

a) Bottled fruit juices brought from market are clearer as compared to those made at home,

b) Large holes are found in swiss-cheese,

c) The insect which are so called pest are not eradicated in organic fumes.

11. Name the gobar gas liberated from biogas plant. Which type of bacteria are responsible for its production? Give advantage.

(3 marks)

1. Differentiate between
 a) Primary sludge and activated sludge,
b) Biofertilizer and chemical fertilizer,
c) Primary sewage treatment and secondary sewage treatement.

(5 marks)

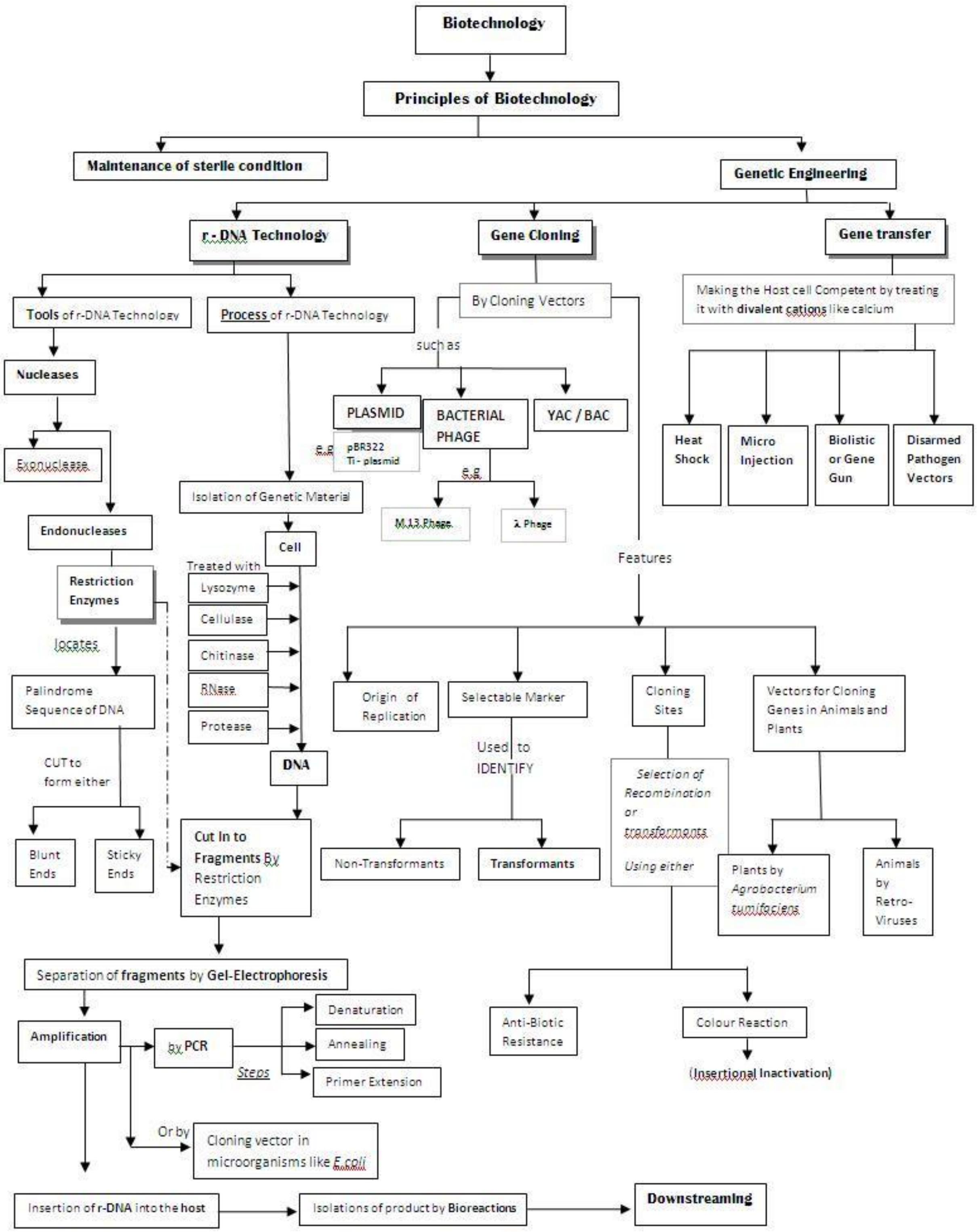
1.Answer briefly:

1) How is sewage harmful to man?
2) What is organic farming?
3) Which group of organisms attack insect and arthopod? How are they best biocontrol biological agent,
4) What is the difference between flocks and primary sludge?

2.Write short notes on: a) bakers yeast, b) alcohol c) statin d)Brewers yeast e) streptokinase

Chapter-11: BIOTECHNOLOGY: PRINCIPLES AND PROCESSES

CONCEPT MAP :-



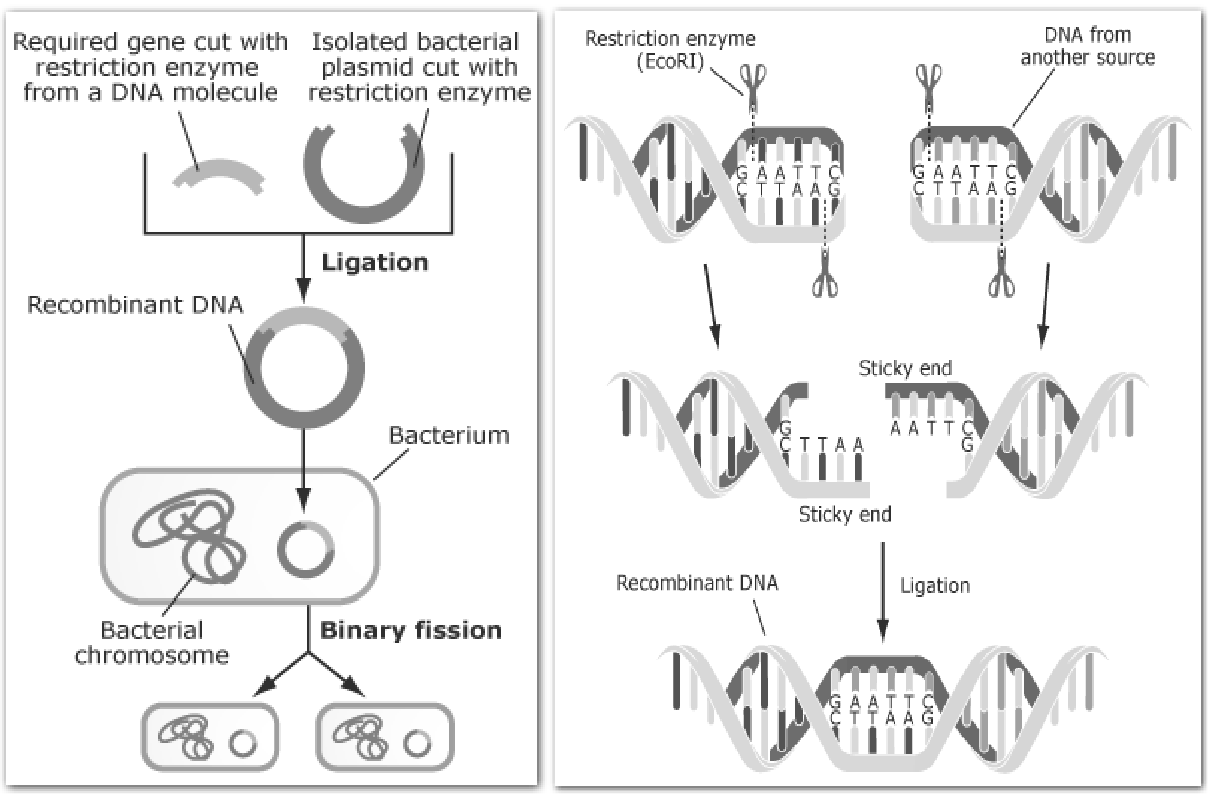
Biotechnology is a broad area of science involving multiple disciplines designed to use living organisms or their products to perform valuable industrial or manufacturing processes or applications pertaining to human benefit.

Recombinant DNA technology:

An organism's genome contains virtually all the information necessary for its growth and development

Steps in producing recombinant DNA

1. The required gene is cut from a DNA molecule using a restriction enzyme.
2. A bacterial plasmid is isolated and cut with the same restriction enzyme. This ensures cut ends are complementary (same base sequence) to the ends of the required gene.
3. The required gene is joined to the plasmid using the enzyme DNA ligase in a process called ligation.
4. The resulting recombinant plasmid is returned to the bacterial cell.
5. The bacteria reproduce and the required gene is cloned.



How do we obtain DNA and how do we manipulate DNA?

Quite straightforward to isolate DNA

For instance, to isolate genomic DNA

1. Remove tissue from organism
2. Homogenise in lysis buffer containing guanidine thiocyanate (denatures proteins)
3. Mix with phenol/chloroform - removes proteins
4. Keep aqueous phase (contains DNA)
5. Add alcohol (ethanol or isopropanol) to precipitate DNA from solution
6. Collect DNA pellet by centrifugation
7. Dry DNA pellet and resuspend in buffer
8. Store at 4°C

Each cell (with a few exceptions) carries a copy of the DNA sequences which make up the organism's genome.
How do we manipulate DNA?
It used to be difficult to isolate enough of a particular DNA sequence to carry out further manipulation and/or characterisation of its molecular sequence

Recombinant DNA Technology

Techniques for

- Isolation
- Digestion
- Fractionation
- Purification of the TARGET fragment
- Cloning into vectors
- Transformation of host cell and selection
- Replication
- Analysis
- Expression of DNA

DNA is manipulated using various enzymes that modify and/or synthesise it
Until 1970 there were no convenient methods available for cutting DNA into discrete, manageable fragments.
1970 - **The Beginning of the Revolution**
Discovery of a **restriction enzyme** in the bacterium *Haemophilus influenzae*

Restriction enzymes

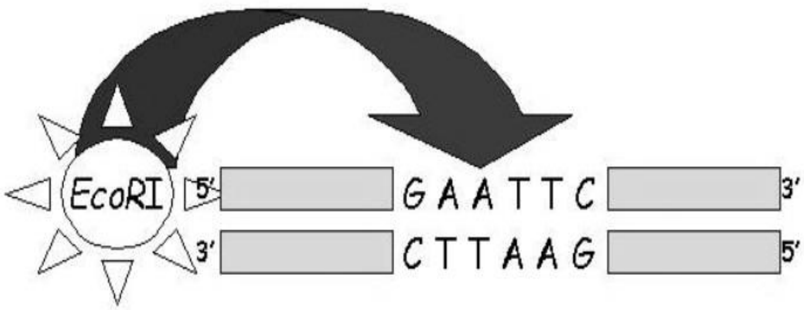
. Restriction enzymes are endonucleases

- Bacterial enzymes
- Different bacterial strains express different restriction enzymes
- The names of restriction enzymes are derived from the name of the bacterial strain they are isolated from
- Cut (hydrolyse) DNA into defined and **REPRODUCIBLE** fragments
- **Basic tools of gene cloning**

Names of restriction endonucleases
Titles of restriction enzymes are derived from the first letter of the genus +
the first two letters of the species of organism from which they were isolated.

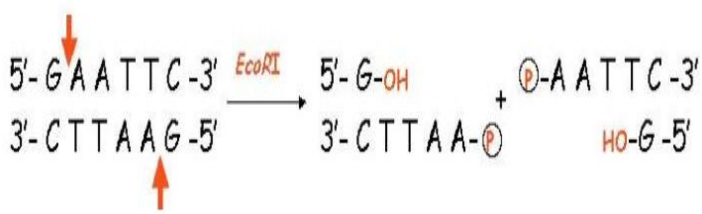
Source microorganism	Enzyme	Recognition Site	Ends produced
Arthrobacter luteus	*Alu* I	AG▯CT	Blunt
Bacillus amyloiquefaciens H	*Bam* HI	G▯GATCC	Sticky
Escherichia coli	*Eco* RI	G▯AATTC	Sticky
Haemophilus gallinarum	*Hga* I	GACGC$(N)_5$▯	Sticky
Haemophilus infulenzae	*Hind* III	A▯AGCTT	Sticky
Providencia stuartii 164	*Pst* I	CTGCA▯G	Sticky
Nocardia otitiscaviaruns	*Not* I	GC▯GGCCGC	Sticky
Staphylococcus aureus 3A	*Sau* 3A	▯GATC	Sticky
Serratia marcesans	*Sma* I	CCC▯GGG	Blunt
Thermus aquaticus	*Taq* I	T▯CGA	Sticky

Restriction enzymes recognise a specific short nucleotide sequence



This is known as a Restriction Site

The phosphodiester bond is cleaved between specific bases, one on each DNA strand

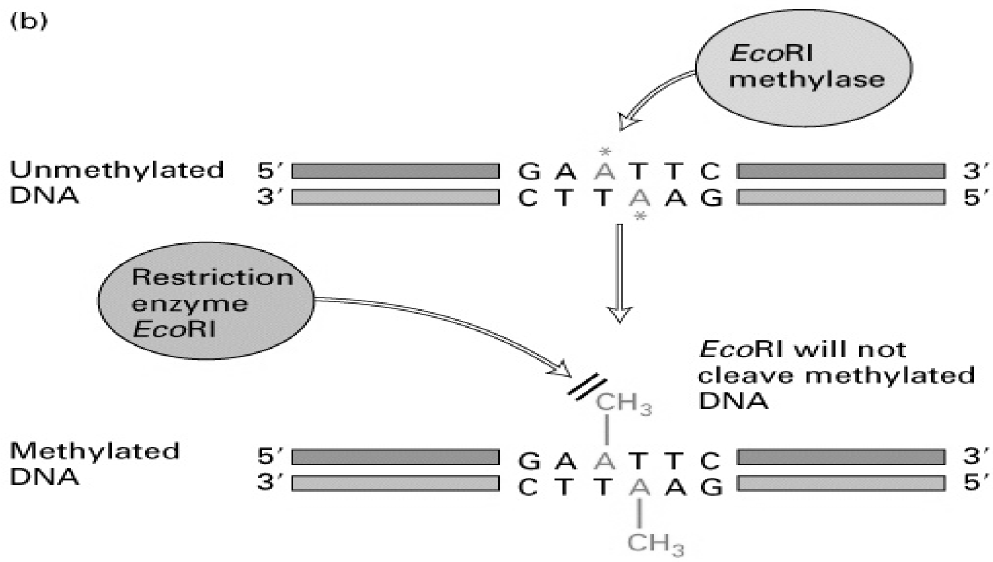


The product of each reaction is two double stranded DNA fragments

Restriction enzymes do not discriminate between DNA from different organisms

Restriction endonucleases are a natural part of the bacterial defence system

- Part of the restriction/modification system found in many bacteria
- These enzymes **RESTRICT** the ability of foreign DNA (such as bacteriophage DNA) to infect/invade the host bacterial cell by cutting it up (degrading it)
- The host DNA is **MODIFIED** by **METHYLATION** of the sequences these enzymes recognise
    - Methyl groups are added to C or A nucleotides in order to protect the bacterial host DNA from degradation by its own enzymes



Types of restriction enzymes

- Type I Recognise specific sequences·but then track along DNA (~1000-5000 bases) before cutting one of the strands and releasing a number of nucleotides (~75) where the cut is made. A second molecule of the endonuclease is required to cut the 2nd strand of the DNA
    - e.g. *Eco*K.
    - Require Mg^{2+}, ATP and SAM (S-adenosyl methionine) cofactors for function
- Type II Recognise a specific target sequence in DNA, and then break the DNA (both strands), within or close to, the recognition site
    - e.g. *Eco*RI
    - Usually require Mg^{2+}
- Type III Intermediate properties between type I and type II. Break both DNA strands at a defined distance from a recognition site
    - e.g. *Hga*I
    - Require Mg^{2+} and ATP

Hundreds of restriction enzymes have been isolated and characterised

- Enables DNA to be cut into discrete, manageable fragments
- Type II enzymes are those used in the vast majority of molecular biology techniques
- Many are now commercially available

Many Type II restriction endonucleases recognise PALINDROMIC sequences (From Greek palindromos, *running back again, recurring* : palin, *again)*

A segment of double-stranded DNA in which the nucleotide sequence of one strand reads in reverse order to that of the complementary strand. (always read from the same direction)

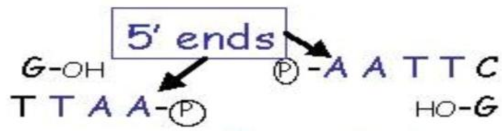
For example, *Eco*RI recognises the sequence

5'-G A A T T C-3'

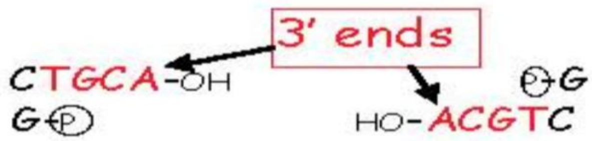
3'-C T T A A G-5'

Different enzymes cut at different positions and can create single stranded ends ('sticky ends')

- Some generate 5' overhangs - eg: *Eco*RI



- Some generate 3' overhangs - eg: *Pst*I



Some generate blunt ends- eg: *Sma*I

Examples of restriction enzymes and the sequences they cleave

The 'sticky' overhangs are known as COHESIVE ENDS

- The single stranded termini (or ends) can base pair (**ANNEAL**) with any complementary single stranded termini

This is the basis for **RECOMBINANT DNA TECHNOLOGY**

- Inserting foreign DNA into a cloning vector

Restriction enzymes are a useful tool for analysing Recombinant DNA

After ligating a particular DNA sequence into a cloning vector, it is necessary to check that the correct fragment has been taken up. Sometimes it is also necessary to ensure that the foreign DNA sequence is in a certain orientation relative to sequences present in the cloning vector.

- Checking the size of the insert
- Checking the orientation of the insert
- Determining pattern of restriction sites within insert DNA

DNA fractionation

Separation of DNA fragments in order to isolate and analyse DNA cut by restriction enzymes

Electrophoresis

Electrophoresis is a technique used to separate and sometimes purify macromolecules - especially proteins and nucleic acids - that differ in size, charge or conformation. When charged molecules are placed in an electric field, they migrate toward either the positive or negative pole according to their charge.
DNA is electrophoresed through the agarose gel from the **cathode** (negative) to the **anode** (positive) when a voltage is applied, due to the net negative charge carried on DNA

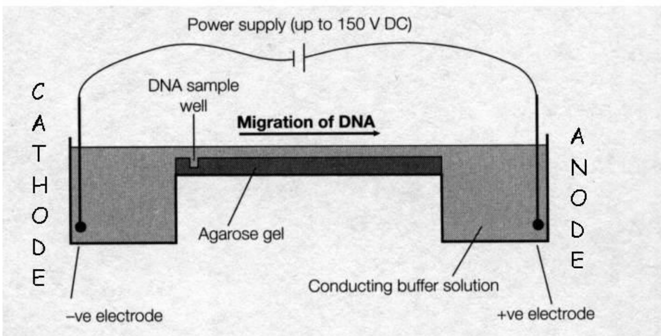
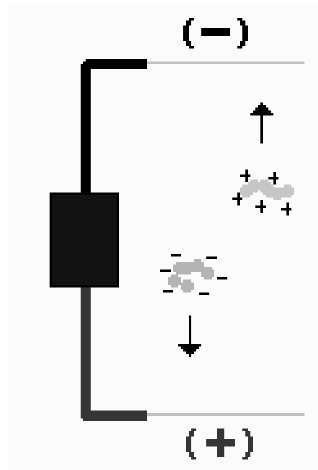


Fig. 3. Agarose gel apparatus.



When the DNA has been electrophoresed,
The gel is stained in a solution containing the chemical **ethidium bromide**. This compound binds tightly to DNA and fluoresces strongly under UV light - allowing the visualisation and detection of the DNA.

Recombinant DNA technology:

Recombinant DNA: Plasmids, cloning
What is DNA cloning?

DNA cloning is the isolation of a fragment or fragments of DNA from an organism and placing in a VECTOR that replicates independently of chromosomal DNA. The RECOMBINANT DNA is propagated in a host organism, the resulting CLONES are a set of genetically identical organisms which contain the recombinant DNA

Three main purposes for cloning DNA

1) DNA sequencing
2) Protein production
3) Engineering animals/plants/proteins

Cloning and Expression Vectors

Isolated DNA is cloned into **VECTORS** for long term storage, propagation of the DNA and for production of protein from gene(s) encoded in the DNA

What are cloning vectors?

Cloning vectors are extra-chromosomal 'replicons' of DNA which can be isolated and can replicate independently of the chromosome. Vectors usually contain a **selectable marker** - a gene that allows selection of cells carrying the vector e.g. by conferring resistance to a toxin. DNA of interest can be cloned into the vector and replicated in host cells, usually one which has been well characterised.

Commonly used vector systems

- Bacterial plasmids
- Bacteriophages
- Cosmids
- Yeast artificial chromosomes (YACs)
- Ti plasmid (plants)
- Eukaryotic viruses such as baculovirus (insect cells), SV40 virus and retroviruses.

Characteristics of a Cloning Vector

- **Origin of replication (ORI)**

This process marks autonomous replication in vector. ORI is a specific sequence of nucleotide in DNA from where replication starts. When foreign DNA is linked to this sequence then along with vector replication, foreign (desirable) DNA also starts replicating within host cell.

- **Selectable Marker**

Charecteristics of Selectable marker:

A gene whose expression allows one to identify cells that have been transforrned or transfected with a vector containing the marker gene.

A **marker gene** is used to determine if a piece of DNA has been successfully inserted into the host organism.. A gene, usually encoding resistance to an antibiotic,.A **selectable marker** will protect the organism from a **selective agent** that would normally kill it or prevent its growth.

- **Restriction sites**

It should have restriction sites, to allow cleavage of specific sequence by specific Restriction Endonuclease. Restriction sites in E.coli cloning vector pBR322 include HindIII , EcoRI , BamHI , SalI, PvuI, PstI, ClaI etc.

Refer NCERT text book diagram of pBR322

A Cloning Vector that Works with Plant Cells

Most commonly used plant cloning vector ***"Ti" plasmid,*** or tumor-inducing plasmid. Found in cells of the bacterium known as ***Agrobacterium tumefaciens***, normally lives in soil. Bacterium has ability to infect plants and cause a **crown gall**, or tumorous lump, to form at the site of infection.

Ti plasmid - called T DNA - separates from the plasmid and incorporates into the host cell genome. This aspect of Ti plasmid function has made it useful as a ***plant cloning vector (natural genetic engineer).***

Plasmids are the most commonly used vector system. Several types available for cloning of foreign DNA in the host organism *Escherichia coli*. Many *E. coli* plasmids allow the expression of proteins encoded by the cloned DNA

Bacteriophage another common vector system used for cloning DNA. These are viruses which 'infect' *E. coli*. The M13 bacteriophage is a single-stranded DNA virus which replicates in *E. coli* in a double-stranded form that can be manipulated like a plasmid. It can be used to produce single-stranded DNA copies which are useful for **DNA sequencing**.

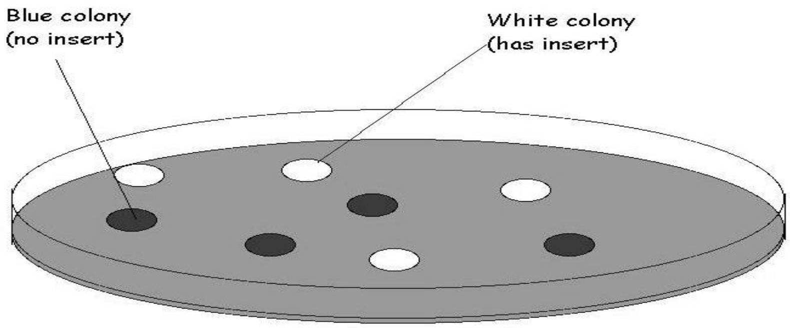
Bacteriophage is another bacteriophage which is commonly used to make DNA libraries. It allows the cloning of larger fragments of DNA than can be incorporated into plasmids.

Transformation is the process by which plasmids (or other DNA) can be introduced into a cell. For *E. coli* transformation with plasmids is quite straightforward, plasmids can be introduced by electroporation or by incubation in the presence of divalent cations (usually Ca^{2+}) and a brief heat shock (42°C) which induces the *E. coli* cells to take up the foreign DNA

1. two antibiotic selection and replica plating
2. color selection: blue/white selection using the lacz gene

Insertional inactivation -
Subcloning a DNA fragment into an active gene (usually a marker gene whose function can be easily detected) will disrupt the function of that gene. This can be detected by looking for colonies that no longer display that phenotype.

Colour selection
A more common method to determine which transformants contain plasmids with inserts is to use **colour selection**. For *E. coli*, this involves the **lac complex** and **blue/white screening.**
Colonies carrying plasmid with no insert will be coloured **blue** whereas colonies carrying recombinant plasmid will be **white**.



For plasmids such as pBR322, which contains two antibiotic resistance genes, cloning an insert into one of these will disrupt that gene and inactivate the resistance to that antibiotic.

Southern/Northern Blotting Analysis
Analysing complex nucleic acid mixtures (DNA or RNA)
The total cellular DNA of an organism (genome) or the cellular content of RNA are complex mixtures of different nucleic acid sequences. Restriction digest of a complex genome can generate millions of specific restriction fragments and there can be several fragments of exactly the same size which will not be separated from each other by electrophoresis.
Techniques have been devised to identify specific nucleic acids in these complex mixtures

- **Southern blotting** - DNA
- **Northern blotting** - RNA

Southern blotting

Technique devised by Ed Southern in 1975, is a commonly used method for the identification of DNA fragments that are complementary to a know DNA sequence. Allows a comparison between the genome of a particular organism and that of an available gene or gene fragment (the **probe**). It can tell us whether an organism contains a particular gene(DNA fragment) or not

In **Southern blotting**,

1 Chromosomal DNA is isolated from the organism of interest, and digested to completion with a restriction endonuclease enzyme.
2 The restriction fragments are then subjected to electrophoresis on an agarose gel, which separates the fragments on the basis of size.
3 DNA fragments in the gel are denatured (i.e. separated into single strands) using an alkaline solution.
4 Transfer fragments from the gel onto nitrocellulose filter or nylon membrane.

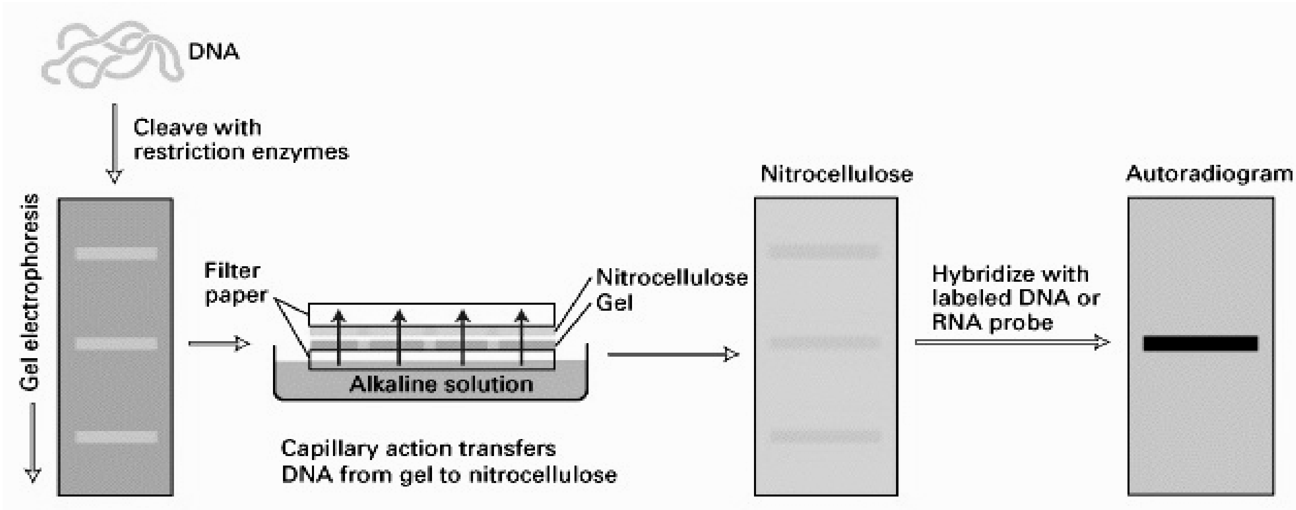
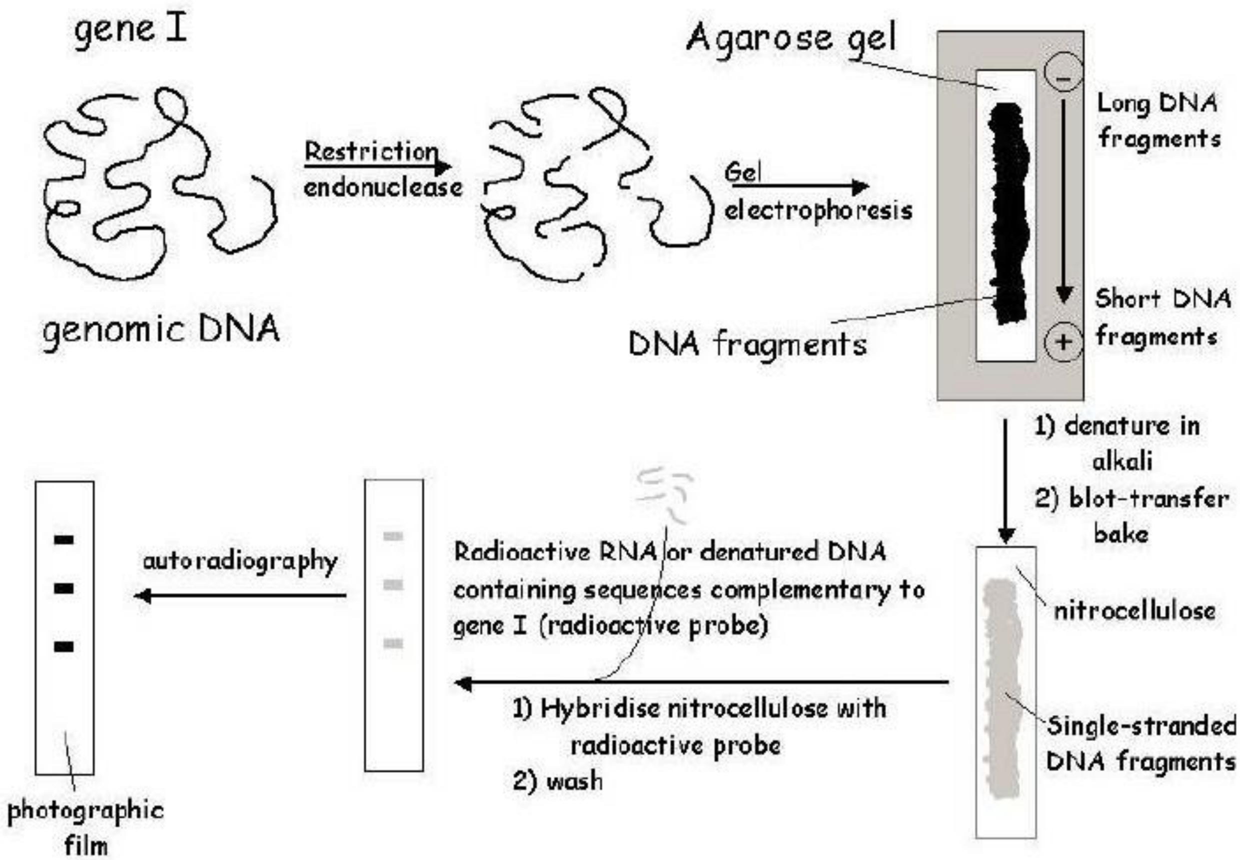


Fig 7-32, Lodish et al (4th ed.)

DNA is bound irreversibly to the filter/membrane by baking at high temperature (nitrocellulose) or cross-linking through exposure to UV light (nylon).

Final step is to immerse the membrane in a solution containing the **probe** - either a DNA (cDNA clone, genomic fragment, oligonucleotide) or RNA probe can be used. This is **DNA hybridisation**
The membrane is washed to remove non-specifically bound probe, and is then exposed to X-ray film - a process called **autoradiography**. **The principle of Southern blotting**



PCR(Polymerase Chain Reaction):

PCR is a technique for the ***in vitro* amplification** of a desired sequence of DNA. PCR allows the generation of a large quantity of DNA product (up to several μg) from only a few starting copies. It has been shown that PCR can be used to generate a detectable quantity of DNA from only one starting **target** (or **template**) molecule.

PCR developed in the mid-1980's, has found multiple applications, such as:

1. Rapid amplification of intact genes or gene fragments
2. Generation of large amounts of DNA for sequencing
3. Generation of probes specific for uncloned genes by selective amplification of a specific segment of cDNA
4. Analysis of mutations for medical applications
5. Detection of minute amounts of DNA for forensic purposes
6. Amplification of chromosomal regions adjacent to genes of known sequence and many more·

Development of PCR won the Nobel prize for Kary Mullis and co-workers.

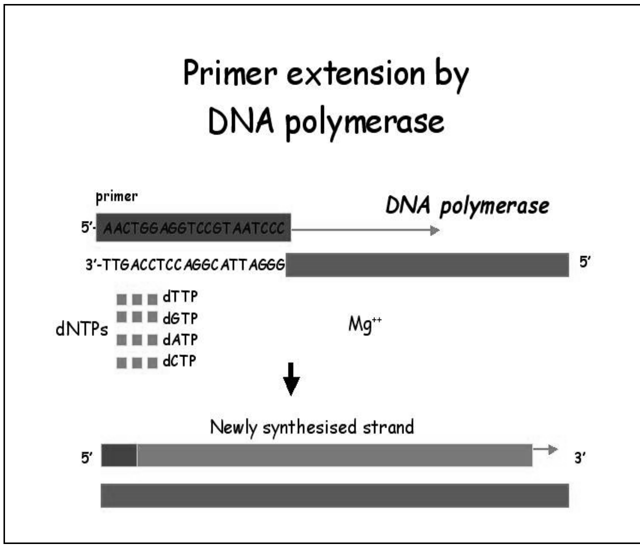
PCR principle

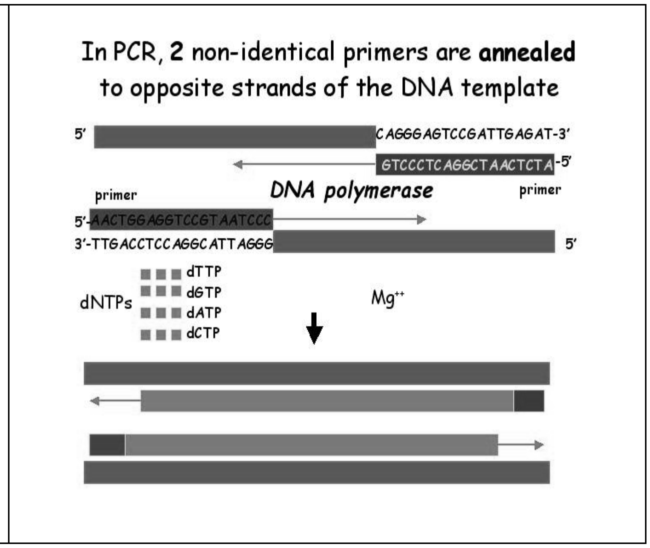
PCR reaction is a DNA synthesis reaction that depends on the **extension** of primers **annealed** to opposite strands of a dsDNA template that has been denatured (**melted apart**) at temperatures near boiling. By repeating the **melting**, **annealing** and **extension** steps, several copies of the original template DNA can be generated.

The amount of starting material (target) needed is very small

Not necessary to isolate the desired sequence, because it will be defined by the **primers** that are used in the reaction. The **primers** are oligonucleotides **complementary** to different regions on the 2 strands of DNA template (**flanking** the region to be amplified).

The **primer** acts as a starting point for DNA synthesis. The oligo is **extended** from its 3' end by **DNA polymerase**.





Primer design

The stages of a PCR reaction

PCR is a **cycle** of three steps:

1. **DENATURATION** - the strands of the DNA are **melted apart** by heating to 95°C
2. **ANNEALING** - the temperature is reduced to ~ 55°C to allow the primers to **anneal** to the target DNA
3. **POLYMERISATION/EXTENSION** - the temperature is changed to the optimum temperature in order for the DNA polymerase to catalyse **extension** of the primers, *i.e.* to copy the DNA between the primers.

The **cycle** is repeated over and over again - as many times as needed to produce a detectable amount of product.

Discovery of a thermostable DNA polymerase

The breakthrough came with the discovery of the thermostable DNA polymerase *Taq* polymerase, from the thermophilic bacterium, *Thermus aquaticus*, which lives in hot springs.

***Taq* polymerase** enzyme can resist **high temperatures** required to melt the template DNA apart without denaturation (loss of activity) and works best at **high temperatures (72°C).** This led to improved specificity & sensitivity. Annealing of primers to sites other than the target sequence is significantly reduced at the higher temperatures used for *Taq* polymerase.

Applications of PCR

1) Cloning a gene encoding a known protein
2) Amplifying 'old DNA'
3) Amplifying cloned DNA from vectors
4) Creating mutations in cloned genes

5) Rapid amplification of cDNA ends - RACE
6) Detecting bacterial or viral infection
  * AIDs infection
  * Tuberculosis (*Mycobacterium tuberculosis*)

7) Cancer
Detecting mutations that occur in cancer and monitoring cancer therapy. Determining if a patient is free of malignant cells

8) Genetic diagnosis
  a. Diagnosing inherited disorders
    * Cystic fibrosis
    * Muscular dystrophy
    * Haemophilia A and B
    * Sickle cell anaemia

  b. Diagnosing cancer - certain cancers are caused by specific and reproducible mutations: e,g. Retinoblastoma - childhood cancer of the eye. The heritable form (germ line mutation of one of the two retinoblastoma allelles): mutation is detected in all cells. Spontaneous form: only detected in tumour tissue.
  c. Blood group typing
  d. Prenatal diagnosis – eg determining the sex of foetus for those at risk of X-linked disorders

PCR is one of the most versatile techniques invented, and has so many applications that this list could go on for quite some time.

Downstream processing

It refers to the recovery and purification of biosynthetic products, particularly pharmaceuticals, from natural sources such as animal or plant tissue or fermentation broth

Stages in Downstream Processing

A widely recognized heuristic for categorizing downstream processing operations divides them into four groups which are applied in order to bring a product from its natural state as a component of a tissue, cell or fermentation broth through progressive improvements in purity and concentration.

Removal of insolubles → Product Isolation → ProductPurification → Product Polishing

GLOSSARY:

Amplification
An increase in the number of copies of a specific DNA fragment; can be in vivo or in vitro.
See also: cloning, polymerase chain reaction

Annotation
Adding pertinent information such as gene coded for, amino acid sequence, or other commentary to the database entry of raw sequence of DNA bases.

Antisense
Nucleic acid that has a sequence exactly opposite to an mRNA molecule made by the body; binds to the mRNA molecule to prevent a protein from being made.

Autoradiography
A technique that uses X-ray film to visualize radioactively labeled molecules or fragments of molecules; used in analyzing length and number of DNA fragments after they are separated by gel electrophoresis.

Bacterial artificial chromosome (BAC)
A vector used to clone DNA fragments (100 to 300 kb insert size; average, 150 kb) in *Escherichia coli* cells. Based on naturally occurring F-factor plasmid found in the bacterium *E. coli*.

Base sequence
The order of nucleotide bases in a DNA molecule; determines structure of proteins encoded by that DNA.

Bioinformatics
The science of managing and analyzing biological data using advanced computing techniques. Especially important in analyzing genomic research data.

Biotechnology
A set of biological techniques developed through basic research and now applied to research and product development. In particular, biotechnology refers to the use by industry of recombinant DNA, cell fusion, and new bioprocessing techniques.

Cancer
Diseases in which abnormal cells divide and grow unchecked. Cancer can spread from its original site to other parts of the body and can be fatal.
See also: hereditary cancer, sporadic cancer

Carcinogen
Something which causes cancer to occur by causing changes in a cell's DNA.
See also: mutagen

Carrier
An individual who possesses an unexpressed, recessive trait.

cDNA library
A collection of DNA sequences that code for genes. The sequences are generated in the laboratory from mRNA sequences.
See also: messenger RNA

Cell
The basic unit of any living organism that carries on the biochemical processes of life.

Chromosome
The self-replicating genetic structure of cells containing the cellular DNA that bears in its nucleotide sequence the linear array of genes. In prokaryotes, chromosomal DNA is circular, and the entire genome is carried on one chromosome. Eukaryotic genomes consist of a number of chromosomes whose DNA is associated with different kinds of proteins.

Clone
An exact copy made of biological material such as a DNA segment (e.g., a gene or other region), a whole cell, or complete organism.

Cloning
Using specialized DNA technology to produce multiple, exact copies of a single gene or other segment of DNA to obtain enough material for further study. Process, used by researchers in the Human Genome Project, referred to as cloning DNA. Resulting cloned (copied) collections of DNA molecules constitute clone libraries. Second type of cloning exploits the natural process of cell division to make many copies of an entire cell. The genetic makeup of these cloned cells, called cell line, is identical to the original cell. Third type of cloning produces complete, genetically identical animals such as the famous Scottish sheep, Dolly.

Cloning vector
DNA molecule originating from a virus, a plasmid, or the cell of a higher organism into which another DNA fragment of appropriate size can be integrated without loss of the vector's capacity for self-replication; vectors introduce foreign DNA into host cells, where the DNA can be reproduced in large quantities. Examples are plasmids, cosmids, and yeast artificial chromosomes; vectors are often recombinant molecules containing DNA sequences from several sources.

Complementary DNA (cDNA)
DNA that is synthesized in the laboratory from a messenger RNA template.

Complementary sequence
Nucleic acid base sequence that can form a double-stranded structure with another DNA fragment by following base-pairing rules (A pairs with T and C with G). The complementary sequence to GTAC for example, is CATG.

Cosmid
Artificially constructed cloning vector containing the cos gene of phage lambda. Cosmids can be packaged in lambda phage particles for infection into *E. coli*; Permits cloning of larger DNA fragments (up to 45kb) than can be introduced into bacterial hosts in plasmid vectors.

Crossing over
The breaking during meiosis of one maternal and one paternal chromosome, the exchange of corresponding sections of DNA, and the rejoining of the chromosomes. This process can result in an exchange of alleles between chromosomes.
See also: recombination

DNA (deoxyribonucleic acid)
The molecule that encodes genetic information. DNA is a double-stranded molecule held together by weak bonds between base pairs of nucleotides. The four nucleotides in DNA contain the bases adenine (A), guanine (G), cytosine (C), and thymine (T). In nature, base pairs form only between A and T and between G and C; thus the base sequence of each single strand can be deduced from that of its partner.

DNA bank
A service that stores DNA extracted from blood samples or other human tissue.

DNA repair genes
Genes encoding proteins that correct errors in DNA sequencing.

DNA replication
The use of existing DNA as a template for the synthesis of new DNA strands. In humans and other eukaryotes, replication occurs in the cell nucleus.

DNA sequence
The relative order of base pairs, whether in a DNA fragment, gene, chromosome, or an entire genome. *See also:* base sequence analysis

Double helix
The twisted-ladder shape that two linear strands of DNA assume when complementary nucleotides on opposing strands bond together.
Electrophoresis
A method of separating large molecules (such as DNA fragments or proteins) from a mixture of similar molecules. An electric current is passed through a medium containing the mixture, and each kind of molecule travels through the medium at a different rate, depending on its electrical charge and size. Agarose and acrylamide gels are the media commonly used for electrophoresis of proteins and nucleic acids.
Electroporation
A process using high-voltage current to make cell membranes permeable to allow the introduction of new DNA; commonly used in recombinant DNA technology.
See also: transfection
Embryonic stem (ES) cells
An embryonic cell that can replicate indefinitely, transform into other types of cells, and serve as a continuous source of new cells.
Endonuclease
See: restriction enzyme
Escherichia coli
Common bacterium that has been studied intensively by geneticists because of its small genome size, normal lack of pathogenicity, and ease of growth in the laboratory.
Eugenics
Study of improving a species by artificial selection; usually refers to the selective breeding of humans.
Exogenous DNA
DNA originating outside an organism that has been introduced into the organism.
Exon
The protein-coding DNA sequence of a gene.
See also: intron
Exonuclease
An enzyme that cleaves nucleotides sequentially from free ends of a linear nucleic acid substrate.
Expressed sequence tag (EST)
A short strand of DNA that is part of cDNA molecule and can act as identifier of a gene. Used in locating and mapping genes.
See also: cDNA, sequence tagged site
Fingerprinting
In genetics, the identification of multiple specific alleles on a person's DNA to produce a unique identifier for that person.
See also: forensics
Fluorescence in situ hybridization (FISH)
A Physical mapping approach that uses fluorescein tags to detect hybridization of probes with metaphase chromosomes and with the less-condensed somatic interphase chromatin.
Forensics
Use of DNA for identification. Some examples of DNA use are to establish paternity in child support cases; establish the presence of a suspect at a crime scene, and identify accident victims.
Functional genomics
Study of genes, their resulting proteins, the role played by proteins in the body's biochemical processes.

Gel electrophoresis
See: electrophoresis
Gene
The fundamental physical and functional unit of heredity. A gene is an ordered sequence of nucleotides located in a particular position on a particular chromosome that encodes a specific functional product (i.e., a protein or RNA molecule)
See also: gene expression
Gene expression
The process by which a gene's coded information is converted into the structures present and operating in the cell. Expressed genes include those that are transcribed into mRNA and then translated into protein and those that are transcribed into RNA but not translated into protein (e.g., transfer and ribosomal RNAs).
Gene library
See: genomic library
Gene mapping
Determination of the relative positions of genes on a DNA molecule (chromosome or plasmid) and of the distance, in linkage units or physical units, between them.
Gene pool
All the variations of genes in a species.
See also: allele, gene, polymorphism
Gene therapy
Experimental procedure aimed at replacing, manipulating, or supplementing nonfunctional or misfunctioning genes with healthy genes.
See also: gene, inherit, somatic cell gene therapy, germ line gene therapy
Gene transfer
Incorporation of new DNA into an organism's cells, usually by a vector such as a modified virus. Used in gene therapy.
See also: mutation, gene therapy, vector
Genetic engineering
Altering the genetic material of cells or organisms to enable them to make new substances or perform new functions.
Genetic engineering technology
See: recombinant DNA technology
Genetic marker
A gene or other identifiable portion of DNA whose inheritance can be followed.
See also: chromosome, DNA, gene, inherit
Genetic material
See: genome
Genetic polymorphism
Difference in DNA sequence among individuals, groups, or populations (e.g., genes for blue eyes versus brown eyes).
Genetic screening
Testing a group of people to identify individuals at high risk of having or passing on a specific genetic disorder.
Genetic testing
Analyzing an individual's genetic material to determine predisposition to a particular health condition or to confirm a diagnosis of genetic disease.

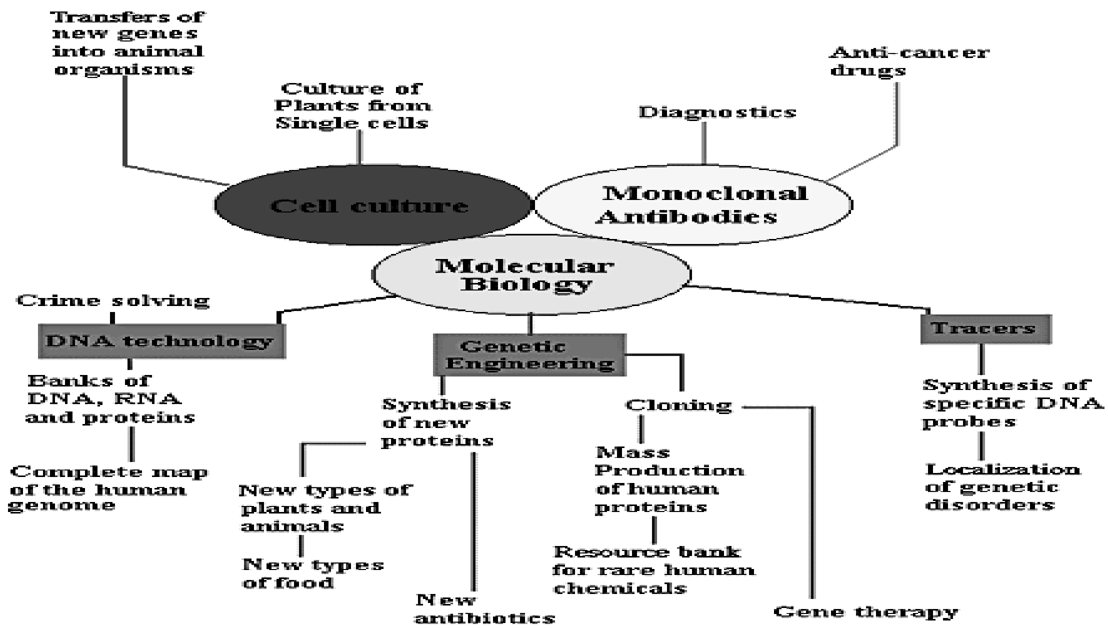
Genetics
The study of inheritance patterns of specific traits.
Genome
All the genetic material in the chromosomes of a particular organism; its size is generally given as its total number of base pairs.
Genome project
Research and technology-development effort aimed at mapping and sequencing the genome of human beings and certain model organisms.
See also: Human Genome Initiative
Genomic library
A collection of clones made from a set of randomly generated overlapping DNA fragments that represent the entire genome of an organism.
Genotype
The genetic constitution of an organism, as distinguished from its physical appearance (its phenotype).
Human Genome Project (HGP)
Formerly titled Human Genome Initiative.
See also: Human Genome Initiative
In situ hybridization
Use of a DNA or RNA probe to detect the presence of the complementary DNA sequence in cloned bacterial or cultured eukaryotic cells.
In vitro
Studies performed outside a living organism such as in a laboratory.
In vivo
Studies carried out in living organisms.
Independent assortment
During meiosis each of the two copies of a gene is distributed to the germ cells independently of the distribution of other genes.
See also: linkage
Informatics
See: bioinformatics
Karyotype
Photomicrograph of an individual's chromosomes arranged in standard format showing the number, size, and shape of each chromosome type; used in low-resolution physical mapping to correlate gross chromosomal abnormalities with the characteristics of specific diseases.
Knockout
Deactivation of specific genes; used in laboratory organisms to study gene function.
See also: gene, locus, model organisms
Marker
See: genetic marker
Microinjection
A technique for introducing a solution of DNA into a cell using a fine microcapillary pipette.
Mitochondrial DNA
Nitrogenous base
A nitrogen-containing molecule having the chemical properties of a base. DNA contains the nitrogenous bases adenine (A), guanine (G), cytosine (C), and thymine (T).
See also: DNA

Northern blot
A gel-based laboratory procedure that locates mRNA sequences on a gel that are complementary to a piece of DNA used as a probe.
Nucleotide
A subunit of DNA or RNA consisting of a nitrogenous base (adenine, guanine, thymine, or cytosine in DNA; adenine, guanine, uracil, or cytosine in RNA), a phosphate molecule, and a sugar molecule (deoxyribose in DNA and ribose in RNA). Thousands of nucleotides are linked to form a DNA or RNA molecule. *See also:* DNA, base pair, RNA
Nucleus
The cellular organelle in eukaryotes that contains most of the genetic material.
Phage
A virus for which the natural host is a bacterial cell.
Plasmid
Autonomously replicating extra-chromosomal circular DNA molecules, distinct from the normal bacterial genome and nonessential for cell survival under nonselective conditions. Some plasmids are capable of integrating into the host genome. Number of artificially constructed plasmids are used as cloning vectors.
Polymerase chain reaction (PCR)
A method for amplifying a DNA base sequence using heat-stable polymerase and two 20-base primers, one complementary to the (+) strand at one end of the sequence to be amplified and one complementary to the (-) strand at the other end. Because the newly synthesized DNA strands can subsequently serve as additional templates for the same primer sequences, successive rounds of primer annealing, strand elongation, and dissociation produce rapid and highly specific amplification of the desired sequence. PCR also can be used to detect the existence of the defined sequence in a DNA sample.
Polymerase, DNA or RNA
Enzyme that catalyzes the synthesis of nucleic acids on preexisting nucleic acid templates, assembling RNA from ribonucleotides or DNA from deoxyribonucleotides.
Primer
Short preexisting polynucleotide chain to which new deoxyribonucleotides can be added by DNA polymerase.
Probe
Single-stranded DNA or RNA molecules of specific base sequence, labeled either radioactively or immunologically. Used to detect the complementary base sequence by hybridization.
Restriction enzyme, endonuclease
Protein that recognizes specific, short nucleotide sequences and cuts DNA at those sites. Bacteria contain over 400 such enzymes that recognize and cut more than 100 different DNA sequences. *See also:* restriction enzyme cutting site
Restriction fragment length polymorphism (RFLP)
Variation between individuals in DNA fragment sizes cut by specific restriction enzymes; polymorphic sequences that result in RFLPs are used as markers on both physical maps and genetic linkage maps. RFLPs are usually caused by mutation at a cutting site.
See also: marker, polymorphism

Restriction-enzyme cutting site
Specific nucleotide sequence of DNA at which a particular restriction enzyme cuts the DNA. Some sites occur frequently in DNA (e.g., every several hundred base pairs); others much less frequently (rare-cutter; e.g., every 10,000 base pairs).
Retroviral infection
Presence of retroviral vectors, such as some viruses, which use their recombinant DNA to insert their genetic material into the chromosomes of the host's cells. The virus is then propogated by the host cell.
Reverse transcriptase
Enzyme used by retroviruses to form a complementary DNA sequence (cDNA) from their RNA. The resulting DNA is then inserted into the chromosome of the host cell.
Ribonucleotide
See: nucleotide
Ribose
The five-carbon sugar that serves as a component of RNA.
See also: ribonucleic acid, deoxyribose
Ribosomal RNA (rRNA)
A class of RNA found in the ribosomes of cells.
RNA (Ribonucleic acid)
Chemical found in nucleus and cytoplasm of cells. Plays important role in protein synthesis and other chemical activities of the cell. Structure of RNA similar to that of DNA. There are several classes of RNA molecules, including messenger RNA, transfer RNA, ribosomal RNA, and other small RNAs, each serving a different purpose.
Sanger sequencing
A widely used method of determining the order of bases in DNA.
See also: sequencing, shotgun sequencing
Satellite
Chromosomal segment that branches off from the rest of the chromosome but is still connected by a thin filament or stalk.
Scaffold
In genomic mapping, a series of contigs that are in the right order but not necessarily connected in one continuous stretch of sequence.
Segregation
The normal biological process whereby the two pieces of a chromosome pair are separated during meiosis and randomly distributed to the germ cells.
Sequencing
Determination of order of nucleotides (base sequences) in a DNA or RNA molecule or the order of amino acids in a protein.
The X or Y chromosome in human beings that determines the sex of an individual. Females have two X chromosomes in diploid cells; males have an X and a Y chromosome. The sex chromosomes comprise the 23rd chromosome pair in a karyotype.

Shotgun method
Sequencing method that involves randomly sequenced cloned pieces of the genome, with no foreknowledge of where the piece originally came from. This can be contrasted with "directed" strategies, in which pieces of DNA from known chromosomal locations are sequenced. Because there are advantages to both strategies, researchers use both random (or shotgun) and directed strategies in combination to sequence the human genome.
Single nucleotide polymorphism (SNP)
DNA sequence variations that occur when a single nucleotide (A, T, C, or G) in the genome sequence is altered.
Single-gene disorder
Hereditary disorder caused by a mutant allele of a single gene (e.g., Duchenne muscular dystrophy, retinoblastoma, sickle cell disease).
See also: polygenic disorders
Somatic cell
Any cell in the body except gametes and their precursors.
Southern blotting
Transfer by absorption of DNA fragments separated in electrophoretic gels to membrane filters for detection of specific base sequences by radio-labeled complementary probes.
Transfer RNA (tRNA)
A class of RNA having structures with triplet nucleotide sequences that are complementary to the triplet nucleotide coding sequences of mRNA. The role of tRNAs in protein synthesis is to bond with amino acids and transfer them to the ribosomes, where proteins are assembled according to the genetic code carried by mRNA.
Transgenic
An experimentally produced organism in which DNA has been artificially introduced and incorporated into the organism's germ line.
See also: cell, DNA, gene, nucleus, germ line
Transposable element
A class of DNA sequences that can move from one chromosomal site to another.
Trisomy
Possessing three copies of a particular chromosome instead of the normal two copies.
See also: cell, gene, gene expression, chromosome
Virus
Noncellular biological entity that can reproduce only within a host cell. Viruses consist of nucleic acid covered by protein; some animal viruses are also surrounded by membrane. Inside the infected cell, the virus uses the synthetic capability of the host to produce progeny virus.
See also: cloning vector
Western blot
A technique used to identify and locate proteins based on their ability to bind to specific antibodies.
See also: DNA, Northern blot, protein, RNA, Southern blotting
Wild type
The form of an organism that occurs most frequently in nature.
Yeast artificial chromosome (YAC)
Constructed from yeast DNA, it is a vector used to clone large DNA fragments.
See also: cloning vector, cosmid

Outline of molecular biology



<u>Questions</u>

1 Mark Questions

1) What is biotechnology?
2) Define plasmid.
3) What are molecular scissors?
4) What do you mean by recognition sequence?
5) Which enzymes act as molecular glue?
6) What is elution?
7) What are cloning vectors?
8) Name the sequence within a cloning vector from where the replication commences.
9) Mention the bacteria that acts as natural genetic engineer.
10) Name any two processes by which alien DNA is introduced into the host cell.
11) Expand the term PCR.
12) Name the microorganism from which the thermostable DNA polymerase required for PCR is obtained?
13) What is a bioreactor?
14) What are the two main processes involved in downstream processing?

HINTS:

1) Large scale production and marketing of products and processes using living organisms, cells or enzymes.
2) Autonomously replicating circular , extra-chromosomal bacterial DNA used in gene manipulation.
3) Restriction enzymes.

4) Restriction endonucleases always cut DNA at a specific point by recognizing a specific sequences of base pair known as recognition sequence.
5) DNA ligases
6) The ultimate step in the separation and isolation of DNA fragments through gel electrophoresis in which separated bands of DNAs are cut out from the gel and extracted from the gel piece.
7) Cloning vectors are extra-chromosomal 'replicons' of DNA which can be isolated and can replicate independently of the chromosome. DNA of interest can be cloned into the vector and replicated in host cells
8) ORI point
9) *Agrobacterium tumefaciens*
10) Microinjection,biolistics(gene gun)
11) Polymerase Chain Reaction 12) *Thermusaquaticus*
13) Large scale biotechnological product involves the use of bioreactor.
14) Separation and purification.

2-Marks Questions

1) Enlist the core techniques that pave the way for modern biotechnology.
2) What is gene cloning?
3) Mention the three steps involve in genetically modifying an organism.
4) Why do bacteria possesses restriction enzyme ?
5) Mention one basic difference between restriction endonucleases and exonucleases.
6) What is a palindromic sequence? Give example.
7) What are ― sticky ends|| and ―blind ends ?
8) Mention the role of selectable marker in cloning vector.
9) What is insertional inactivation?
10) How can you make a bacterial cell competent to take up foreign DNA ?

HINTS:

1) (a) Genetic engineering (b) maintenance of sterile ambience.
2) The process of cloning multiple copies of a gene.
3) (a) identification of DNA with desirable genes
    (b) introduction of the identified DNA into the host and
    (c) maintenance of introduced DNA in the host and transfer of DNA to its progeny.
4) By restriction enzyme bacteria can attack and destroy the phage DNA in case of viral attack and thereby prevent viral attack.
5) Exonucleases digest DNA from the flank (beginning/end) of the DNA strands. Whereas endonucleases catalyses the hydrolytic cleavage of DNA in the middle.
6) A segment of double-stranded DNA in which the nucleotide sequence of one strand reads same in reverse order to that of the complementary strand. (always read from the same direction)
7) Double stranded ends of a DNA molecule (without any overhangings) produced by the action of certain restriction enzymes .-[blunt ends)/ Sticky ends - Double stranded ends] of a DNA molecule (with overhangings) produced by the action of certain restriction enzymes
8) The selectable marker genes in a cloning vector allow for the selection and identification of bacteria that have been transformed with a recombinant plasmid compared to nontransformed cells. Some of the most common selectable markers are genes for ampicillin resistance (ampR) and tetracycline resistance (tetR) and the lacZ gene used for blue white selection.
9) Insertional inactivation refers to the loss of activity of the selectable marker genes due to the insertion of foreign DNA within the coding sequence of the marker gene in a transfected bacteria.

3-Marks Questions:

1)Enlist the major steps in recombinant DNA technology.
2)Mention the steps involved in the separation and isolation of DNA fragments through agarose gel electrophoresis.
3)Describe in brief the principle of DNA isolation through gel electrophoresis.
4)Highlight the salient features that are required to facilitate cloning into a vector.
5) Enumerate the major steps for isolation of DNA.
6) Draw a neat ,labeled diagram of (a) simple stirred tank bioreactor/ (b) sparged tank bioreactor.
Answers:
1) R-DNA Technology:
Restriction enzyme cuts double stranded DNA at its particular recognition sequence.
The cuts produce DNA fragments with cohesive ends
DNA from a plasmid was also cut by the same restriction enzyme
When two of the above mentioned DNA come together they can join by base pairing.
DNA ligase enzyme used to unite the backbones of the two DNA fragments ,producing R-DNA
2) Agarose gel electrophoresis:
3) DNA When charged molecules are placed in an electric field, they migrate toward either the positive or negative pole according to their charge. In contrast to proteins, which can have either a net positive or net negative charge, nucleic acids have a consistent negative charge imparted by their phosphate backbone, and migrate toward the anode DNA is electrophoresed through the agarose gel from the cathode (negative) to the anode (positive) when a voltage is applied, due to the net negative charge carried on DNA
4)Salient features of a DNA cloning Vectors:

- Size: small enough to be easily separated from the chromosomal DNA of the host bacteria.
- Ori site; must have the site for DNA replication that allows the plasmid to replicate separately from the host cell's chromosome.
- Multiple Cloning sites :a stretch of DNA with recognition sequence for many different commonb restriction enzymes.
- Selectable marker genes
- RNApolymerase promoter sequence

5) Major steps for isolation of DNA: Cell containing DNA is treated with lysozyme/cellulose/chitinase
DNA along with RNA,Protein,lipid are released
Treatment with RNAase,protease to remove RNA and Protein
Appropriate treatment to remove other impurities
Addition of chilled ethanol to get precipitation of purified DNA
6) Consult NCERT Textbook page number 204

5-Marks Questions:

1) What do you mean by PCR? Briefly enumerate the major steps of PCR. Mention the utility of PCR.
Ans: PCR is a cycle of three steps:
DENATURATION - the strands of the DNA are melted apart by heating to 95°C
ANNEALING - the temperature is reduced to ~ 55°C to allow the primers to anneal to the target DNA
POLYMERISATION/EXTENSION - the temperature is changed to the optimum temperature in order for the DNA polymerase to catalyse extension of the primers, *i.e.* to copy the DNA between the primers.
The cycle is repeated over and over again - as many times as needed to produce a detectable amount of product (DNA)

Chapter-12 BIOTECHNOLOGY & ITS APPLICATION

Biotechnology is making Genetically modified organisms-microbes, plants, animals for industrial production of Bio-Pharmaceuticals and other useful products.

Applications –

i) Diagnostic & therapeutic

ii) Genetically modified crops

iii) Waste treatment

iv) Energy production

v) Food processing

vi) Bioremediation

Application in agriculture

Genetically modified organisms (GMO)-Plants, bacteria, fungi, animals. whose genes are altered by manipulation.

Transgenic crops(GMO) -Crops contain or express one or more useful foreign genes.

Advantages -i) More tolerant to stresses (heat, cold, drought).

ii) Pest resistants GM crops, reduce the use of Chemical pesticides. Eg- BT-Cotton

iii) Reduced post harvest losses. Eg- Flavr savr tomato.

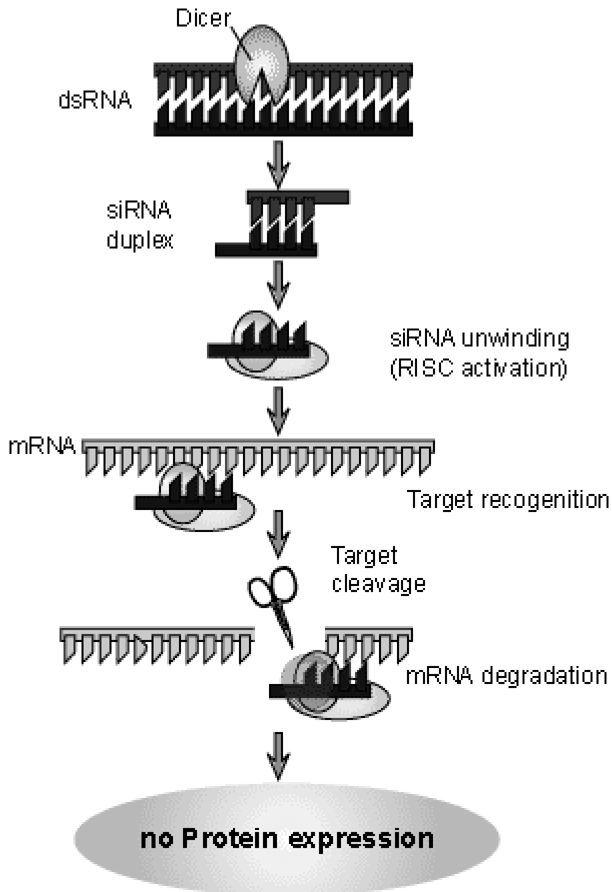
iv) Enhance nutritional value of food. Eg- Golden Rice (Vitamin A enriched).

v) Increased efficiency of mineral use.

PEST RESISTANT PLANTS

Bt- cotton -- BT stands for *Bacillus thuringiensis* (Soil Bacteria). Bacterium produces proteins (Crystal Protein-*cry* I AC, *cry* II AB). A crystalliane insecticidal protein that kills the insects. Hence *cry*-Genes have been introduced in plants to produce crystal proteins as Protoxin (inactive toxin), which is converted to toxins in alkaline medium (i.e. in the gut of insects) and cause death of the insect larva.

Protection of plants against nematodes – Nematode, *Meloidogyne incognita* infects tobacco plants & reduces yield. Specific genes (DNA) from nematodes introduced into the plants using *Agrobacterium tumifecians* (soil bacteria). Genes produce sense and antisense complementary RNA. Act as dsRNA and initiates RNAi (RNA interference) and silences the specific mRNA. Complementary RNA neutralizes the specific RNA of nematodes by a process called RNA Interference and parasite cannot live in transgenic host.



In medicine- genetically engineered insulin—

Human insulin consists of Polypeptide chains A & B. Insulin secreted as Prohormone, which contains C peptides, removed during maturation.

In 1983, Eli Lilly, an American company prepared 2 DNA sequences coding for chains A & B.

– Genes inserted into the cells and tissues to correct certain hereditary diseases.

Gene therapy

Gene therapy corrects the gene defects in child or embryo. Deficiency of ADA causes SCID due to the disorder of a gene. It can be cured by bone marrow transplantation. Functional ADA-cDNA is introduced in lymphocyte and returned to the patient.

Molecular diagnosis -- *PCR* (Polymesase chain reaction) used for early diagnosis of disorder.

ELISA *(Enzyme Linked Immunosorbent Assay)* used to detect AIDS.

Transgenic Animals

Animals with manipulated genes or a foreign gene to be expressed are called as transgenic animals. They are useful-

1. To know how genes contribute to development of disease.
2. To use proteins for treatment of disease.
3. To verify vaccine and chemical safety.

Biropiracy -- Some organizations and multinational companies exploit or patents bioresources of other nations without proper authorization. Indian patent bill is there to prevent such unauthorized exploitation.

GEAC- For validity of GM research and the safety of introducing GM organism

Three mark question

1) What is the main advantage of producing genetically engineered insulin?

Ans- Produces only A&B peptides.

No C-Peptides produced .

No need to remove C-Peptides during maturation.

2) What are the advantages of Molecular diagnosis technique?

Ans- 1) Accurate,

Disease can be detected at very early stage

Can be diagonised even if the number of pathogens is very low.

What are the potential risks (Three) of using GM food?

Ans – Potential risks- i) Products of transgene - allergic or toxic

ii) Cause damage to natural environment

iii) Weeds also become resistant

iv) Can endanger native species

4)What is hirudin? How do you get it?

Ans- Anti coagulant. obtained from transgenic brassica napus.

5) How does agro bacterium help to increase Tobacco production?

Ans - Introduction of Nematode specific gene.

Production of dsRNA(Sense and anti-Sense)

Silence specific MRNA.

6) Why do farmers face the problems in Agro chemical based farming?

Ans - 1. Too expensive 2. Conventional breeding not able to increase production.

7) Why should farmers in India cultivate GM crops?

Ans - Tolerant to stress, pest resistant, less post harvest losses, increased mineral using efficiency.

Five mark question

1)Explain the steps involved in the production of genetically engineered insulin?

Ans- i) Human insulin consists of 51 amino acids arranged in chains of A and B bearing 21 and 30 a. a respectively interconnected by disulphide bridges.

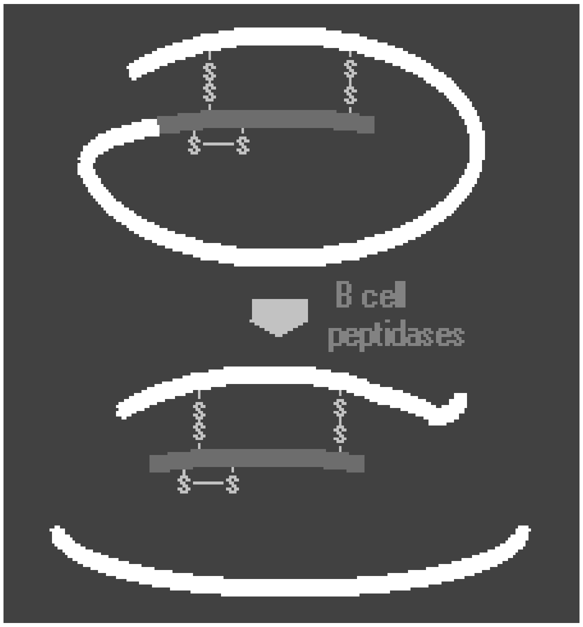


Diagram- Maturation of proinsulin into insulin after removal of c- peptide

ii) Insulin synthesized as prohormone has extra c -peptide which is removed during maturation.
iii) In 1983 , Eli Lilly, American company prepared two DNA sequences similar to A and B chains of human insulin(humulin).
iv) Chain A and B extracted and combined by creating disulphide bonds.

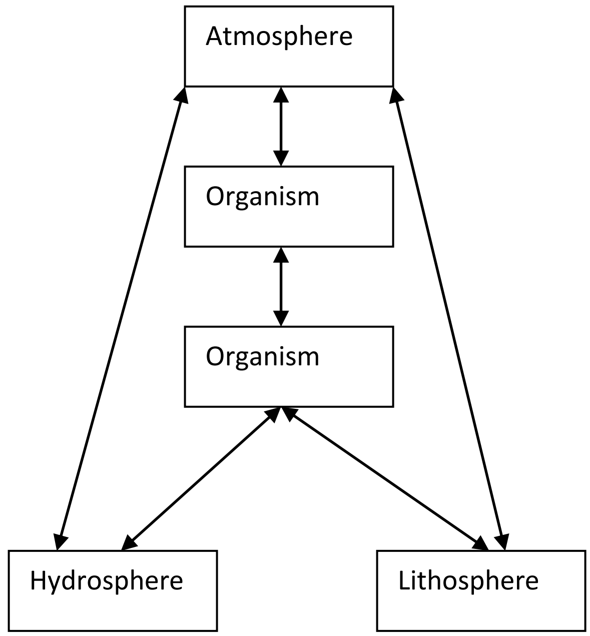
Keywords of the chapter

Genetically Modified Organism(GMO), Bt cotton, insecticidal proteins, cry genes, pest resistant plants, RNA interference(RNAi)/RNAsilencing, dsRNA, Genetically engineered insulin, gene therapy, ADA deficiency , c DNA, Molecular diagnosis, transgenic animals, Bio ethics, Genetic Engineering Approval Committee(GEAC), Bio piracy, Indian patent bill.

Chapter 13 ORGANISMS AND POPULATIONS

Ecology

It deals with the interaction (i) Among organisms (ii) Between organisms (iii) Physical environment.



Biome

Combination of various communities.
Seasonal variation and annual variation lead to biome formation
E.g. Artic and Alpine tundra, coniferous forest, temperate forest, grass land and desert.

Environment

Abiotic factors
Temperature, soil, water, light

Biotic factors
Microorganisms, plants, Animals

Temperature

Average temperature varies seasonally
Organisms Eurythermal or Stenothermal
Organisms affected by Global Warming.

Water

Influences life of organisms. No life without water.
Productivity and distribution of plants water dependent.
#Organisms Euryhaline or Stenohaline.

Light

Photosynthesis and release of oxygen light dependent.

Sciophytes need to use diurnal and seasonal light intensity of forage, migration and reproduction.

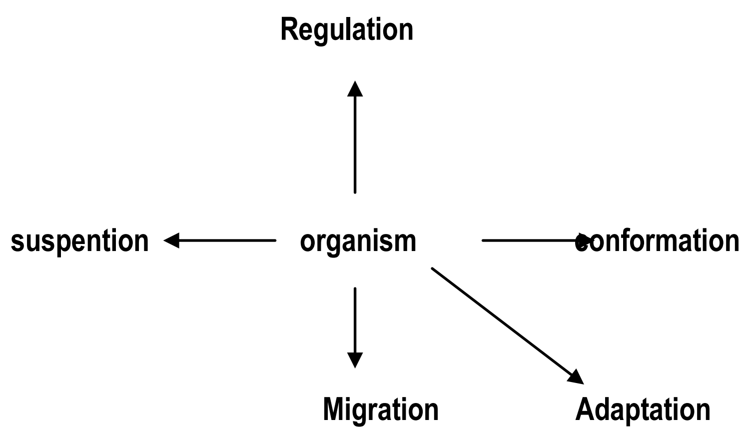
Soil

Nature and proportion of soil in a place depends on climate, weathering process and types of soil.

Soil composition, grain size and aggregation determine percolation and water holding capacity of soil.

Physical and chemical properties determine type of plants and Animals that survive in a habitat.

Response to environmental condition



Regulation

Organisms maintain homeostasis achieved by physiological and behavioral means

Thermo regulation and osmo regulation.

Conformation

Cannot maintain constant internal Environment

Body temperature and osmotic concentration of body changes with ambient temperature and concentration of medium.

Migration

Organism moves away temporarily to another habitat in stressful condition.

e.g.- Migratory birds

Suspension

Organisms suspend their metabolic activities during stressful condition

Resume their function at the return of favorable conditions.

E.g. Hibernation of Frog, Reptiles, Polar Bear etc

Aestivation in Snail and Fish.

Seed dormancy.

Adaptation

Morphological, physiological and behavioral changes that enable organisms to adjust to the ever changing environment .

E.g. Kangaroo rat survives in desert conditions through internal oxidation of fat, removing concentrated urine of less quantity.

Allen's rule-cold climate mammals have shorter ears and limbs to minimize heat loss.

Polar mammals like seals have blubber to prevent heat loss.

Burrowing habit to escape form heat

Higher count of RBC, Hb at high altitudes.

Population attributes

*Birth Rate – Number of individuals born per thousand per year.

*Death Rate – Number of individuals die per thousand per year.

*Sex Ratio – Ratio of male-female in the population.

*Population density.

Age pyramids

Three ecological ages:

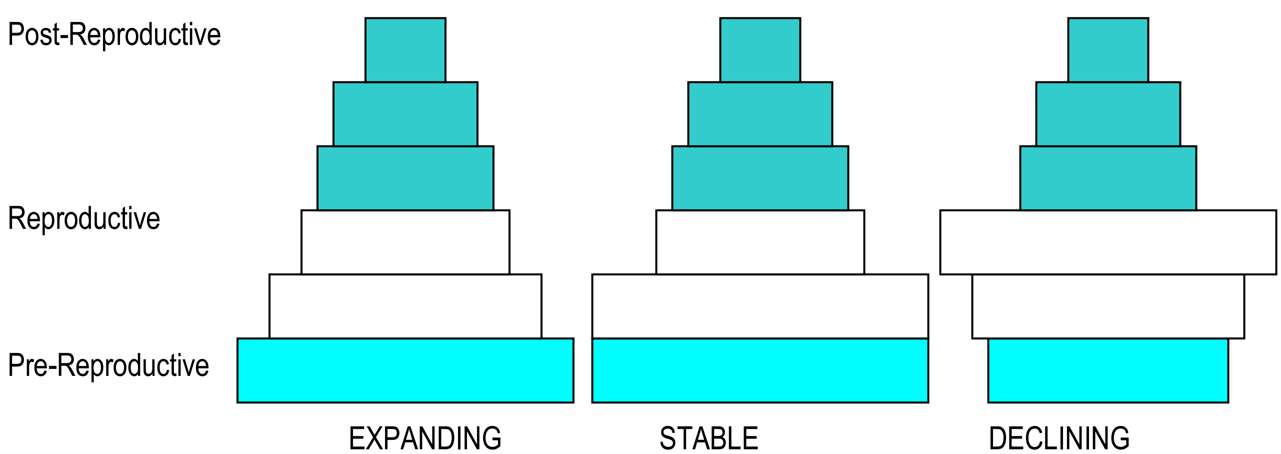
Pre-reproductive, Reproductive and Post-Reproductive

High proportion pre-reproductive individuals occur in expanding population

Pre-reproductive individuals are uniform in stable population.

Pre-reproductive individuals are less in Declining population.

Representation of age pyramids for human population



Population growth

Factors that affect the size of population

Food availability
Weather
Predation pressure
Competition
Density of population at any time at a given place depends on
Natality, Mortality, Emigration Immigration

Population growth models

Refer to NCRT text book Pg.No.230

Factors that affect population density

IMMIGRATION
[I]
↓ +

NATALITY [B] $\xrightarrow{+}$ POPULATION DENSITY [N] $\xrightarrow{-}$ MORTALITY [D]

↓ -
EMIGRATION
[E]

Types of population interactions

INTERACTION	SPECIES a	SPECIEC b
Mutualism	+	+
Predation	+	-
Parasitism	+	-
Commensalism	+	0
Competition	-	-
Ammensalism	-	0

Mutualism

Both the species get benefited.
Lichens Relationship between Non-photosynthetic Fungus and photosynthetic Algae or Cyanobacteria.
Mycorrhiza Asociation between Fungui and Higher Plants like Pinus.
Plants and insects for pollination
Orchid ophrys and male bee a good example for co-evolution of plants and Animals.

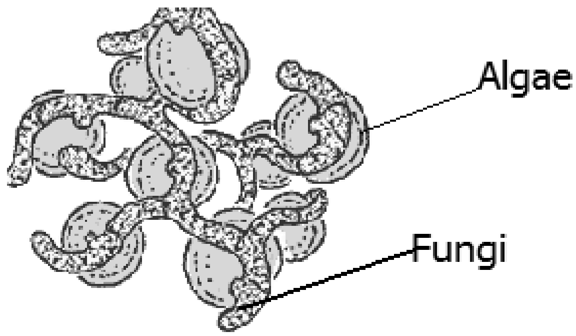
PREDATION

One species get benefited and the other harmed.
Tiger and Deer
Snake and Frog
Herbivores and plants

Competition

Both the species are harmed.

Flammingoes and resident fishes compete for the common food zooplankton in South American lakes.



Abington Tortoise and goats in Galapagos Islands for food.

Gouse‘s Competitive Exclusion Principle -Two closely related species competing for the same resource cannot co-exist indefinitely and the competitively inferior one will be eliminated eventually.

Parasitism

One species gets benefit and the other is harmed.

Parasites

Endoparasites	ectoparasites	brood par asites
Liver fluke, plasmodium	lice, ticks	koel

Adaptations of parasites

Loss of sense organs
Presence of adhesive organs or suckers
Loss of digestive system
High reproductive capacity.

Ammensalism

One species hurts the other but the other is not affected.
Penicillium secretes Penicillin and kill Bacteria but by this Penicillium does not benefit.
Algal bloom leads to death of fishes, but the death of fishes is of no use to the algal bloom.

Commensalism

One species benefits and the other neither harmed nor benefited.
The cattle egret catches the insects disturbed by moving cattle, but the cattle neither harmed nor benefited.

Another example

The clown fish gets protection from predators by close association with sea anemone, but the sea anemone is not effected.

Short answer type questions (3 marks)

1. What is brood parasitism? Give an example. What adaptation has evolved in this phenomenon?

Ans. One species lays eggs in the nest of another bird, lets the host incubate them. e.g. Cuckoo lays eggs in the nest of a crow.

The Eggs of the parasite resemble the eggs of the host in colour, size. Reduce chances of the host bird detecting the foreign eggs and ejecting them from nest.

2. Name and explain the kind of interaction in the following.

Ans. 1. Algae and Fungi in Lichens
2. Head Louse Humans
3. Hermit Crab and Sea Anemone

(i) Interaction of mutualism where the two species are equally benefited. Fungus provides protection, helps in absorption of water and minerals, Algae provide food for the Fungus.

(ii) This is case of Parasitism where the louse is an ectoparasite. Parasite takes shelter on humans and also derives nutrition.

(iii) It is commensalisms where one species is benefited and the other is neither benefited nor affected. Sea Anemone is benefited as it does not have to move to places rich in nutrients, while hermit crab is neither benefited nor harmed.

3. How does Ophrys get pollinated by bees?

Ans.1. Sexual deceit.
2. One petal resembles female.
3. Male pseudocoupulates with the flower.
4. Pollen grain transferred from one flower to another.

4. Biomass is a more meaningful measure of population size. Explain with an example.

Ans. (i) Population large Total number is not an easily adoptable measure. Counting takes long time or practically impossible

(ii) There is no need to know the absolute population size for some investigations.

(iii) Number may sometimes be misleading e.g. In a given area there are 200 *Parthenium* plants and a single banyan tree. Here biomass size of the banyan tree is much more than those of 200 *Parthenium* plants.

5. Give example of how plant protects themselves from the predators.

Ans. (i) Thorns. E.g. – Rose, babool etc.

(ii) Chemicals that can kill the animals. E.g.- Calotropis etc.

6. What is interference competition? Define competitive exclusion principles.

Ans. (i) Feeding efficiency may be reduced due to interference of another species. E.g. –Tiger and deer.

(ii)Two closely related species need same resource can not co-exist indefinitely.

(5 Marks) Questions:

1.What are the different types of population growth pattern? Mention their differences.

Ans: a. Logistic and Exponential growth

b. S Shaped curve, J shaped curve. Limiting Factors, No-limiting Factors

2.With the help of age pyramids explain the nature of a population.

Ans: a. Pre-reproductive/ re-productive/ post-reproductive

b. increasing population/ stable population/ declining population

CHAPTER – 14. ECOSYSTEM

QUESTIONS

[2 MARKS QUESTIONS]

Q1.What are decomposers? Write their function.

Ans-a)Saprotrophs feed on dead bodies of organisms, b) Decomposition and mineralization.

Q2.What is the difference between gaseous and sedimentary cycle?

Ans-a) Gaseous-Reservoir in atmosphere ,Nitrogen cycle b) Sedimentary-Soil,e.g-phosphorus.

Q3.Why is the length of a food chain in an ecosystem generally limited to 3-4 trophic levels?

Ans –As 90% energy is lost in the form of heat from one trophic level to another, residual energy decreases drastically within 2-3 trophic levels.

Q4.What are the differences between detritus and grazing food chains?

Ans-a) Begins with Detritus-dead and decaying organic matter. b) Grazing-Begins with Living green plants.

Q5.What are the two basic catagories of ecosystem? Give example.

Ans-a) Terrestrial-Forest, grassland, desert. b) Aquatic-Pond, lake, sea, ocean

Q6.Mention two factors by which productivity is limited in an aquatic ecosystem.

Ans-a) Light-decreases with increasing water depth. b) Nutrient –Limiting factor in Deep Ocean

Q7.What is food chain? Give an example.

Ans-a) Food and feeding relation among organisms makes a chain like structure b) Grass—Deer—Lion

Q8.Expand PAR, How much PAR is used in gross primary productivity?

[**3 MARKS QUESTIONS]**

Q1.Briefly describe the process and products of decomposition.

Ans-Breakdown of complex organic matter by decomposers.a)Process-i)fragmentation ii)leaching iii)catabolism. Humification and mineralization –humification leads to accumulation of dark colour substance called humus. Mineralisation result in release of inorgranic substances.

Q2.Give account of factors affecting the rate of decomposition.

Ans-a) climatic factor – i)temp ii) soil b) chemical quality of detritus Higher temp and moist condition – high rate of decomposition Dry soil , High temp – Low rate

Q3) What are ecological pyramids ? Mention its limitations .

Ans –a) Arrangement of trophic levels from producers to top carnivores forms pyramid like structure 3 types – i) Pyramid of number ii) Biomass iii) Energy

Limitations – i) Assumes simple food chain ii) Single species may operate at two or more trophic levels.

Q4) Explain carbon cycle with ray diagram .

Ans – Given in text.

Q5 .Describe pond as an ecosystem .Ans- Pond has biotic and abiotic components

a) Biotic – Phytoplankton ,Zooplankton , small fishes , large fishes , frogs , snake ,etc.

b) Abiotic - water , dissolved organic and inorganic substances ,sunlight , temp .

Phytoplankton (microscopic plants) – producers . Zooplankton (microscopic animals) – primary consumers Small fishes - secondary consumers Large fishes , frog, snails – tertiary consumers.

[5 Marks Questions]

Q1. Describe the major components of ecosystems.

Ans- a) Biotic-i) Producer-green plants. ii) Consumers-primary, secondary,tertiary and decomposers. b) Abiotic-i) Physical and climatic factors-soil, temperature,light, humidity. ii) Chemical factors-inorganic chemical substances (sodium, potassium, nitrogen etc.) organic substances-(humus, protein, fat etc.)

Q2. Give an account of energy flow in an ecosystem.

Ans- Rate of energy transfer between the organisms of different trophic levels is called energy flow. Energy flow is unidirectional, 10% loss of energy in each trophic levels. 2-10% PAR captured by green plants.Energy flow diagram from the text.

Q3.What is xerosere?

Describe the process of succession on a bare rock. Ans-a) Succession on bare rock. b) Steps in Xerosere i) Lichens-Pioneer Community. ii) Mosses iii) Herbs iv) Shrubs v) Trees-Climax community.

Chapter-15: BIODIVERSITY AND CONSERVATION

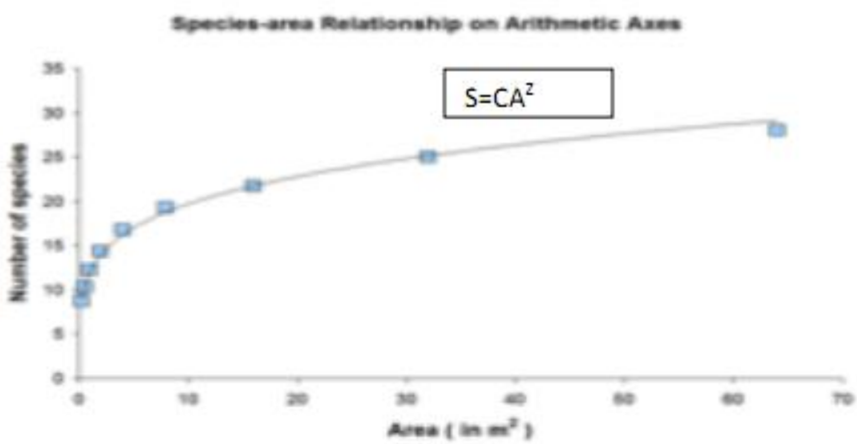
Biodiversity is defined as the totality of genes, species and ecosystems of a given region, i.e. the combined diversity at all levels of biological organisation. It is the variety and variability of life form (all animals, plants and microbes on earth) and the ecological complexes in which they occur. The term was first coined by Walter G. Rosen(1985),however the term was popularized by the American sociobiologist Edward Wilson(1988)

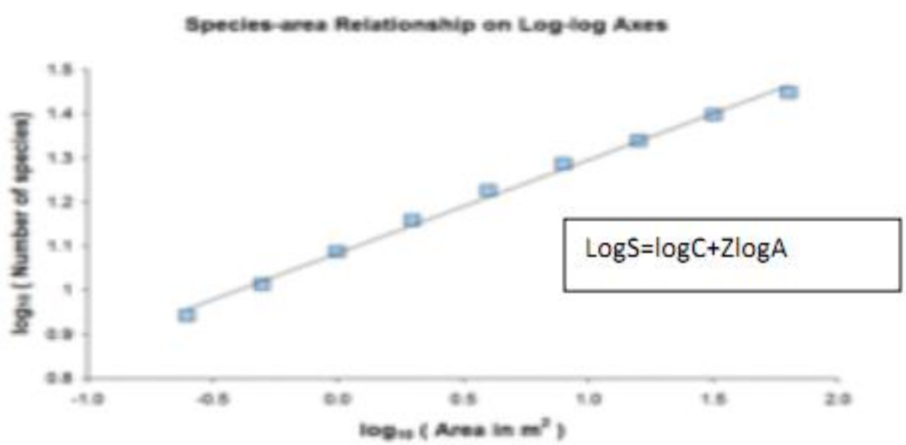
Hierarchial levels of Biodiversirty:

1)Species Diversity 2)Genetic Diversity and 3)Ecosystem/Community/Habitat Diversity

Patterns of Biodiversity:1) Lattitudinal gradients – Generally, species diversity decreases, as we move from equator to poles.e.g. However , Tropics(23.50N -23.50S) show richest species diversity. Speciation is generally a function of time. Temperate region is subjected to glaciation. Tropical regions remained relatively undisturbed for millions of years and thus had a long evolutionary time for species diversification. Moreover, tropical environments are less seasonal, relatively more constant and predictable. Such constant environment facilitates niche specialization and lead to greater species diversity. Tropical latitudes also get huge solar radiations which promotes higher productivity

SPECIES – Area relationships :





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.

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.***

Loss of biodiversity:

Loss of biodiversity in a region may lead to

1)decline in plant production

2)lowered resistance to environmental changes such as drought.

3)increased variability in certain ecosystem processes such as plant productivity, water use, pest & disease cycles.

Major causes of biodiversity loss:

i)Habitat loss and fragmentation ii)over exploitation iii)Alien species invasions iv)Co-extinctions and mass extinctions, , v) overexploitation , vi) urbanization, vii)pollution viii) Global climate change

Biodiversity conservation

Reasons for conservation can be grouped into three categories:

a)narrow utilitarian-for deriving direct economic benefit from nature.

b)broad utilitarian-as biodiversity plays a major role in many ecosystem services.

c)ethical-we need to realise that every species has an intrinsic value and we need to pass on our biological legacy to future generations.

How to conserve biodiversity:

In-situ**Conservation**– Threatened /endangered plants and animals are provided with urgent measures to save from extinction **within their natural habitat**(in wildlife sanctuaries, national parks & biosphere reserves, sacred groves /lakes-i.e. in **protected areas**)

Biodiversity hotspots – regions with very high levels of species richness and endemism. Norman Myers developed the concept of hotspots in 1998 to designate priority areas for *insitu* conservation. They are the most threatened reservoir of biodiversity on earth. In India 2 hotspots are there,e.g.Western ghats, and the Eastern Himalayas.

Ex-situ **Conservation** –Threatened animals & plants are **taken out from their natural habitat** & placed in a setting where they can be protected and given care as in botanical gardens, zoological gardens, seed/pollen/gene banks etc.

Efforts to conserve biodiversity:

Convention on Biological Diversity(CBD)

The three main goals of CBD are

1)Conservation of biological diversity

2)Sustainable use of components and

3)Fair and equitable sharing of benefits

Indian efforts:

Taking cognizance of the provisions of the CBD,India has enacted an umbrella legislation called the Biological Diversity Act,2002 and also notified the Biological Diversity Rulkes,2004.Its primary aim is to endorse the main goals of CBD suiting to India's national needs and circumstances.

India will host the 11th Conference of Parties(COP) (known as RIO+20)in October2012.

Questions:

Q1. Define Biodiversity.

Q2.What is ecosystem diversity?

Q3.Expand the term IUCN.(*International Union for Conservation of Nature and Natural resources*)

Q4.Who popularized the term biodiversity?

Q5.Can you mention the estimated number of species so far identified on earth?

Q6. Establish the relationship between species richness and explored area.(*comment on the species – area relationship curve).*

Q7."Plots with more species showed less year to year variation in total biomass"-who showed this? (*David Tilman*)

Q8.Who proposed the 'Rivet popper hypothesis'? Comment on the major postulate of this hypothesis. (*Paul Ehrlich*)

Q9.Mention the major causes behind biodiversity loss.

Q10. Why should we conserve biodiversity?(*comment on the broad/narrow utilitarian and ethical value of biodiversity*)

Q11.What do you mean by the term 'ecosystem services'?

Q12. What is meant by the term 'endemism'?

Q13.What are hot spots? Name two factors for declaring a hot spot. What are the hot spots found in India?

Q14. Distinguish between in-situ and ex-situ conservation measures with examples.

Q15.Can you mention some national and international efforts towards biodiversity conservation?

Q16. Write short notes on i) sacred groves and ii) traditional ecological knowledge.

Chapter – 16: Environmental Issues

Pollution: Any undesirable change in physical, chemical or biological characteristics of air, land, water or soil which harms the human beings.

POLLUTION

AIR POLLUTION | WATER POLLUTION | SOIL POLLUTION | NOISE POLLUTION

Pollutants: Agents that bring about pollution E.g. smoke, dust, pollen, chemical pollutants, wastes from hospitals, E-wastes etc.

Biodegradable and non -biodegradable pollutants

Ways of removing particulate matter

1. **Electrostatic Precipitator**
2. **SCRUBBER**
3. Proper maintenance of Automobiles

Reference Fig 16.1 NCERT

Advantage of CNG over diesel

- CNG burns most efficiently.
- Cheaper Cannot be siphoned.
- Cannot be adulterated.

Problems in use of CNG

- Difficulty in laying down pipelines Non-assurance of uninterrupted supply

Steps taken in Delhi to reduce pollution.

- Phasing out old vehicles.
- Use of unleaded petrol.
- Use of low sulphur Petrol and Diesel.
- Use of catalytic converters in vehicles Application of stringent pollution level norms for vehicles.

Noise pollution

- It is undesirable high level of sound.

Harmful effects of noise pollution

- Psychological and Physiological disorders
- Damage of eardrums and hearing ability
- Cause Sleeplessness, increased heartbeat altered breathing pattern, stress etc.

Steps to be taken to control noise pollution

- Use of sound absorbent materials or by muffling noise in industries
- Demarcation of horn free zones around hospitals and schools.
- Permissible sound levels of crackers,
- Timings after which Loudspeakers cannot be played

Water pollution

- Biological Oxygen Demand (BOD) indicates the amount of dissolved oxygen utilised by the microorganisms for oxidising the oxdisable organic matter present in the water body. Greater the organics, greater would be the pollution and lesser the dissolved oxygen.

Effects of BOD

Algal bloom

- It is free floating (Planktonic) Algae.
- Imparts a distinct colour to water bodies
- Cause deterioration of water quality and fish mortality.
- Some blooms are toxic to humans and Animals.

Water hyacinth (*Eichornia crassipes*)

World's most problematic aquatic weed

Called as _Bengal Terror'Grows faster than our ability to remove.

Bio magnification

Increase in concentration of the toxicant at successive tropic levels

Bio magnification of DDTIN Aquatic food chain

Water →	Zooplankton →	Small Fish →	Large Fish →	Fish-eating Birds
0.0003 ppm	0.04 ppm	0.5 ppm	2 ppm	5 ppm

Eutrophication

Natural ageing of lake by biological enrichment of its water.

Cultural or accelerated eutrophication

Acceleration of ageing process of a lake by effluents from industries and homes.

Integrated waste water treatment in arcata

It consist of two steps

a) Conventional sedimentation, filtering and chlorine treatment,

b) Passing this water through marshes for neutralization absorption and assimilation of pollutants.

c) Upkeep of this project by FOAM (Friends of Arcata Marsh).

SOLID WASTES

↓ Biodegradable ↓ Recyclable ↓ Non-Biodegradable

Ecological sanitation (Ecosan)

A sustainable system for handling human excreta without using water but with composting method.

Advantages of ecosan

a) Wastage of water is reduced

b) Practical and efficient

c) Hygienic and cheap

d) Excreta can be recycled and used as natural fertilizer.

Hospital wastes

Syringes, discarded medicines, Used gloves, Post-operative materials etc.

Should be treated before disposing off.

E-wastes

- Unused or damaged computers, calculators, mobile phones etc.
- Developed countries have plants for recycling e-wastes for recycling of metals.
- In developing countries e-wastes are buried in landfills or incinerated.

Agro chemicals

- Chemicals used in agricultural fields, Fertilizers, pesticides, weedicides etc.
- They are toxic to even non target organisms.
- Excess fertilizers cause Eutrophication.
- They cause soil pollution

Advantages of organic farming

- Economical Wastes do not get accumulated but recycled
- Does not cause Eutrophication

Radioactive wastes

- Emit radiations and damage biological organisms.
- Nuclear wastes are called potent pollutants, as they are lethal even in lower doses.

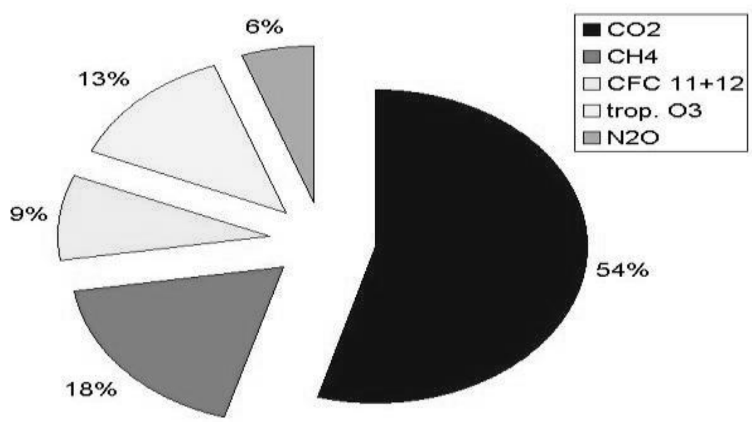
Disadvantages of nuclear plants

- Accidental leakages may happen
- Unsafe disposal of radioactive wastes
- Radiation emitted cause mutations in organisms
- Radiation causes genetic disorders

Greenhouse effect

Earth's atmosphere acts as a cover, which allows heat and light to enter in, but heat cannot escape. Thus warming up the earth.

Green House Gases:-Carbon dioxide, methane etc.



Ozone

- Triatomic molecule of oxygen.
- Found in stratosphere of atmosphere.
- CFCs discharged from lower atmosphere move upward
- UV rays act on these CFCs and release chlorine atoms.
- Chlorine degrades ozone and release molecular oxygen
- This process is irreversible and thus ozone is depleted

OZONE HOLE

Reference Fig 16.8 NCERT

Soil erosion

The removal of top fertile layer due to human activities

Reasons: -

- Over cultivation
- Over grazing
- Deforestation
- Improper irrigation practices

Waterlogging

- The crops may droop
- Leads to salinity of the soil.

Slash and burn agriculture/jhum cultivation

- Farmers cut down the trees of the forest and burn the plant remains.
- Ash is used as fertilizer and land is used for farming or cattle grazing
- Later, Land is left uncultivated for several years for replenishment of minerals

Effects of deforestation

- Leads to global warming due to excess carbon-dioxide
- Loss of biodiversity
- Damage to hydrological cycle
- Leads to soil erosion
- Desertification of land

Reforestation

- Restoring forest that was existing earlier
- E.g. Observing Van-Mahotsavas
- It also occurs naturally

Afforestation

- Developing a forest in a new area where no such forest existed in that area.

A case study of people's participation in forest conservation

A king of Jodhpur wanted to arrange wood for his new palace in 1731.

Few Bishnois hugged the trees and asked to cut them first rather than cutting trees.

365 persons lost their lives in this act

A small temple is now present there in remembrance of this act

Amrita Devi Bishnoi Wild Life Protection Award is instituted for individuals of rural areas who take keen interest in protecting wild life.

Chipko movement

It was started by local women of Garhwal, They hugged the trees to protect them from the axes of contractors.

Joint forest management (jfm)

- Startedy Government of India in 1980
- Local communities worked with the government to save the forest.
- Communities get forest products for encouragement.

Environmental issues

Very short answer type questions (1mark)

1. What is meant by algal blooms? What is its significance?

Ans. Excess growth of certain phytoplankton due to excess nutrients in water causes Deteriorates water quality, leads to fish mortality.

2. Define eutrophication.

Ans. Nutrient enrichment in water bodies leading to depletion of oxygen and loss of life supporting Environment.

3. What is bio magnification?

Ans. Increase in the concentration of certain toxic chemicals at successive trophic levels.

4. What is BOD?

Ans. Biological Oxygen Demand is the measure of organic matter in any water sample.

5. What is the effect of DDT in birds?

Ans. DDT disturbs calcium metabolism in birds, thinning of egg shell and premature breaking of Eggs lead to decline in bird population.

6. What do you understand by _Ecosan'?

Ans. Ecosanare the toilets which use compositing method for ecological sanitation.

7. Why are nuclear wastes called potent pollutants?

Ans. Because they are lethal even at lower doses and cause damaging disorders.

8. What is Jhum cultivation?

Ans Farmers cut down the tress, burn, use cattle for grazing and then allow the land to recover.

9. Mention two problems that have arisen due to green revolution.

Ans. Water logging and soil salinity.

10. What is snow blindness?

Ans. Inflammation of cornea caused by a high dose of UV-B radiation.

11. Which is the world's most problematic weed, also known as ―terror of Bengal"?

Ans. *Eichorniacrassipes*(Water hyacinth).

12.. What is the effect of DDT in birds?

Ans. Disturbs Calcium metabolism Thinning of egg shells and premature breakage of eggs, Decline of bird population.

Short answer type questions (2 marks)

1. Mention the harm caused by fine particulate matter to human beings?

Ans. (i) Cause respiratory problems
(ii) Irritation of eyes
(iii) Inflammation of lungs
(iv) Premature death.

2. Differentiate between biodegradable and non-biodegradable wastes.

Biodegradable wastes	Non-Biodegradable wastes
*Can be broken down into harmless simple Compounds by the action of decomposers.	*Cannot be broken down by microbes and get accumulated in the biosphere
*Can be used as manure	*Enter the food chain
*Cause little pollution	*Cause bio magnifications

3. Describe Chipko Movement.

Ans. It was launched in Garwhal, Himalayas by Sh Sunder LalBahuguna in 1974.

Local women showed enormous bravery in protecting the trees from the axes of the contractors by hugging them.

4. What are the advantages of Organic farming?

Ans. Economical procedure as recycling takes place.

Waste not accumulated but recycled

Efficiency and utilization of resources increased

Does not lead to eutrophication.

5. Write an account on Ecological sanitation (Ecosan).

Ans.A sustainable system for handling human excreta, using dry composting toilets. Practical,

Hygienic, efficient and cost-effective solution to human waste disposal Human excreta can be Recycled into manure Used in Kerala and Sri Lanka.

6. How do radioactive wastes cause damage to living organism?

Ans. Cause mutations in living organisms at a very high rate. Lethal in high doses Causes cancer And other disorders.Reduces the vegetation cover.

7. What is ecological sanitation? What are its advantages?

Ans. It is sustainable system for handling human excreta without using water but by composting Method.

Advantages

Hygienic, practical and efficient, Conserves water can be recycled and, Acts as a natural fertilizer.

Short answer type questions (3 marks)

1. Mention harmful effects of noise pollution on human health.

Ans. Stress Altered breathing pattern

Increased heart beating and blood pressure

Sleeplessness and headache

Hearing impairment.

2. What measures should be taken to reduce global warming?

Ans. Reduce use of fossil fuel

Efficient use of energy.

Avoid deforestation

Reduce human population Control greenhouse gases.

3. How can we reduce automobile pollution?

Ans. Un-Leaded Petrol- Reduces lead pollution in air.

Low Sulphur Diesel- Reduces sulphur pollution in air

Four stroke engines to reduce emission of unburnt hydrocarbons.

Tube-Ups to increase air-fuel ratio and help in better combustion.

Catalytic Converters to reduce pollution.

CNG to reduce pollution and conserve fossil fuels.

4. Mention the adverse effects agrochemicals.

Ans. They are toxic to non-target organisms. They cause soil pollution Excess fertilizers cause eutrophication.

5. Write a short note on ozone depletion.

Ans. Ozone found in stratosphere. CFCs discharged from lower atmosphere move upward. In stratosphere UV rays act on these CFCs release chlorine atoms. Chlorine degrades ozone and release molecular oxygen (O3O2). In this reaction chlorine acts, as catalyst and loss ozone is irreversible.

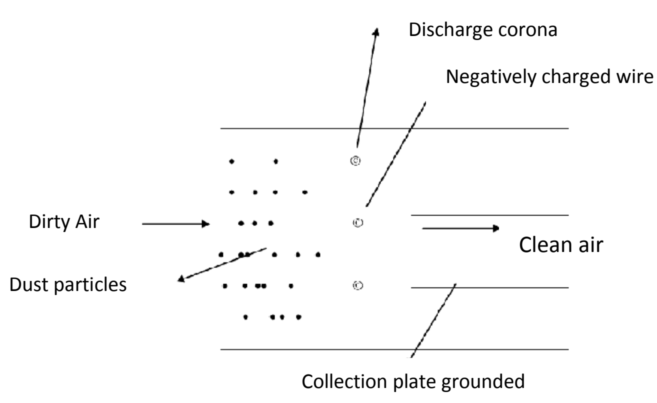
6. Mention the Supreme Court directions to the Government to reduce pollution.

Ans. Switch over to CNG in public transport system
Enforcement of Euro II norms for vehicles.
Compulsory periodic check-up of pollution.
Use of unleaded petrol Low sulphur petrol and diesel
Catalytic converters in vehicles
Phasing out of old vehicles.

Long answer type questions (5marks)

1. a) Explain the functioning of electrostatic precipitator with the help of a diagram.
   b) Mention the consequence if the electrostatic precipitator does not work in a power plant.

Ans. Used for removing particulate air pollutants.
Removes about 99 of the particulate pollutants from the exhaust of thermal power plants.
Electrode wires that are maintained at several thousand volts, which release electrons.
Electrons become attached to dust particles giving a net negative charge.
Collecting plates are grounded and attract the charged dust particles.
Velocity of air between the plates must be low enough to allow the dust particles to fall.
If electrostatic precipitator of a thermal plant stops working, all the particulate pollutants get released and pollute the air.



ELECTROSTATIC PRECIPITATOR

WORD LIST BINGO

Chapter-1: REPRODUCTION IN ANIMAL

Life span, reproduction, asexual reproduction, clone, binary fission, buds, zoospores, conidia, gemmules, vegetative propagation, runner, rhizome, sucker, tuber, offset, bulb,vegetative propagules, nodes,sexual reproduction, seasonal flowering, oestrous cycle, fertilization, gametogenesis, isogametes, heterogametes, antherozoid, homothallic, monoecious, hetrothallic, dioecious, staminate,pistillate, unisexual, bisexual, hermaphrodites, meiocytes, pollination

Syngamy, zygote, parthenogenesis, external fertilization, internal fertilization, embryogenesis, cell differentiation, oviparous,viviparous,ovary, pericarp.

Chapter-2:SEXUAL REPRODUCTION IN FLOWERING PLANTS

Androecium, Gynoecium, stamen, filament, dithecous, microsporangia, pollen sacs,tapetum, sporogenous tissue, microsporogenesis, microspore tetrad, pollen grains, exine, intine, germ pores, vegetative cell , generative cell,monocarpellary multicarpellary,syncarpous, stigma , style, ovary,placenta,megasporangia(ovule) funicle, hilum, integuments, micropyle, chalaza, nucellus, embryo sac (female gametophyte), megasporogenesis, megaspore mother cell, megaspore, monosporic, egg apparatus, synergids, antipodals, egg cells, filiform apparatus, polar nucleus, secondary nucleus, pollination, autogamy, chasmogamous and cleistogamous flower, geitenogamy, xenogamy, outbreeding devices, pollen- pistil interaction, artificial hybridization, emasculation, bagging, primary endosperm nucleus, triple fusion, endosperm , embryo, post fertilization events, scutellum, heart shaped embryo, plumule, hypocotyle, epicotyle, plumule, radical, coleorrhiza, coleoptiles, albuminous/nonalbuminous seed, perisperm, seed dormancy, pericarp,false/true /parthenocarpic fruit,apomixes, polyembryony

Chapter-3:HUMAN REPRODUCTION

Insemination, implantation, testes, scrotum, seminiferous tubules, sertoli cells, interstitial cells of Leydig, rete testis, vasa efferentia, epididymis, vas deferens, urethral meatus, accessory reproductive glands-seminal vesicles, prostate, bulbourethral glands, ovaries, oviduct, uterus, cervix, vagina, mammary glands, infundibulum, fimbriae, ampulla, isthmus, perimetrium, myometrium, endometrium,fallopian tube,clitoris,lactiferous duct,spermatogenesis, spermatogonia, primary spermatocytes,secondary spermatocytes, spermatids, spermatozoa, spermiogenesis/spermateleosis, spermiation ,acrosome, semen, oogenesis, oogonia, primary oocyte, primary/secondary follicle, antrum, graffian follicle, zona pellucid, ovulation, polar bodies,menstrual cycle- menarche,corpus luteum, progesterone, menopause,cleavage,morula, blastomeres,trophoblast cells, inner cellmass, implantation, chorionioc villi, h CG, h PL, estrogen, relaxin, umbilical cord, germ layers-ectoderm, mesoderm, endoderm, stem cells, parturition, foetal ejection reflex, lactation, colostrums.

Chapter-4:REPRODUCTIVE HEALTH

Health,STDs,AIDS,Reproductive & child health care, amniocentesis, maternal mortality rate(MMR), infant mortality rate(IMR), contraceptive,natural methods, periodic abstinence, withdrawal method/coitus interruptus ,barrier methods, condoms, diaphragms, cervical caps, vaults, intra uterine devices(IUDs), pills, sterilization, vasectomy,tubectomy,Medical Termination of Pregnancy(MTP), Infertility, Assisted Reproductive technologies(ART),in-vitro fertilization(IFV), embryo transfer, test tube baby, zygote intra fallopian transfer(ZIFT),intra uterine transfer(IUT), in-vivo fertilization, gamete intra fallopian transfer(GIFT), Intra cytoplasmic sperm injection(ICSI), artificial insemination(AI), intra –uterine insemination(IUI),Adolescence Reproductive and Sexual Health(ARSH), Reproductive Health

Chapter-5:PRINCIPLES OF INHERITANCE AND VARIATION

Inheritance, Fillial progeny, factors,traits, homologous chromosome, gene, loci/locus, allele homozygous,heterozygous ,phenotype, genotype, monohybrid cross, dominant , recessive, punnett square,segregation, dihybrid cross, independent assortment,test cross,back cross, incomplete dominance, co-dominance, chromosomal theory of inheritance,linkage, recombination,sex determination, autosomes, sex chromosomes/allosomes,homogametic, heterogametic, mutation, chromosomal aberrations, frame-shift mutation, pedigree analysis, consanguineous mating, Mendelian disorders, nondisjunction, haemophilia, sickle cell anaemia, phenylketonurea, in born error of metabolism/metabolic disorder,aneuploidy,polyploidy, syndrome, Down's syndrome, trisomy, Klinefeltor's syndrome, gynaecomastia, Turner's syndrome, rudimentary/streak gonad.

Chapter-6:MOLECULAR BASIS OF INHERITANCE

Deoxyribonucleic Acid(DNA), Ribonucleic Acid(RNA),nucleotide, nucleoside, nitrogenous bases(purine, pyrimidine), sugar(pentose-deoxyribose/ribose),Adenine,Guanine, Thymine, Cytosin,Uracil, N-glycosidic linkage, Phosphodiester linkage, double helix, Chargaff's rule, anti parallel polarity, central dogma, histones, octamer, nucleosome, chromatin, euchromatin, heterochromatin, nonhistone chromosomal protein(NHC),Transformation(Griffith's experiment), Transduction (Hershey-Chase experiment), replication,semiconservative replication,template DNA, Meselson-Stahl's experiment,replication fork, helicases, topoisomerases, single stranded binding protein, primase,DNA polymerase, DNA ligase,Okazaki fragments, continuous (leading)strand, discontinuous (lagging)strand, Transcription, promoter,structural genes/cistrons,terminator,DNA dependent RNApolymerase,coding strand, polycistronic, monocistronic, coding sequence(exon),non-coding sequence(intron), messengerRNA(m RNA), transferRNA(t RNA),ribosomal RNA(r RNA), Initiation factor, termination factor, Eucaryotic transcription, heterogenous nuclear RNA(hn RNA),capping,tailing, splicing,Translation, genetic code,codon, unambiguous, degenerate, universal, methionine/fMet, START/initiation codon(AUG), STOP/NONSENSE CODON(UAA,UAG,UGA),frame shift (insertion/deletion) mutation, adapter molecule, untranslated region,anti codon, aminoacylation of t RNA, release factor,regulation, gene expression,operon, regulator, promoter,operator,lac-Operon, B-galactosidase,permease,trans-acetylase,lactose,inducer,switch on/off, inducible system,negative regulation, Human Genome Project (HGP),GENOME, bioinformatics, DNA sequence, Expressed Sequence Tags(ESTs), Sequence Annotation

Bacterial artificial chromosome(BAC),Yeast artificial chromosome(YAC),Single nucleotide polymorphism(SNPs), DNA fingerprinting, DNA polymorphism, repetitive DNA, satellite DNA, Variable Number Tandem Repeats(VNTRs),isolation of DNA, Electrophoresis, blotting, hybridization, probe, autoradiography.

Chapter-7:EVOLUTION

Evolution, Big bang, spontaneous generation, panspermia, Miller's experiment, HMS Beagle, CharlesDarwin,fitness,AlfredWallace,fitness,naturalselection,evidences,morphology,anatomy,homologous organ, divergent evolution, analogous organ, convergent evolution, industrial melanism, adaptive radiation, branching descent, saltation, stabilising selection, directional selection, disruptive selection, gene migration, gene flow, genetic drift, mutation, genetic recombination, founder effect, geological periods, Dryopithecus, Ramapithecus, *Homo habilis, Homo erectus, Homo sapiens,* Neanderthal man, brain capacity.

Chapter-8:HUMAN HEALTH AND DISEASES

Health, disease ,infection, genetic disorders, life style disorders, infectious/ non-infectious, pathogen, typhoid, widal test, pneumonia, common cold, malaria, *Plasmodium* sp. *Anopheles sp.* ,Haemozoin, sporozoites, gametocytes, amoebiasis, ascariasis, elephantiasis/filariasis, *Wuchereria bancrofti,* ringworms, personal hygiene, public hygiene, air borne disease, water borne disease, vector borne diseases, biological control*(Gambusia), Aedes,* immunity, innate immunity, physical barrier, physiological barrier, cellular barrier, cytokine barrier, acquired immunity, B lymphocytes,T ,lymphocytes, antibody(Immunoglobulin), light chain, heavy chain, Humoral immune response, cell mediated immunity, active immunity, passive immunity, colostrums, IgA, vaccination, immunization, allergies, IgE, histamine, serotonin, auto immunity, lymphoid organs, bone marrow, thymus, mucosal associated lymphoid tissue(MALT),Acquired Immuno Deficiency Syndrome (AIDS),retro virus, HIV, Enzyme Linked Immuno Sorbent Assay(ELISA),Cancer, contact inhibition, benign tumor, malignant tumor, neoplastic cells, metastatis, carcinogens, viral oncogenes ,proto oncogenes, radiotherapy, chemotherapy, immunotherapy, a-interferon ,drugs, opioids, cannabinoids, cocaine, barbiturates, amphetamines, LSD, hallucinogens, drug abuse, addiction, dependence, withdrawal syndrome, alcohol abuse , liver cirrhosis, danger signs, peer pressure.

Chapter-9:STRATEGIES FOR ENHANCEMENT IN FOOD PRODUCTION

Animal husbandry, dairy, poultry, animal breeding, inbreeding, out breeding, homozygosity, inbreeding depression, out breeding, out crossing , cross breeding, interspecific hybridization, artificial insemination, Multiple Embryo Transfer Technology(MOET), apiculture, fisheries, plant breeding, green revolution, germplasm collection, cultivars, disease resistance, mutation breeding, insect pest resistance, biofortification, Single Cell Protein(SCP), tissue culture, explants, totipotency, micropropagation, somaclones,meristem, somatic hybrids.

Chapter-10:MICROBES IN HUMAN WELFARE

Microbes, Lactic acid bacteria(LAB), *Saccharomyces cerevisiae,* fermentors, distillation, antibiotics, bioactive molecules, streptokinase, clot buster, cyclosporine A, immunosuppressive agents, statins, cholesterol lowering agents, sewage, primary treatment, primary sludge, flocs, Biochemical Oxygen Demand(BOD), Activated sludge, anaerobic sludge digesters, biogas, Ganga action plan, Yamuna action plan, methanogens, Bt cotton, *Bacillus thuringiensis,* baculoviruses, *Trichoderma* spp. Integrated Pest Management(IPM), Biofertilisers, organic farming, mycorrhiza, cyanobacteria.

Chapter-11:BIOTECHNOLOGY:PRINCIPLES AND PROCESSES

Biotechnology, genetic engineering, recombinant DNA, gene cloning, gene transfer, origin of replication, plasmid, restriction enzymes, cloning, restriction endonuclease, recognition sequence, nucleases, exonucleases, endonucleases, palindrome, sticky end ,blunt end, gel electrophoresis, elution, cloning vectors, selectable markers, transformation, antibiotic resistance, insertional inactivation, tumor, Ti plasmid, *Agrobacterium tumifaciens,* micro injection, biolistic/gene gun, lysozyme, cellulose, chitinase, Polymerase Chain Reaction(PCR),denaturation, annealing, extension, thermostable DNApolymerase, bioreactors, downsteam processing.

Chapter-12:BIOTECHNOLOGY AND ITS APPLICATION

Genetically Modified Organism(GMO), Bt cotton, insecticidal proteins, cry genes, pest resistant plants, RNA interference(RNAi)/RNA silencing, dsRNA, Genetically engineered insulin, gene therapy, ADA deficiency , c DNA, Molecular diagnosis, transgenic animals, Bioethics, Genetic Engineering Approval Committee(GEAC), Bio piracy, Indian patent bill.

Chapter-13:ORGANISMS AND POPULATIONS

Organisms, population, communities, ecosystems, biomes, ecology, grassland,tundra, desert, coniferous forest, temperate forest, tropical forest, abiotic features, temperature,stenothermal, eurithermal, water, salinity, pH, light, soil, moisture,conformers, regulators, partial regulators,migration, suspension, hibernation, aestivation,adaptation,altitude sickness, Allen,s rule population attributes,age pyramid(expanding, stable, declining),population density, natality, mortality, immigration, emigration, exponential growth, logistic growth,mutualism, competition, predation, parasitism, commensalism, amensalism.

Chapter-14:ECOSYSTEM

Terrestrial ecosystyem, aquatic ecosystem, stratification, productivity, Gross primary productivity (GPP),Net primary productivity(NPP),Secondary, productivity,decomposition, detritus, detritivores, fragmentation, leaching, catabolism, humification, humus, mineralization, Photosynthetically active radiaton(PAR),energy flow, producers,consumers,herbivores,carnivores,Grazing food chain(GFC), Detritus Food Chain(DFC), food web, trophic level, standing crop, biomass, Ecological pyramids, upright pyramid, inverted pyramid, succession, pioneer, sere/seral stage, climax community, Hydrarch succession, Xerarch succession, nutrient cycling , biogeochemical cycles, ecosystem services.

Chapter-15:BIODIVERSITY AND CONSERVATION

Biodiversity, genetic diversity, species diversity, ecological/habitat diversity,mega diversity country, loss of biodiversity,habitat loss, habitat fragmentation, over exploitation, alien/non native/invasive species, coextinctions, narrowly utilitarian, broadly utilitarian,in situ conservation, endemism, hotspots, sacred groves, Ex situ conservation,Earth summit, sustainable development.

Chapter-16:ENVIRONMENTAL ISSUES

Pollution, pollutants, Environmental Protection Act(EPA), Electrostatic Precipitator(ESP), Vehicular pollution, Compressed Natural Gas(CNG), Euro ii, Bharatii, Air prevention and pollution control act, noise pollution, decibel, water pollution, domestic sewage, dissolved oxygen(DO), Oxygen sag curve, biochemical/biological oxygen demand(bod), algal bloom, planktonic, Bioaccumulation, Biomagnificationj,solid wastes, municipal solid waste, sanitary landfills, plastic waste, e-wastes, agro-chemicals, radioactive wastes, enhanced Greenhouse effect , Global warming, CFCs, stratospheric Ozone depletion, deforestation,slash & burn agriculture, Jhum cultivation, deforestation, reforestation, chipco movement, Joint Forest Management(JFM)

QUESTION

CLASS : XII (Sc.);   SUBJECT: (BIOLOGY)

M.M.:70 ;   TIME: 3 HRS.

General instructions:

1. All question are compulsory.
2. The question paper consists of four sections A,B,C&D.Section A contains 8 questions of one mark each, Section B contains 10 questions of two marks each, Section C contains 9 questions of three marks each & Section D contains 3 questions of five marks each.
3. There is no overall choice.However, internal choice is provided in few question where student should attempt only one of the alternative given.
4. Wherever necessary, neat labeled diagram should be drawn.

SECTION : A

Q1.Chromosome number in meiocytes of Apple is 34. Write the chromosome number in gamete ? (1)

Q2. Which kind of evolution is shown by the thorn & tendril of bougainvillea & Cucurbita? (1)

Q3How water pollinated flowers protect the pollen grains from water ? (1)

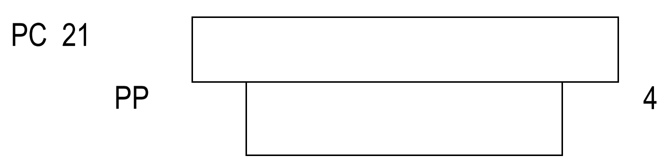
Q4.What kind of chromosomal disorder results in the genetic disorder of Klinefelter's syndrome? (1)

Q5.Some cells release interferons. Why? (1)

Q6.Name the bio-reactive molecule used as immunosuppressive agent & mention the organism from which it is produced ? (1)

Q7.Identify the kind of population interaction in an Orchid growing as an epiphyte on a mango branch? (1)

Q8. What type of growth status the following pyramid represents: (1)



SECTION : B

Q9.Differentiate between Chasmogamous & Cleistogamous flower. (2)

Q10 Explain the following: i) I V F ii) I C S I (2)

Q11.i)What kind of disorder leads to the disease Phenylketonuria?

ii) What is the resultant effect of the disorder in man? (1+1=2)

Q12. Name the missing organisms/ diseases in the table given below. (1/2X4=2)

Organism	**Disease**
Microsporum	A
B	Elephantiasis
C	Amoebiasis
Plasmodium falciporam	D

Q13.i) Write the use of Cyclosporin A & write the name of the organism from which it is produced?

ii)Give one example each of fermented beverages with &without distillation. (1+1=2)

Q14. Complete the following gaps in A, B, C & D in the following table : (2)

Crops	Variety	Resistance to disease
Wheat	A	Resistant to leaf and stipe rust
B	*Pusa swarnim*	Resistant to white rust
Cauliflower	C	Resistant to black rot
D	*Pusa kamal*	Bacterial blight

Q15.i) Expand GEAC.

ii)Mention two modern biotechnological techniques for early molecular diagnosis of diseases. (1+1=2)

Q16.Differentiate between Exponential &Logistic growth with the help of population growth curve. (2)

Q17 .Differentiate between in-situ & ex-situ conservation of biodiversity with suitable example (2)

Q18.i) What is e-waste?

ii)Mention different kinds of impurities present in waste water. (1+1=2)

SECTION : C

Q19.i) Explain Hardy-Weinberg equilibrium with suitable example.

ii) Mention five factors affecting Hardy-Weinberg equilibrium. (2+1=3)

Q20. Draw a neat diagram of structure of a Nucleosome & label four parts of it.

OR

Draw a neat diagram of structure of Human sperm & label four of its parts. (3)

Q21. Answer the following about Opioid drugs: i)Name opioid receptors in human body

ii) Give one example of opioid drug iii)How it is extracted iv) How it is taken by man

v)What is its effect on human body? vi) Chemical name of the drug. (3)

Q22. Explain the following in relation to sewage treatment: i) Floc ii) BOD
iii) Anaerobic sludge digesters. (3)

Q23. i)What is Biomagnification?

ii)What is meant by Green house effect? (1+2=3)

Q24. Explain the steps involved in the process of Decomposition in the ecosystem. (3)

Q25.How biotechnological application for production of Pest resistant could be developed in Bt cotton plant. (3)

Q26. i)Explain the oral administrative contraceptive device & time period of its effectiveness.

ii) Give example of one copper releasing & one hormone releasing IUDs. (2+1=3)

Q27. Mention the six steps followed in the technique of DNA fingerprinting. (3)

SECTION : D

Q28.i)Name the male accessory glands & its function in man.

ii)Explain the hormonal changes that occur during Menstrual cycle in human with the help of graphical diagram.

iii)What is Placenta? (1+3+1=5)

OR

i)Explain the stages of Megasporogenesis in flowering plants with the help of suitable diagram.
ii)Draw a neat labeled diagram of mature pollen grain.

iii)Differentiate between Perisperm & Pericarp. (3+1+1=5)

Q29.i) Draw a neat labeled diagram of a Transcription unit & define the following:

a) Function of RNA polymerase III b) Splicing c) Tailing.

ii)What is Frame-shift insertion? (3+2=5)

OR

i) Differentiate between Benign tumour & Malignant tumour.

ii) Mention two methods of detection & diagnosis of cancer.

iii) Write any two methods for prevention of drug abuse in adolescence. (1+2+2=5)

Q30. i) Complete the following palindrome sequence and name the restriction endonuclese that recognizes this.

5’ 3’

G	?	A	?	T	C
C	?	T	?	A	G

3’ 5 ‘

ii) Explain three methods for transfer of recombinant DNA in competent host in rDNA technology.

iii) What is meant by Insertional inactivation ? (1+3+1=5)

QUESTION

CLASS : XI (Sc.); SUBJECT: (BIOLOGY)

M.M.:70 ; TIME: 3 HRS.

General instructions:

- All question are compulsory.
- The question paper consists of four sections A, B, C & D.Section A contains 8 questions of one mark each, Section B contains 10 questions of two marks each, Section C contains 9 questions of three marks each & Section D contains 3 questions of five marks each.
- There is no overall choice.However, internal choice is provided in few question where student should attempt only one of the alternative given.
- Wherever necessary, neat labeled diagram should be drawn.

SECTION : A

Q1.Name the kind of Leucoplast that stores oil & protein? (1)

Q2. Where do you find Porins?Mention its function. (1)

Q3.In which stage of cell division chromosome number could be counted easily? (1)

Q4.Name the following organisms:-

i) A cyanobacterium used as Protein rich food?

ii) A Dianoflagellate causing Red tide? (1)

Q5.Locate Companion cells in plant tissues & write its function. (1)

Q6.Name the component parts in mouth of Cockroach. (1)

Q7.Certain marine brown & red algae produce large amount of hydrocolloids that are commercially used.

Name those two substances. (1)

Q8.Identify the symbols used in writing the floral formula of a flower :- i) % ii) $\underline{G}$ (1)

SECTION : B

Q9.Differentiate between Symplastic & Apoplastic pathway of movement of water in plants. (2)

Q10. Write one point difference between:

i) Peptide bond & Glycosidic bond ii) Nucleoside & Nucleotide (2)

Q11.Fill in the blanks with suitable secondary metabolites/Examples :-

i) Pigment : ____________

ii) ______ : Lemon grass oil

iii)Toxins : ____________

iv)______ : Rubber (2)

Q12. Write the composition of Fluid Mosaic model proposed by Singer & Nickolson. (2)

Q13. What is Heterocysts ? Give two examples where heterocyst is found. (1+1=2)

Q14. Complete the following gaps in A, B, C & D in the following table using suitable words : (2)

A	Roots of Rhizophora
B	Leaves of Calotropis
C	Fruit of Mango
D	A scar on seed coat

Q15.i) What is Mesosome? Write its function.

ii) Omnis cellula-e cellula." Illustrate. (1+1=2)

Q16.Differentiate between Areolar tissue & Adipose tissue with suitable example. (2)

Q17 .Identify the following : i) Periderm ii) Conjoint vascular bundle. (2)

Q18.Draw a neat labelled diagram of different kinds of chromosomes based on the position of centromere.

OR

Draw a neat labelled diagram of a Bacteriophage. (2)

SECTION : C

Q19.Mention the events that happen during the following phases of cell cycle:

i) G1 phase ii) S phase iii) Quiescent phase (3)

Q20. Draw a neat diagram of a monocotyledonous seed & label different parts of it.

OR

Draw a neat diagram of Digestive system of frog & label different parts of it. (3)

Q21. Answer the following :

i)Name the central cavity in sponges through which water passes.

ii) Name the part in Ctenophores having external ciliated rows meant for locomotion.

iii)Name the specialised cells in flat worms that help in osmoregulation.

iv)Name the kind of scales that cover the skin of bony fishes.

v)Name the part that represent ear in Amphibians.

vi) Name the lateral appendages that help in swimming in Nereis. (3)

Q22. Classify different types of Nephridia in Earthworm & locate each type in it. (3)

Q23. The transpiration driven ascent of xylem sap depends on some physical properties of water.

Explain three such properties of water. (3)

Q24. Explain the activity of following enzymes: i) Hydrolase ii) Lyase iii) Transferases. (3)

Q25.Mention the universal rules to be followed in Binomial nomencleture. (3)

Q26. Which group of fungi are called as imperfect fungi? State reasons. (3)

Q27. Mention two ways that Ammonia can be utilized by plants through Nitrogen cycle. (3)

SECTION : D

Q28.i)Differentiate between Chordates & Non- chordates with suitable examples.

ii)Write the name of the group in which following structures are found & mention function of each:-

a) Choanocytes b) Malpighian tubules c) Water vascular system (2+3=5)

OR

i)Explain the steps involved in the process of Double fertilization in flowering plants with the help of suitable diagram.

ii)What does Haplo-diplontic phases of life cycle signify? Give suitable example. (3+2=5)

Q29. Describe the floral characters of the family Fabaceae.Write the floral formula & floral diagram of it.

OR

i) Categorise various kinds of Aestivation & explain each with suitable diagrammatic representation.

ii)What is Pericarp? (3+2=5)

Q30. i)Explain the steps involved in Prophase I of Meiosis I with suitable diagram.

ii) Write the significance of Meiosis. (3+2=5)

LIST OF IMPORTANT DIAGRAM

Chapter1:
Fig1.2(a) and (b),NCERT,page5
Fig18(a) and (b),NCERT,page16

Chapter2:
Fig2.1,NCERT,page20
Fig2.3(a),(b) and (c),NCERT,page22
Fig2.7(d),NCERT,page25,(anatropous ovule the fig should be turned upside down)
Fig2.8,NCERT,page26
Fig2.12c and d,NCERT,page32
Fig2.13,NCERT,page34
Fig2.15a(maize seed),NCERT,page37

Chapter3:
Fig3.1,NCERT,page43
Fig3.4,NCERT,page46
Fig3.5,NCERT,page47
Fig3.6,NCERT,page48
Fig3.7,NCERT,page49
Fig3.8,NCERT,page49
Fig3.9,NCERT,page50
Fig3.12,NCERT,page53

Chapter6:
Fig6.1,NCERT,page96(for HOTS)
Fig6.2,NCERT,page98(for HOTS)
Fig6.4,NCERT,page99(for HOTS)
Fig6.8,NCERT,page107(for HOTS)
Fig6.9,NCERT,page108(for HOTS)
Fig6.12,NCERT,page114(Consult any reference book for correct diagram)

Chapter7:
Fig7.1,NCERT,page128(for HOTS)
Fig7.8,NCERT,page136(for HOTS)

Chapter8:
Fig8.1,NCERT,page148(for HOTS)
Fig8.4,NCERT,page151

Chapter10:
Fig10.2,NCERT,page180
Fig10.8,NCERT,page186(HOTS)

Chapter11:
Fig11.1,NCERT,page196(HOTS)
Fig11.4,NCERT,page199(HOTS)
Fig11.1,NCERT,page196(HOTS)

Chapter12:
Fig12.3,NCERT,page211(HOTS)

Chapter13:
Fig13.1,NCERT,page220(HOTS)
Fig13.3,NCERT,page223(HOTS)
Fig13.4,NCERT,page227(HOTS)
Fig13.5,NCERT,page230(HOTS)

Chapter14:
Fig14.1,NCERT,page244(HOTS)
Fig13.5,NCERT,page230(HOTS)

Chapter15:
Fig15.1,NCERT,page260(HOTS)
Fig15.2,NCERT,page262(HOTS)

Chapter16:
Fig16.1,NCERT,page271(HOTS)
Fig16.3,NCERT,page274(HOTS)
Fig16.6 16.7,NCERT,page281(HOTS)

Notes: Diagram should be drawn in pencil, labeled with pencil, a caption depicting the Fig must be given.
Diagram should be drawn scientifically without stressing on unnecessary shades/colour.

HIGH ORDER THINKING (HOTS) QUESTIONS

CHAPTER-2

- What is Pollen Viability?How the pollen grains of different species are kept stored?
- What is meant by free nuclear endosperm. Give one example.
- Name the single cotyledon found in grass family. Differentiate between coleoptile and coleorhiza?
- Production of Hybrid seed is a costly affair then why do farmers produce such seeds every year? How can this problem be solved.

CHAPTER- 3

Q. Why cleavage is called as fractionating process?

A-Cleavage results in increase in number of blastomeres but decrease in size of blastomeres.

Q. Which factor determines the pattern and speed of cleavage?

A- Amount and distribution of yolk.

Q. Name the extra-embryonic membranes in human embryo and mention its function.

A- Yolk Sac – Vestigial, act as extra embryonic gut.

Amnion-Protect embryo, acts as shock absorber, prevents desiccation of embryo.

Allantois- Stores nitrogenous wastes, acts as extra embryonic kidney.

Chorion – Helps exchange of gases, acts as extra embryonic lung.

Q. Which type of Placenta is found in man?

A- Chorionic (finger-like out growth) , haemochlorial , metadiscoidal(Chorionic villi exposed like disc) and deciduate (part of uterine wall expelled during parturition).

Q. Why testis lies outside the body cavity in scrotal sac ?

A- Scrotal sacs act as thermo regulators, keep testicular temperature 2 degrees lower than the normal body temperature for normal spermatogenesis.

Q. What happens if testes fail to descend into scrotal sac?

A-High temperature of abdomen will kill the spermatogenetic tissues of the testis and no sperm will be formed (azoospermia) causing sterility , the phenomenon called Crytorchidism.

Q Vitellogenesis is an important phenomenon after fertilization . Give reasons .

A-After fertilization Vitelline membrane is transferred into fertilization membrane which checks polyspermy

Q Penetration of sperm is a chemical process. Illustrate.

A Sperm head i.e. acrosome contains sperm lysin / hyaluronidase enzyme which help dissolving hyaluronic acid binding the follicular cells of corona radiata from penetration of sperm nuculeus to egg nucleus

Q In morula stage the cells divide without any increase in size why ?

A Since, zona pellucida of egg cell remain intact till completion of cleavage.

Q What is the importance of fertilizin–Antifertilizin reaction?

A Ovum secretes fertilizin(glyprotein or mucopolysaccharide) which has a number of spermophiliic sites on its surface where sperm can be bound by their antifertilizin site (on sperm head containing acidic amino acid) In this process thinning out of number of sperms take place to avoid polyspermy.

CHAPTER-4
(REPRODUCTIVE HEALTH)

Q.Why oral contraceptive pills are called as combined pills?
Ans.Since the same medicine contains mainly Progestogen& Estrogen that shows combined action inhibiting ovulation as well as contraception.

Q.Amniocentesis is illegal for detection of sex of foetus.Why?
Ans. The method is misused for identification of female child during foetal development & aborted due to a misconception of rejection of female child by the society.

Q.Removal of gonads can not be considered as contraceptive options. Why?
Ans. Contraception basically includes preventing unwilling conception without affecting normal body function that can be disrupted by removal of gonads.

Q. What are the essential features for an ideal contraceptive?
Ans. Ideal contraceptive should be user friendly, comfortable & easy to use, without any side effect & completely effective against pregnancy.

Q. All RTIs are STDs but all STDs are not RTIs. Justify.
Ans.Reproductive tract infections are basically transferred through sexual contact & hence may be termed as sexually transmitted diseases whereas some STDs like Hepatitis-B, AIDS are not caused due to infection of reproductive tract although transmitted through sexual contact.

Q. Now a day's number of childless couples is decreasing. Why?
Ans.Various improvised scientific methods are available for infertile couples to have a child through assisted reproductive technology.

Q.How CVS technique is more advanced than Amniocentesis?
Ans. Chorionic Villi Sampling technique may be applied by 8^{th} to 10^{th} week of pregnancy whereas Amniocentesis is done in about 14^{th} to 15^{th} week. Hence, abortion is easier & less risky in CVS techniques.

Q. 'Test tube baby' has raised several legal problems. Explain.
Ans. Method used for test tube baby need artificial need artificial collection of sperm & ovum, implantation in surrogate mother in some occasions which very often discouraged by the society. Couples become selective & avoid natural process.

Q. Population explosion is the resultant effect of reproductive health awareness. Why?
Ans. Reproductive health awareness resulted in reduced infant mortality rate , discouraging early marriage, contraceptive devices, control against diseases could increase in population.

Q.What is meant by induced abortion?

Ans. It is an intentional or voluntary termination of pregnancy before full term due to unprotected intercourse or failure of effect of contraceptive during coitus or rape.

CHAPTER 5

Principle of inheritance and Variation:

1 If a dominant allele for tall plants is represented by the letter D, what letter should represent the corresponding recessive allele?

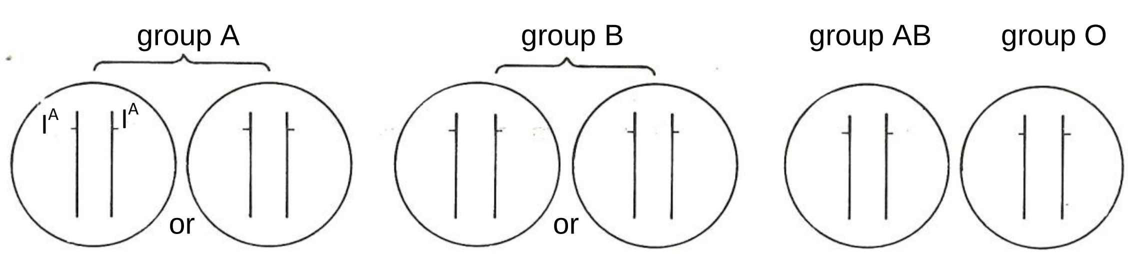
2 In cats, the allele (**S**) for short fur is dominant to the allele (**s**) for long fur.
(a) What is the genotype of a true-breeding, long-furred cat?
(b) What is the phenotype of a cat with the genotype **Ss**?
(c) In an **Ss** genotype, which allele is expressed in the phenotype?
(d) Which of the fo1lowing genotypes is (i) heterozygous (ii) homozygous dominant?
SS, **Ss**, **ss**

3 In rabbits, assume that the dominant allele (**B**) produces black fur. The allele (**b**) for white fur is recessive to **B**.
(a) What colour fur will each of the following rabbits have?

Rabbit 1 *Rabbit 2* *Rabbit 3* *Rabbit 4*
genotype**BB** **BbbBbb**

(b) Which of them will breed true?
(c) Which rabbits are homozygous for coat colour?
(d) If rabbits 1 and 4 were mated together and had 12 babies,
how many of these would you expect to be black?
(e) If rabbits 2 and 3 are interbred and produce several litters, totalling 48 babies, how many white babies would be predicted by the laws of genetics?
(f) If rabbits 3 and 4 are mated together on several occasions and have 50 babies
Altogether, how many of their babies would you 'expect' to be black?

4 The alleles controlling the ABO blood groups are given the letters **I^A** (group A), **I^B** (group B) and **i** (group O). On the drawings below, write in the alleles on the chromosomes for each of the blood groups. (clue : The first one has been done for you)



5 Give three examples of human disorders which are caused by the action of a single pair of alleles. In each case say whether the harmful allele is dominant or recessive to the non-harmful allele.

6 In humans, maleness or femaleness is determined by a pair of sex chromosomes called X and Y.

(a) What is the genotype for males?
(b) What is the genotype for females?
(c) what are the symbols used for represent male and female genotype in birds?

7 (a) In humans, is it the sperm or the ovum which determines the sex of the offspring?
(b) Give a reason for your answer.

8 When a particular gene is said to be 'sex-linked', on which chromosome is that gene usually present?

9 colour-blindness is a sex-linked inherited condition controlled by a recessive allele. Use the symbols **X** and **Y** for the sex chromosomes and **N** and **n** for the alleles for normal or defective colour vision to show the genotypes of

(a) a normal male
(b) acolour-blind male
(c) a normal (non-carrier) female
(d) a colour-blind female
(e) a normal (carrier) female.

10 Use the genotypes you have written for your answer to question 9 to show the Chances of (a) a son being colour blind, (b) a daughter being a carrier, resulting From a marriage between a normal man and a carrier woman.

11. In a cross between pure tall plants with green pods and a pure dwarf plant with yellow pods, how many short plants do you expect in F2 generation

a) 9, b) 3 c) 4 d) 1

12. Is it possible that a male with an extra X chromosome in his genome? If so how it can happen? Mention its phenotypic characters?

13. a disputed child with blood group 'O' was claimed by two couples; their blood groups are are as following:

	mother	father
Couple-I	A	B
Couple-II	O	AB

State with your knowledge of genetics which couple could be the real parent of the child? Also mention their genotypes.

<u>Note for questions related with **pedigree refer study material pg no.54 -58**</u>

<u>Few hinds</u>

3. b)-Rabbit 1Rabbit 4
   c) Rabbit 1Rabbit 4
   d) 12
   e) 3:1
   f) 50%

5.Haemophilia (recessive), albinism (recessive), phenylketonuria (recessive), red-green colourblindness (recessive), sickle-cell anaemia (partially recessive) (any
three)
11) 4
12. Klinefelterssyndrone.
13. couple I when both are heterozygous

CHAPTER 7

Explain the following:

1. **Biological evolution is the sum total of genetic changes.-Substantiate.**
2. **In terms of evolution 'fittest' does not necessarily means strongest.-Explain(**the fittest are not necessarily the strongest individuals, but those individuals who are the bearers of advantageous inherited traits that allow them to survive and reproduce more than others-natural selection**.)**
3. **Besides, descent from common ancestor two species can share common characteristics .-Explain(**due to evolutionary convergence**).**
4. **Genetic drift affects small populations.-Explain.**
5. **The footprint of evolutionary change can be found throughout the nature- substantiate the statement highlighting predator-prey relationship in terms of natural selection. (**Natural selection favours individuals whose characteristics improve either their ability to consume others or their ability to avoid being consume**.)**
6. **Indiscriminant use of antibiotics will jeopardize your future battle against bacteria-Justify.(**every time we use antibiotics we are applying selection pressure ,killing off any nonresistant bacteria thereby , we are actually helping to speed the evolution of resistance to antibiotics**)**

CHAPTER 8

Human health and disease

1. 1) Why do children of metro cities of India suffer from allergies and asthma?
2. Ans (Hint.-Pollution)
3.
4. 2) A patient has lost his immunity.
5. i) Name the diseases associated with it.
6. ii) Name the confirmatoroe test to diagnose the disease.
7. iii)Why did he lost his immunity.
8. Ans (Hint:-AIDS)
9.
10. 3)A person claimed that he has seen sounds,heardcolours and smelt light.
11. i)What could be the possible reason?
12. ii) Name two chemicles responsible for this conditions.
13. iii) Mention any one source for these chemicles.
14. Ans (Hint:- Drug Abuse)

CHAPTER 09

Q.1.In mung bean resistance to yellow mosaic vein was developed.(3)

1) Name the phenomenon used.
2) How it is induced?
3) What happens to genes in this method?

HINT:1) Mutation breeding 2)mutations can be induced by chemicals or gamma radiations 3)base sequences within genes are changed to create variations that results in new characters .

Q.2.What is hidden hunger? what are the defects caused? Name a method of production of improved quality food that can minimize/prevent it.(3)

Hint: 3billion people suffer from micronutrient,protein and vitamin deficiencies.

Increases risk of diseases, reduces lifespan & mental abilities.

Biofortification.

Q.3.Conventional agriculture is not able to meet demand of food for ever increasing population.SCP can serve as an alternate.Justify.(3)

Hint: *Spirulina & Methylophilus methlotrophus.*

Q.4.a)Following are some statements arrange them in sequence beginning from the first step(2)

1.Transferred to a surrogate mother.

2.It is either mated with an elite bull or artificially inseminated.

3.Fertilized eggs at 32 cell stage are recovered non surgically.

4.It produces 6 to 8 eggs instead of one egg which they normally yield per cycle.

b)These steps are of which method of animal breeding?(1)

Q.5.Animal protein can be used extensively for feeding growing population.However nothing much has been done in this area.Suggest some alternative ways how animal proteins can be obtained on alarge scale cost effectively?(5)

CHAPTER10

Q.1.How is sewage subjected to various treatments in sewage treatment plant? (3)

Hint: explaination of primary and secondary treatment.

Q.2. Biofertilisers are preferred over chemical fertilizers - Substantiate ?

Hint: Mention the eco friendly sustainable use of biofertilisers.

Q.3.Three water samples labeled A (river water); B(untreated sewage water) and C(secondary effluent)were taken for BOD test. The BOD values were 20mg/l; 8mg/l &400mg/l, respectively. Which water sample is most polluted? Assign the correct label to each assuming the river water is relatively clean? (3)

Hint: sample A BOD 20mg/l; sample B BOD 8mg/l &sample C 400mg/l

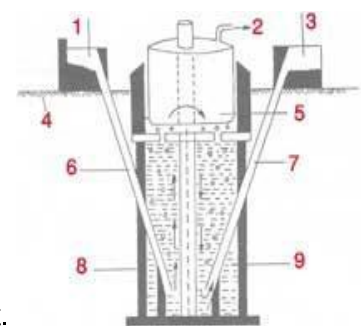
Q.4.A) Who gave the medicinal importance of Antibiotics? (1)

B) Give the functional importance of *Propionibacterium*. (1)

c) Name the bacterium that produces the insecticidal 'cry protein'? (1)

Q.5.Supply the scientific terms for the following (5)

1) The waste and waste water produced by residential and commercial sources and discharged into sewers.
2) An approach to farming based on biological methods that avoid the use of synthetic crop/livestock production inputs.
3) A group of gram positive bacteria that carry out lactic acid fermentation of sugars.
4) The sludge produced by primary treatment in a wastewater treatment plant.
5) A systems approach that combines a wide array of crop production practices with careful monitoring of pests and their natural enemies.
Hint: a)sewage b)organic farming c)LAB d)primary sludge e)IPM
Q.6.why should biological control of pests and pathogens be proffered to the conventional use of chemical pesticides? Explain how the following microbes act as biocontrol agents:(1+1+1)
a)*Bacillus thuringiensis* b)*Nucleopolyhedroviruses*
Q.7. During secondary treatment of the primary effluent how does the significant decrease in BOD occur? (3)



Q.8a) Draw a labelled diagram of a typical biogas plant.
hint:5) floating gas holder 3)sludge 9) digester 1) Dung and water
b) Give the role of spent slurry

Q.9 Explain Why :
(a) Cow dung is used in the generation of biogas.
(b) A small amount of curd is added in fresh milk to convert it into curd.
(c) Baculovirus are used in narrow spectrum insecticidal application.

Q.10 What are antibiotics? Give two examples. What is their significance?(3)

Q.11. Give one example and one use of the following: a) Free living fungi b) Symbiotic fungi c) Free living bacteria (3)

Q12) How is it that the Cry protein produced by Bacillus thuringiensis (Bt) does harm the bacteria but only killsthe insect larvae? (3)

5 Marks Questions

Q1)Explain how microbes are used in sewage treatment?

Q2)What do you understand by integrated pest management (IPM)? Explain with example and state its importance

Q5) Differentiate Antibodies and antibiotics Q6) How are biofertilizers different from fertilizers such as NPK that we buy in the market? Justify the role of Rhizobium as a biofertilizer

CHAPTER 11

1) Why don't restriction enzyme digest chromosomal DNA in bacterial cells ?
2) Why do bacteria have plasmids?
3) Why thermostable DNA polymerase is essential in PCR?
4)Eukaryotes do not have restriction endonuclease, then how they manage with normal endonuclease enzyme?
5) It is advisable to use different restriction endonucleases to cut the vector DNA and source DNA.Why ?
6) Uncontrolled recombinant DNA technology experiments is dangerous to mankind. Comment on it. 167
4) Foreign DNA + plasmid =…………??…………

5). Complete the above sequence of diagrammatic representation and name it.
  (a) Which is the most commonly used matrix in gel electrophoresis ?
  (b) What is the source of it?
6) Find the 'odd one out and write why that is 'odd'
  (a) Sal I, Pst I, Cla I, BamH I, pBR 322
  (b) Bacteria, Virus, Gene-gun, Fungi
7) Detect the mismatch from the following and replace the wrong match with a right one
  (a) ECOR I –Bacteria
  (b) Ethidium Bromide- Gel electrophoresis
  (c) Lysozyme- Fungi
  (d) Palindrome sequence-Restriction enzyme
8). Name the enzyme involved in the following process:
  (a) Repeated amplification of DNA fragments.
  (b) Formation of short piece of RNA strand for annealing.
  (c) Breaking of bacterial cell to release DNA and other macromolecules.
  (d) Cutting and rejoining DNA fragments.
  (e) Formation of m-RNA
  (f) Joining of foreign DNA fragments with plasmid.
9)Explain how recombinants and non- recombinants are differentiated on the basis of colour production in the presence of a chromogenic substrate. Name that procedure.

Have some more

1. When scientist make an animal superior by view of genotype, introducing some foreign gene in it , the phenomenon is called ______________.
2. Why DNA is unable to pass through cell membrane?
3. Why don't the restriction enzymes destroy the DNA of the organism in which they are produced?
4. What function the enzymes DNA ligase perform in genetic engineering?
5. What are the essential features of a vector?
6. Which property of plasmid makes them ideal vectors for gene cloning
7. Discuss the use of molecular probes in forensic science for identification of criminals.
8. What is vector less gene transfer? What are the methods used to transfer genes directly in plants?
9. Name two bacterias found to be very useful in genetic engineering?
10. *Agrobacterium tumefaciens* is known as "natural genetic engineer of plants" why?
11. What do you understand by insertion inactivation genetic engineering? State its usefulness
12. What is the significance of *ori*-gene (origin of replication) in a plasmid?
13. Name the substance used to stain DNA fragments separated in gel electrophoresis? How they are visualized

Few clues

5. refer concept map

6.Self replicating

8.gene gun, microinjection etc

9.Escherichia coli ,*Agrobacterium tumefaciens*

10 the can cause Crown Gall disease by transferring Ti plasmid to higher plants naturally

13 Ethidium bromide/UV light

CHAPTER12:

1.Gene medicine refers to the use of gene manipulation technology to ameliorate or even permanently cure disease in human-Name the technique.(Gene therapy)
2. *Agrobacterium tumefaciens* are considered as natural genetic engineer.-Justify.
3.The bacterium *Bacillus thuringiensis* provides the major source of insect resistant gene-clarify.
4. 'RNAsilencing is a form of genomic defense'-elucidate the statement taking *M. incognitia* as example.

CHAPTER13:

Organism,population

1.When two species of *Paramoecium(P. caudatum and P. aurelia* were grown together in the laboratory, at first both the species grow in number,eventually however, *P. caudatum* declines in number while *P. aurelia* continues to increase in number.-Which type of animal interaction can substantiate the above phenomenon?(competition)

2.Plants like beech, Oak and Pine gain amino acids from fungal associationship , while the fungi in return receive carbohydrates and vitamins from the tree-What type of interaction can be inferred from this?(Mutualism)

3.In the stomach of ruminants huge number of Cellulolytic bacteria are present which help the herbivores to digest the plant material, in turn, the bacteria receive Nitrogen that has been secreted or ingested into the rumen in the form of urea-Name the type of interaction.

CHAPTER 14

1 Why is dry weight chosen for expressing the the biomass of a species ?

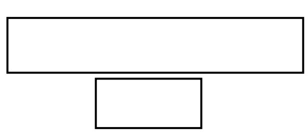
Hint To avoid variation in weight due to seasonal moisture difference

2 In a pyramid of biomass drawn below name themembers of each trophic levels

1one which issupported

2the one which supports.

In which ecosystem such apyramid is found?



Ans 1zooplankton

2 phytoplankton

Aquatic ecosystem

3Explain why ecological succession will be faster in forest devastated by fire than on bare rock?Also compare succession in case of an abandoned land after floods with that on a bare rock?

CHAPTER 15

Explain Why ?

1. Indonesia exhibits more biological diversity than Polland. (*Mention why there is more biodiversity in tropics*)
2. National Parks is a better option for the conservation of biodiversity than zoological gardens.(Mention about the advantages of *in-situ* conservation over *ex-situ* conservation).
3. Loss of Key stone species from an ecosystem will be a major threat to ecosystem function.(*Give your answer on the basis of 'rivet popper hypothesis'*.)
4. India is a megadiversity country.
5. Within your sibling there are lots of variation although, all of you have the same parents(*answer on the basis of genetic diversity*).
6. India nurtures a lot greater biodiversity than Norway.(*answer the question based on greater ecosystem diversity in India than in Norway*).
7. Justify the killing of elephants at North Bengal in the light of biodiversity conservation.(*Habitat loss/fragmentation/shrinkage by the construction of rail line through the elephant corridor in North Bengal leads to man – animal conflict and resultant loss of biodiversity*).
8. 'The unique mangrove biodiversity of Sunderbans will totally wiped away ' (*Frame your answer on the basis of global climate change and subsequent biodiversity loss*)
9. Find the odd one out:
   *Eicchornia*sp., *Lantana* sp. ,*Parthenium*sp. , *Oryza sativa*.(Besides, *Oryza sativa all other are invasive species)*

CHAPTER 16

1) What is the norms set by Euro-II for petrol and Diesel vehicles

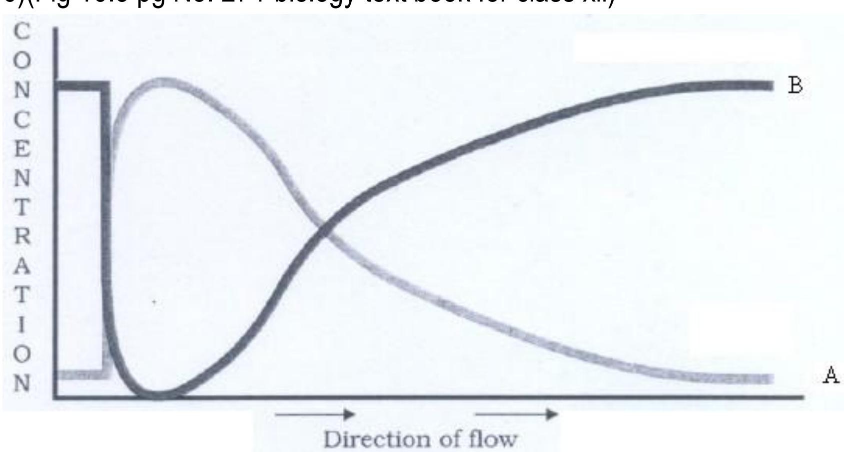
2) Name the Phenomena Which Keeps the Earth Warmer than Moon.

3) Name the important ozone depleting substances.

4) Why is thermal pollution harmful for aquatic life?

5) Why are cloudy, dusty & humid Nights warmer than clear dust free and dry nights?

6)(Fig 16.3 pg No. 274-biology text book for class xii)



In the above graph what does A & B depict?

LIST OF ABBREVIATIONS AND THEIR EXPANSION

Chapter2:

MMC: Megaspore Mother Cell
PEC: Primary Endosperm Cell

Chapter3:

LH: Luteinising Hormone
FSH: Follicle Stimulating Hormone
hpl : Human placental lactogen
hcg: human chorionic gonadotropin

Chapter4:

STDs; Sexually Transmitted Diseases
RCH: Reproductive and Child Health Care
MMR: Maternal Mortality Rate
IMR: Infant Mortality Rate
IUDs: Intra Uterine Devices
MTP: Medical Termination of Pregnancy
VD: Venereal Diseases
RTI: Reproductive Tract Infection
HIV: Human Immunodeficiency virus
PID: Pelvic Inflammatory Diseases
ART: Assisted Reproductive Technologies
IVF: In vitro Fertilization
ZIFT: Zygote intra fallopian transfer
IUT: Intra Uterine transfer
GIFT: Gamete intra fallopian transfer
ICSI: Intra Cytoplasmic Sperm Injection
AI: Artificial Insemination
IUI: Intra uterine insemination

Chapter6:

sn RNAs: small nuclear RNAs
hn RNAs: heterogenous nuclear RNA
HPG: Human Genome Project
ESTs: Expressed Sequence Tags
BAC: Bacterial Artificial Chromosomes
YAC: Yeast Artificial Chromosomes
SNPs: Single Nucleotide Polymorphism
VNTR: Variable Number of Tandem Repeats

Chapter8:

PMNL: Polymorpho nuclear leucocytes
CMI: Cell mediated immunity
MALT: Mucosal Associated Lymphoid Tissue
AIDS: Acquired Immuno Deficiency Syndrome
ELISA: Enzyme Linked Immuno-sorbent Assay
NACO: National AIDS Control Organisation
MRI: Magnetic Resonance Imaging
CT: Computed Tomography

Chapter9:

SCP: Single Cell Protein

Chapter10:

LAB: Lactic Acid Bacteria
BOD: Biochemical/Biological Oxygen Demand

Chapter11:

PCR: Polymerase Chain Reaction

Chapter12:

RNAi: RNA interference
GMO: Genetically Modified Organism
ADA: Adenosine deaminase deficiency
GEAC: Genetic Engineering Approval Committee
GPP: Gross Primary PRODUCTIVITY
NPP: Net Primary ProductivityGFC: Grazing Food Chain
DFC: Detritus Food Chain
DU: Dobson unitCFCs: Chloroflurocarbons
JFM: Joint Forest Management