



**केन्द्रीय विद्यालय संगठन**  
**केन्द्रीय कार्यालय चंडीगढ़**  
**Kendriya Vidyalaya Sangathan**  
**Regional Office Chandigarh**

## **MINIMUM LEARNING CAPSULE**

**CLASS XII - BIOLOGY**

**SESSION 2017-2018**

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## TIPS FOR EASY LEARNING

- **Get Organized** - Carry a notebook, in which you can record and track important information. **Organize your study space.**
  - Organize study groups with friends
  - Have balanced diet and drink plenty of water
  - **Leave Notes**- Have colored pens to make notes .
  - **Don't Multitask** - While multitasking feels efficient, it can actually decrease focus and memory. Stick to one task at a time.
  - **Remove Distractions** - Maintaining focus will help you learn and remember. Minimize study place distractions.
  - **Keep Your Mind Sharp** - Minimize activities that allow your brain to zone out, such as watching television. Try to keep your mind sharp by engaging in challenging activities like chess, reading, crossword puzzles, or brain games.
  - **Understand How You Learn** - Know what environment suits your learning style best. Try different learning methods to see what is most effective. You may want to record presentations, take note in longhand, or learn by repeating the task yourself.
  - **Read, Record, Recite:** Go through the text again and record important points in your own words separately.Recite the points you noted to yourself.
  - **Learn and write:** Reading the chapters and highlighting important portions help a lot, but when you write down the important points you read in a piece of rough paper or your notebook, it helps you retain information even more. Read important points aloud and write them down after. This makes sure that you don't just SEE the points, but you HEAR them and WRITE them too. **Practice flow charts and diagrams as many times.**
  - **Review:** Ask yourself the questions you noted and see if you can answer them properly.
  - **Reflect:** Repeat the above steps and reflect on the topic you learned till it's completely memorized.
  - **Stick a couple of chart papers on your wall and cupboards** and write down tit-bits of important information that are very difficult to learn. Keeping these in front of your eyes all the time will help you learn them more easily than trying to mug them. Create flashcards for the difficult bits and carry them around. You can go through them while commuting, or standing in a queue somewhere.
  - **Use Scents or Gum to Jog Your Memory:** This may seem a bit random but spraying an unfamiliar scent while you're studying is one of the study methods that can help jog your memory when you spray it again just before an exam. Chewing a gum will work the same way and keep you awaken.
  - **Explain your answers to others :** One quick test that can tell you how much you have learned is trying to explain the concepts of a topic to someone who doesn't know it yet. It could be a sibling, parent, grandparent or friend. The moment you face trouble trying to explain a certain concept in layman's terms, you will understand you need another revision.
- So, keep aside the stress, and get down to work! All the best!



## Unit I-Reproduction

### Chapter – 1: - REPRODUCTION IN ORGANISMS

#### Life Span

- Period from birth till natural death. Eg Elephant 60 -90 years, Fruit fly 4-5 weeks.

**Reproduction** –Producing young-ones of their kind, generation after generation.

#### Types of reproduction:

- **Asexual reproduction** :single parent capable of producing offspring. **Offspring is called clone because it is genetically and morphologically similar to parents.**
- **Sexual reproduction** :two parents are involved in producing offspring.

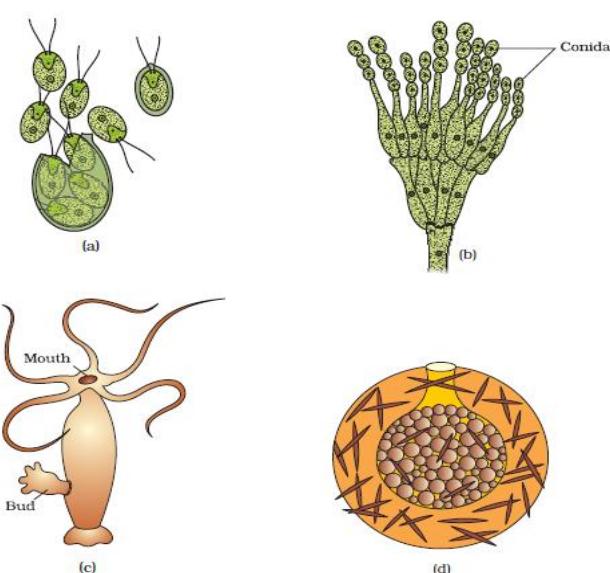
#### Modes of asexual reproduction

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

Amoeba

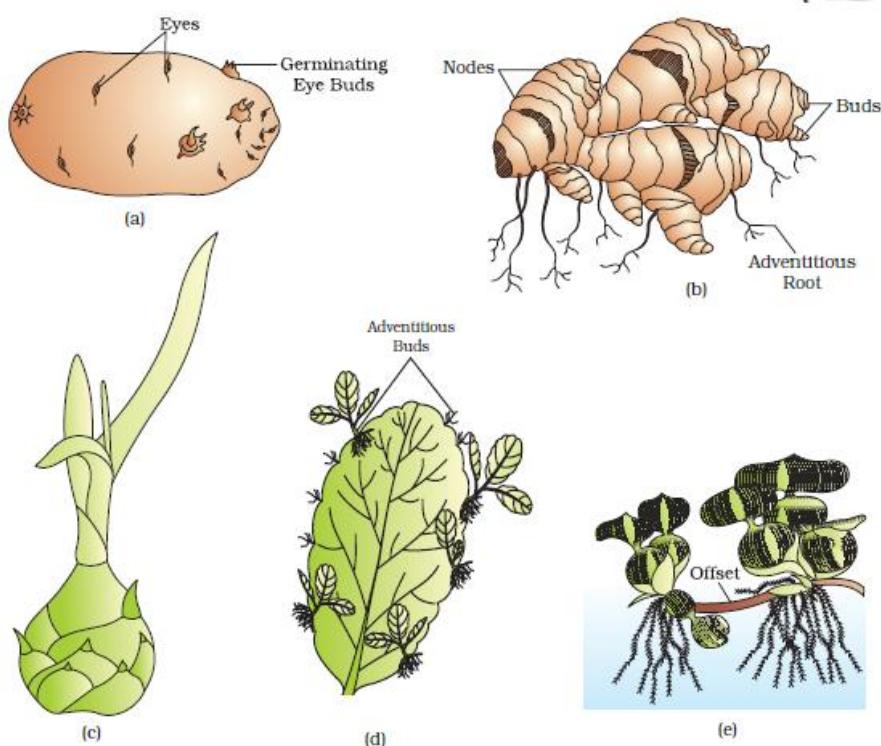
- **Multiple fission**: parent body divides into many daughter organisms : Plasmodium.

- **Budding**: Ex : Yeast, Hydra.



**Figure 1.3 Asexual reproductive structures:** (a) Zoospores of *chlamydomonas*; (b) Conidia of *Penicillium*; (c) Buds in *Hydra*; (d) Gemmules in sponge

- **Zoospores**: microscopic motile structures eg. Algae.
- **In plants** : term vegetative reproduction frequently used instead of asexual reproduction, units of vegetative propagation called **vegetative propagules**. Eg runner, rhizome, sucker, tuber offset, bulb give rise to new plant



**Figure 1.4** Vegetative propagules in angiosperms: (a) Eyes of potato; (b) Rhizome of ginger; (c) Bulbil of *Agave*; (d) Leaf buds of *Bryophyllum*; (e) Offset of water hyacinth

## PHASES IN LIFE SPAN OF SEXUALLY REPRODUCING ORGANISMS.

- **Juvenile phase**: The phase of growth before reproductive maturity.
- **Reproductive phase**: Reproductive maturity.
- **Senescent phase**: Phase between reproductive maturity and death.

**Oestrus cycle**: The cyclical changes during reproduction in non-primate mammals like cows, sheep, rats, deers, dogs, tiger etc.

**Menstrual cycle**: The cyclical changes during reproduction in primate mammals like monkeys, ape, and humans.

**Seasonal breeders**: The reproductive cycle takes place only in favorable seasons as in wild animals.

**Continuous breeders**: They are reproductively active throughout their reproductive phase. Ex: birds in captivity

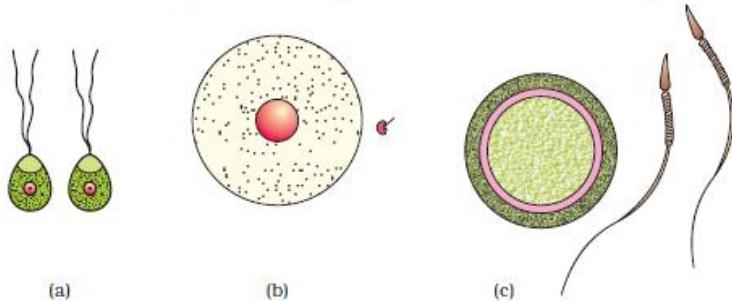
➤ The main events of sexual cycle are:

### 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.



Types of gametes: (a) Isogametes of *Cladophora* (an alga); Heterogametes  
(b) *Fucus* (an alga); (c) Human beings

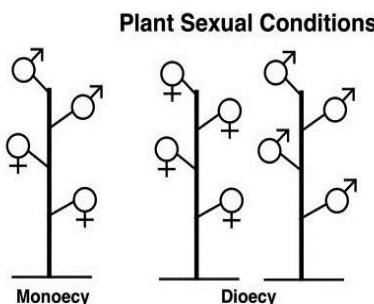
- ❖ **Sexuality in organisms : In plants Bisexual term is used for Homothallic and Monoecious plants**

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:-**

- ❖ 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).

**ii 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.

**iii 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, humanbeings
- **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

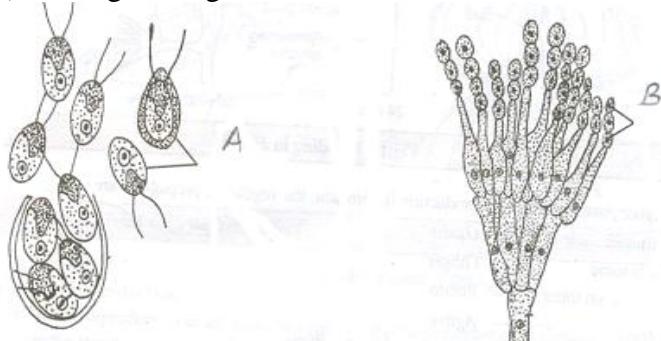
Stamen	Fall off
Zygote	Embryo
Primary endosperm nucleus	Endosperm (3 N)
Synergid	Disintegrate
Antipodals	Disintegrate
Ovary	Fruit
Ovule	Seed
Ovary wall	Pericarp (epicarp + mesocarp + endocarp)
Integument	Seed coat (testa + tegmen)

- **Parthenogenesis:** Female gamete develops into new organism without fertilisation
- **Seedless fruits formed by parthenocarpy**
- **Clone:** A group of individuals of the same species that are morphologically and genetically similar to each other & their parents
- **Bulbil :**Fleshy buds that produce new plant Eg *Agave and Oxalis*
- **Uniparental :** Single parent
- **Fragmentation :** form of asexual reproduction where an organism splits into fragments and each fragment develops into individual e.g Spirogyro, Fungi, some annelids
- **Regeneration :** Process of renewal , restoration and growth. It occurs at the level of cells. Common in Hydra, Planaria, Flatworm,Echinoderms.

### QUESTIONS FOR PRACTICE

#### 2 mark questions

1. Identify (A) and (B) in the given figures and state the difference between these.



2. Why do organisms like algae and fungi shift to sexual method of reproduction just before the onset of adverse conditions.  
 3. In nature for both plants and animals, hormones are responsible for transition between the three phases of their life span. Which three phases are being referred to here?  
 4. Both tape worm and earth worm are hermaphrodite. How do they differ from each other with reference to fertilization?

#### 3 mark questions

5. (i) What are zoospores? Name two groups of organisms that produce them?  
 (ii) Differentiate between a zoospore and a zygote?  
 6. Why Dogs and cats have oestrus cycle but human beings have menstrual cycle, through all are mammals? Why some mammals are called seasonal breeders?  
 7. In some organisms like rotifers and honeybees, the female gamete undergoes development to form new organisms without fertilization. What is the phenomenon called as?

## (Answers)

- 1.(i) A) Zoospores of *Chlamydomonas* B) Conidia of *Penicillium*  
(ii) Zoospores of *Chlamydomonas* are formed endogenously whereas Conidia of *Penicillium* are formed exogenously.
2. In organisms belonging to fungi and algae, zygote develops a thick wall that is resistant to dessication and damage..
- 3 . (a)juvenile (b) maturity phase c) reproductive phase
4. In tapeworm self fertilization takes place while in earthworm cross fertilization takes place.
5. (i) Zoorospores are thin walled , motile sexual reproduction units e.g. Algae, aquatic fungi.

### (II) Differences:

Zoorospore	Zygote
It is thin walled asexually formed spore	It is sexually formed structure that develops a thick wall
It germinates immediately as it is formed during favourable conditions.	It undergoes a period of dormancy, as it is formed at the end of favourable season/period.

6. Dogs and cats have heat period during which ovulation takes place but human female have this cycle every month. Some mammals are called seasonal breeders because they exhibit these cycles only during favourable seasons in their reproductive phase while others are reproductively active throughout their reproductive phase

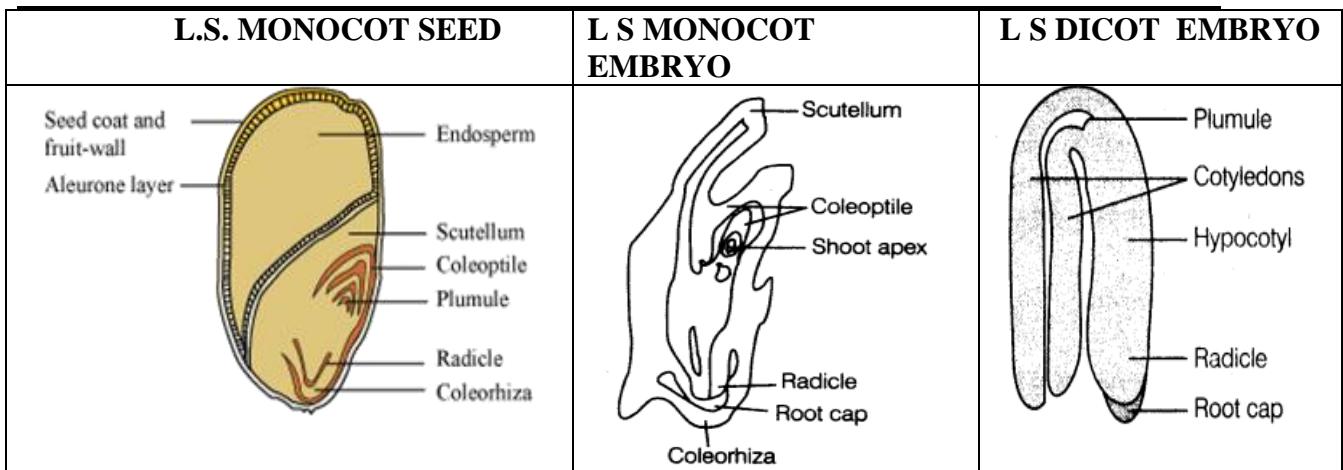
7. Parthenogenesis,

**THERE IS NO  
SUBSTITUTE  
FOR HARD WORK**

**Ch-2--Sexual Reproduction In Flowering Plants**

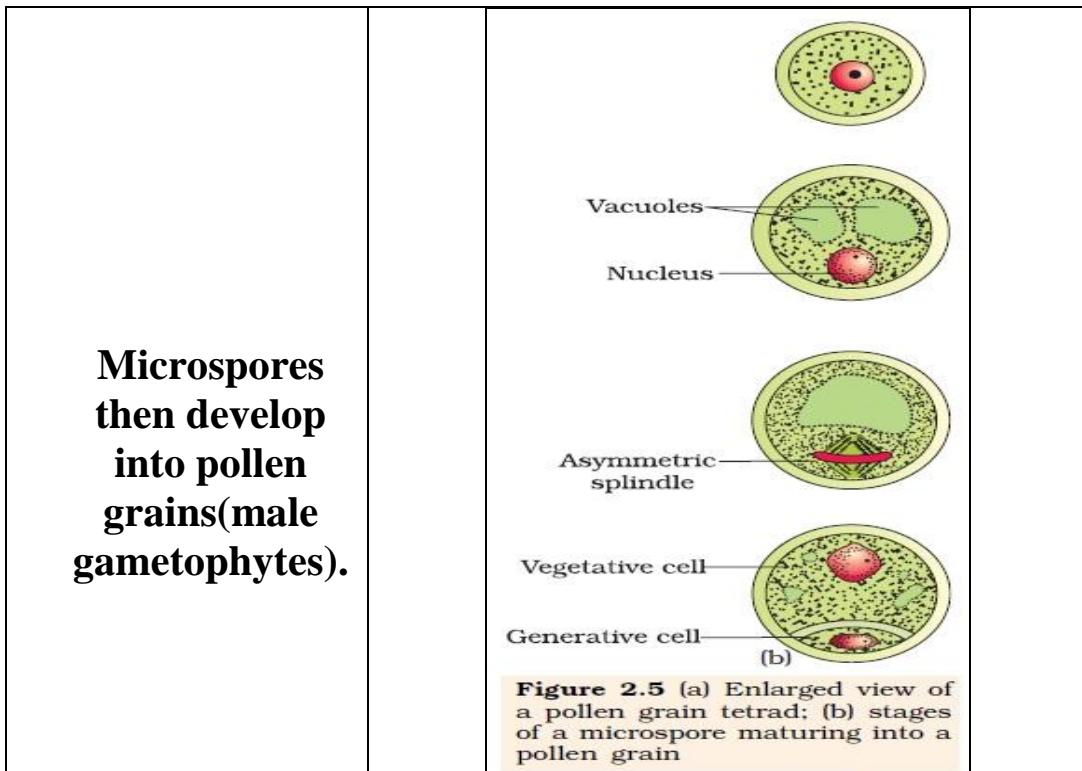
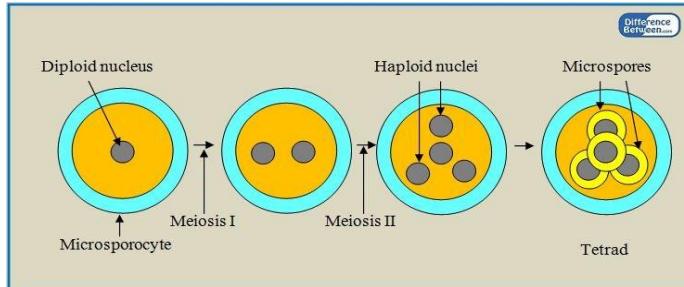
**Diagrams**

<b>T.S. mature anther</b>	<b>Structure of mature pollen grain</b>
<b>V.S. anatropous ovule</b>	<b>Structure of mature embryo sac</b>

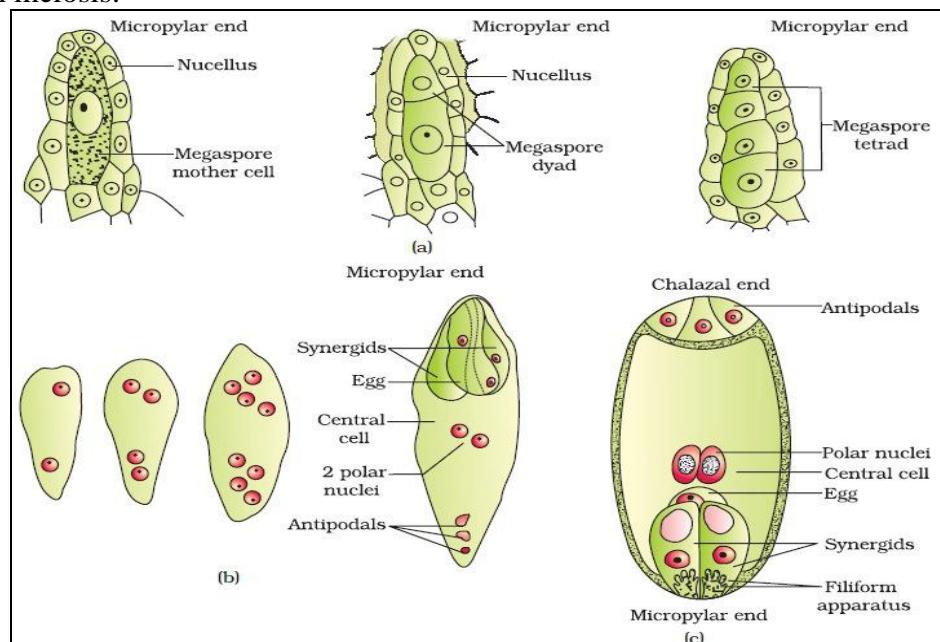


### KEY CONCEPTS

**Microsporogenesis**-The process of formation of microspores from microspore mother cell through meiosis.



**Megasporogenesis**-The process of formation of megasporocytes from megasporocyte mother cell through meiosis.



**Figure 2.8** (a) Parts of the ovule showing a large megasporocyte mother cell, a dyad and a tetrad of megasporocytes; (b) 1, 2, 4, and 8-nucleate stages of embryo sac and a mature embryo sac; (c) A diagrammatic representation of the mature embryo sac.

**Monosporic development**-The method of embryo sac formation from a single megasporocyte.

#### Kinds of pollination-

<u>Autogamy</u> (self pollination)-	<u>Geitonogamy</u> (genetically self pollination, functionally cross pollination)-	<u>Xenogamy</u> (Cross pollination)-
Transfer of pollen grains from anther to stigma of the same flower.	Transfer of pollen grains from anther to stigma of another flower of the same plant.	Transfer of pollen grains from anther to stigma of another flower of another plant but of same species. <b>It brings genetically different pollen grains to stigma</b>

- **Chasmogamous flowers (open flowers)**-Such flowers have exposed anthers and stigma. Cross pollination is common among such flowers. Ex: Rose, China rose, Petunia,etc.
  - **Cleistogamous flowers (closed flowers)**-Such flowers do not open at all. In such flowers only self pollination occurs. Ex: *Viola* (common pansy), *Oxalis*, and *Commelina*
- 

**Outbreeding devices**-Devices developed by bisexual plants to **prevent self pollination** and to **encourage cross pollination** are called outbreeding devices. They are

- Pollen release and stigma receptivity **not synchronized**.
  - **Different positions** of anther and stigma of same flower.
  - **Self incompatibility** i.e. genetic mechanism which inhibits pollen germination or pollen tube growth in the pistil.
  - Production of **unisexual flowers** on different plants (dioecy) as in papaya.
- 

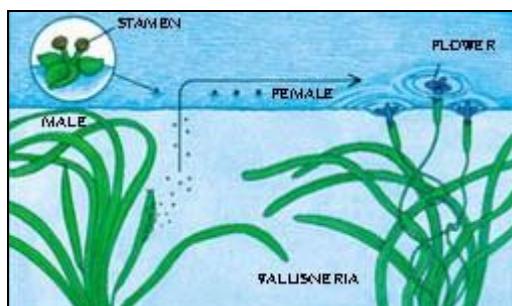
### Adaptations of plants to various types of pollinating agents

#### **Anemophilly (wind pollination)**

1. The flowers produce enormous amount of pollen grains
2. pollen grains are light and non-sticky
3. well-exposed stamens
4. feathery stigma
5. flowers often have a single ovule in each ovary and numerous flowers packed into an inflorescence

#### **Hydrophilly (Adaptations of plants to water pollination)**

1. The flowers produce enormous amount of pollen grains
2. In *Vallisneria*, the female flower reach the surface of water by the long stalk and the male flowers or pollen grains are released on to the surface of water



3. Pollen grains are long, ribbon like
4. **Pollen grains covered by a mucilaginous covering.**

Not all aquatic plants use water for pollination. In a majority of aquatic plants such as water hyacinth and water lily, the flowers emerge above the level of water and are pollinated by insects or wind.

#### **Entomophilly (Insect Pollination)**

1. Flowers colorful
2. Flowers produce nectar
3. Sweet smelling flowers

**Double Fertilisation :** In flowering plants two fertilizations occur as follows:

**Syngamy :** One male gamete(n) + Egg cell(n) = Zygote (2n)

**Triple Fusion :** Second male gamete (n) + 2 polar nuclei(n+n+n) = PEN (3n)

**Polyembryony-** Production of more than one embryo in a seed. **Ex:** *Citrus* and *Mango*

**Apomixes-** Production of seeds without fertilization. Its advantageous in hybrid seed industry.

**ADVANTAGE:** There is no segregation of characters in the hybrid progeny.

**True fruit-** Fruits which develop only from the ovary. Ex-*Mango*, *Guava*

**False fruit**-In fruits like apple, strawberry, cashew **thalamus also contributes** to fruit formation.

### **QUESTIONS FOR PRACTICE**

#### **SA-II (2 MARKS)**

1. In angiospermic plant before formation of microspore sporogenous tissue undergo cell division

(a) Name the type of cell division.

(b) What would be the ploidy of the cells of tetrad?

2. Outer envelop of pollen grain made of a highly resistant substance. What is that substance? At which particular point the substance is not present?

3. Fruits generally develops from ovary, but in few species thalamus contributes to fruit formation.

(a) Name the two categories of fruits.

(b) Give one example of each.

4. Among the animal, insects particularly bees are the dominant pollinating agents. List any four characteristic features of the insect pollinated flower.

5. Differentiate between geitonogamy and xenogamy.

6. In the given figure of a dicot embryo, label the parts (A) and (B) and give their function.

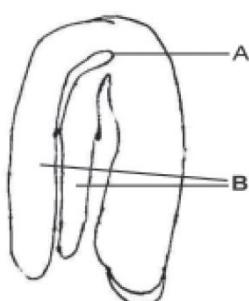


Figure 1

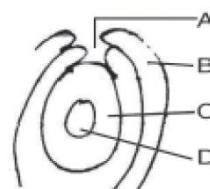


Figure 2

7. Name the parts A, B, C and D of the anatropous ovule (Figure 2) given above.

#### **SA-I (3 MARKS)**

8. Continued self pollination lead to inbreeding depression. List three devices, which flowering plant have developed to discourage self pollination?

9. What will be the fate of following structures in the angiospermic plant? Ovary wall, Ovule, zygote, outer integument Inner integument and primary endosperm nucleus.

10. Differentiate between microsporogenesis and megasporogenesis. What type of cell division occurs during these events. Name the structure formed at the end of these two events.

**LA (5 MARKS)**

11. Draw the embryo sac of a flowering plants and label :
  - (a) (i) Central Cell (ii) Chalazal end (iii) Synergids
  - (b) Name the cell that develops into embryo sac and explain how this cell leads to formation of embryo sac.
  - (c) Mention the role played by various cells of embryo sac.
  - (d) Give the role of filiform apparatus.

**ANSWERS**

1. (a) meiosis division (b) haploid
2. Sporopollenin; at germpore sporopollenin is absent.
3. Two categories of fruits are :
  - (i) True fruits e.g., Mango
  - (ii) False fruit e.g., Apple
4. i. Flowers are large.
  - ii. Colorful petals of flower.
  - iii. Presence of fragrance.
  - iv. Rich in nectar.
- 5.

<i>Geitonogamy</i>	<i>Xenogamy</i>
1. Transfer of pollen grains from the another to stigma of another flower of the same plant	Transfer of Pollen grains from another to stigma of different plant.
2. Does not provide opportunity for gametic recombination.	Provide opportunity for gametic recombination.

6. A = Plumule . To form shoot system  
B = Cotyledons . Storage of food
7. A = Micropyle, B = Outer integument, C = Nucellus, D = Embryo sac

**SA - I (3 MARKS)**

8. (a) Release of pollen and stigma receptivity is not synchronised in some species  
(b) Anther and stigma are at different position/heights in some plants  
(c) Self-incompatibility a genetic mechanism.
9. Ovary wall = Pericarp ; Ovule = Seed, Zygote - Embryo; Outer integument = Testa;  
Inner integument = Tegmen; Primary endosperm nucleus = Endosperm.
10. Microsporogenesis . Process of formation of microspore from a Pollen mother cell.  
Megsporogenesis . Process of formation of megasporangium from megasporangium mother cell.  
Meiotic division in both  
Microsporogenesis results in the formation of pollen grain while megasporogenesis results in the formation of megasporangium.

**LA (5 MARKS)**

11. A. Refer to figure above in diagrams  
B. Functional Megasporangium, Refer text on page 27 NCERT book.  
C. Egg : Fuses with male gamete to form zygote or future embryo  
Synergid : Absorption of nutrient, attract and guides pollen tube.  
Central Cell : After fusion with second male gamete forms Primary endosperm cell which gives rise to Endosperm  
D. Guides the entry of pollen tube

यूँ ही नहीं मिलती राही को मंजिल,  
एक जनन सा दिल मैं जगाना पड़ता है।  
पूँछा चिंड़िया से कैसे बना आशियाना तो  
बोली भरनी पड़ती है उडान बार बार  
तिनका तिनका उठाना पड़ता है... !!!

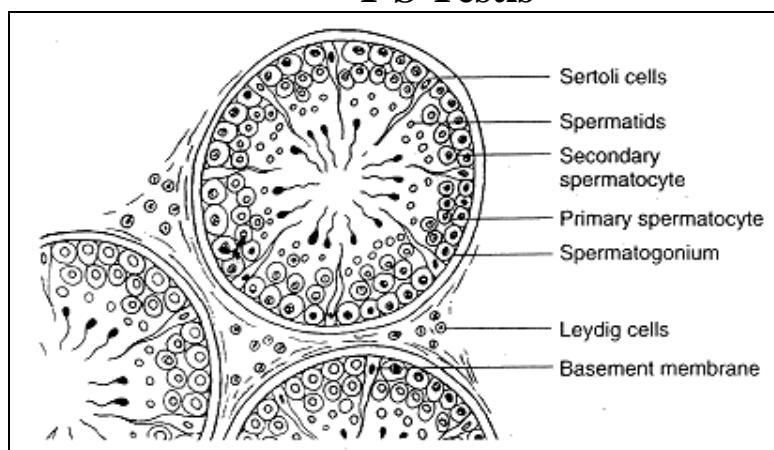
### Ch-3 -Human reproduction

#### Key concepts

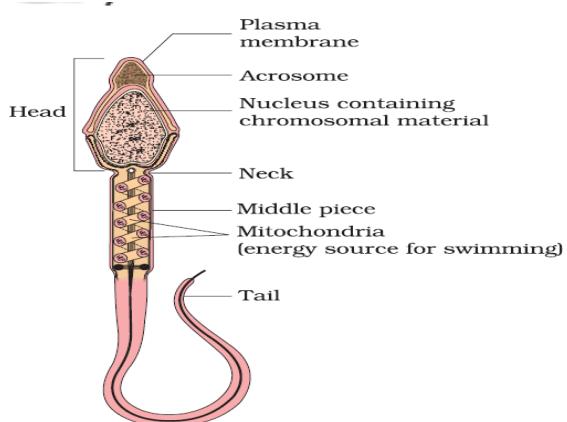
1. **Male reproductive system-** It consists of a pair of testis, accessory ducts( rete testis, vasa efferentia, epididymis and vas deferens), glands( paired seminal vesicles, a prostate and paired bulbourethral gland) and the external genitalia(penis). Diag. page 43 of NCERT.

The testes are situated outside the abdominal cavity within a pouch called scrotum. The scrotum helps in maintaining the low temperature of the testes ( $2-2.5^{\circ}\text{C}$  lower than the normal internal body temperature) necessary for spermatogenesis.

**T S Testis**

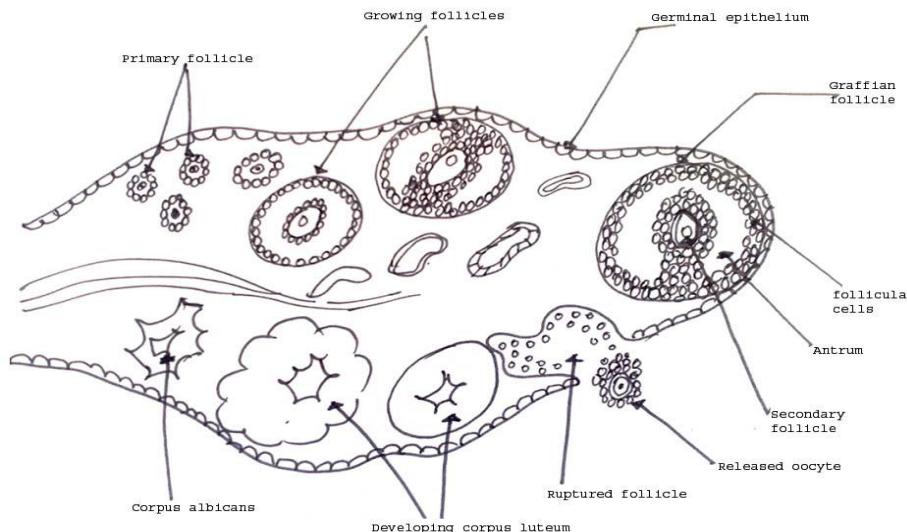


#### **Structure of sperm**

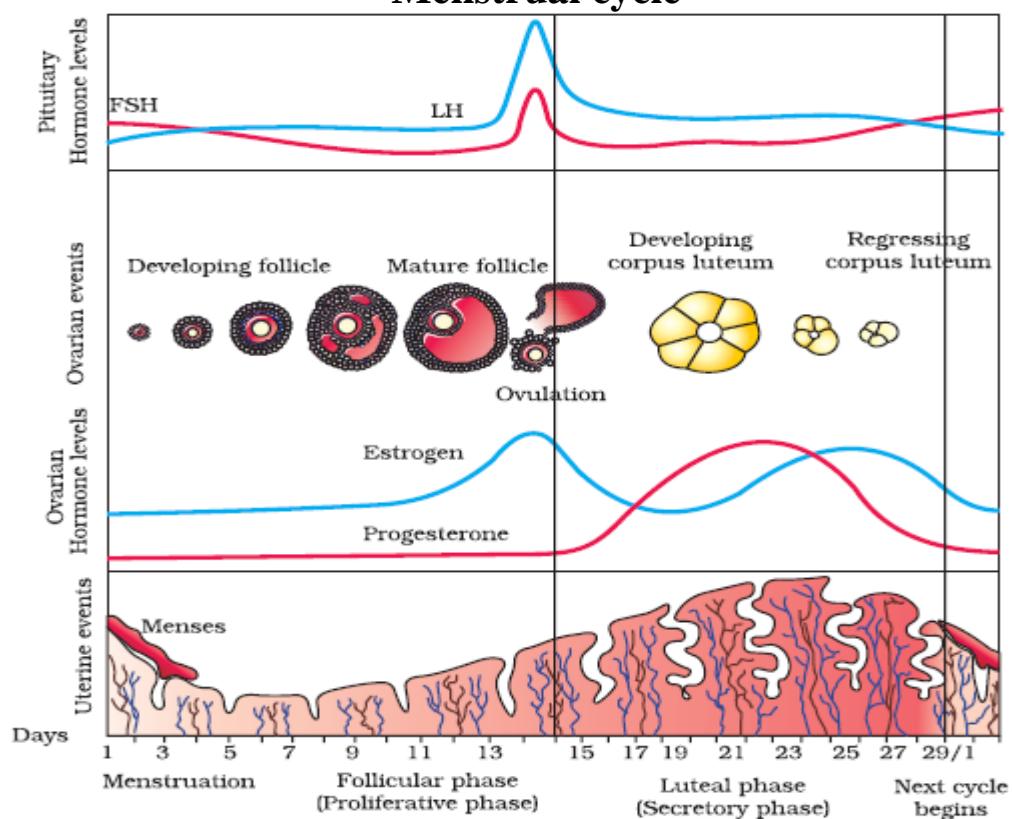


1. **Female reproductive system-** It consists of a pair of ovaries, paired oviduct (fallopian tubes), uterus, cervix, vagina and external genitalia (mons pubis, labia majora, labia minora, hymen and clitoris). Diag. page 45 of NCERT.

### T.S. Ovary



### Menstrual cycle

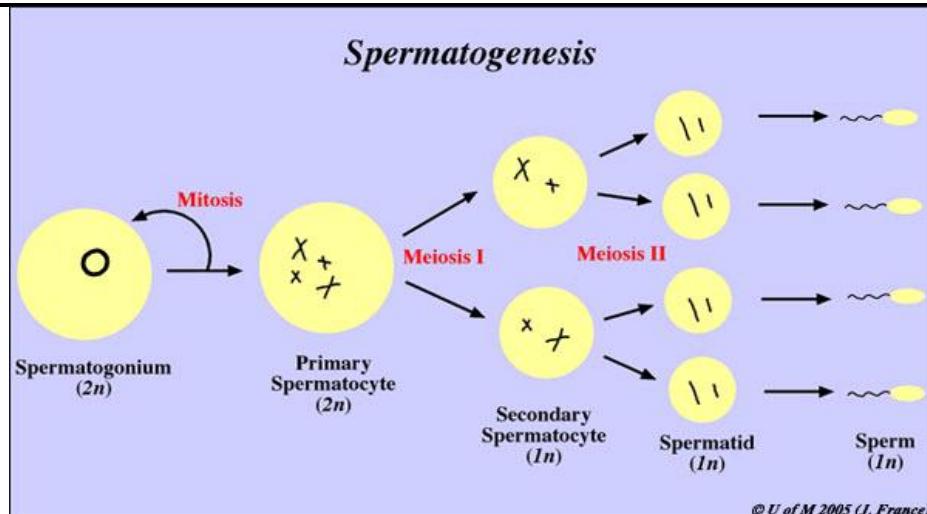


**Menstrual cycle:** 28/29 days cycle

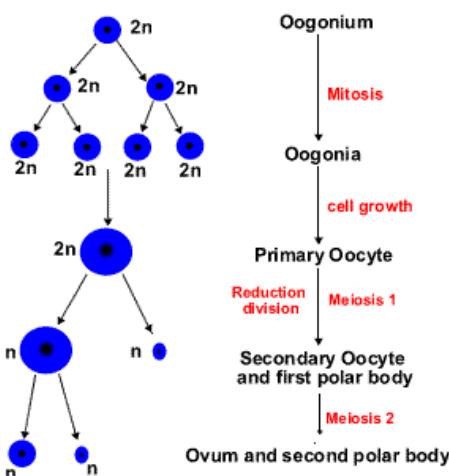
## Phases of cycle

1. **Menstrual phase (From day 1 to 5):** The uterus sheds its inner lining of soft tissue and blood vessels which exits the body from the vaginal opening in the form of menstrual fluid.
2. **Follicular phase (From day 6 to 13):** Development of primary, secondary tertiary and graffian follicles
3. **Ovulation phase (Day 14):** The pituitary gland secretes a hormone (Luteinising hormone, LH Surge) that causes the ovary to release the matured egg cell.
4. **Luteal phase (From day 15 to 28):** Transformation of Graafian follicle into corpus luteum. The corpus luteum secretes large amounts of progesterone which is essential for maintenance of the endometrium during pregnancy

**Spermatogenesis-** The process of formation of sperms from spermatogonia through meiosis.



7. **Spermiogenesis-** The transformation of spermatids into spermatozoa is called spermiogenesis.
8. **Spermiation-** Release of spermatids from the sertoli cells is called spermiation.
9. **Oogenesis-** The process of formation of ovum from oogonia through meiosis.



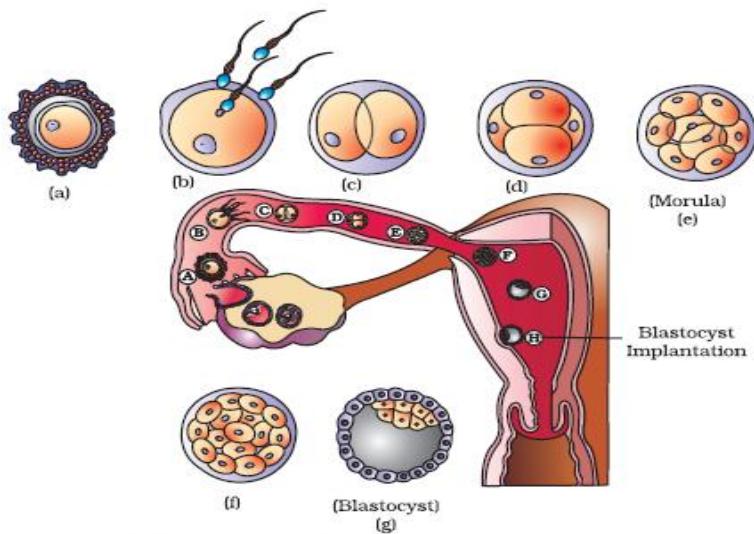
10. **Ovulation-** The release of ovum from ovary is called ovulation.

**11. Functions of placenta-** Supply of oxygen and nutrients to the embryo and removal of carbon dioxide and excretory waste by the embryo. Hormones secreted by it are human chorionic gonadotrophin (hCG), human placental lactogen(hPL), estrogens, progesterone etc

### FERTILISATION AND IMPLANTATION

The process of fusion of a sperm with an ovum is called **fertilisation**. During fertilisation, a sperm comes in contact with the *zona pellucida* layer of the ovum and induces changes in the membrane that block the entry of additional sperms. Thus, it ensures that only one sperm can fertilise an ovum.

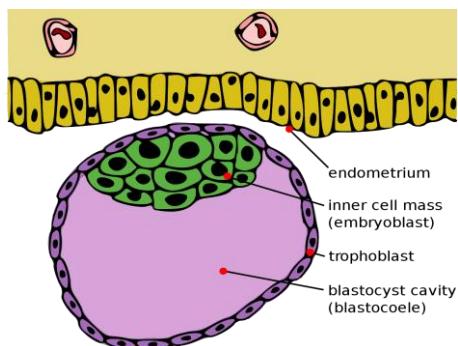
The **blastocyst** (32 celled embryo) becomes embedded in the endometrium of the uterus. This is called **implantation**.



Transport of ovum, fertilisation and passage of growing embryo through fallopian tube

### Structure of Blastocyst

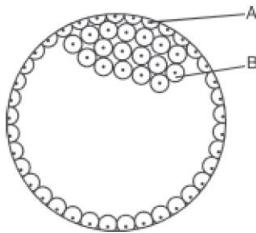
The blastomeres in the blastocyst are arranged into an outer layer called **trophoblast** and an inner group of cells attached to trophoblast called the **inner cell mass**. The trophoblast layer then gets attached to the endometrium and the **inner cell mass gets differentiated as the embryo**.



### QUESTIONS FOR PRACTICE

#### SA-II (2 MARKS)

1. Give the function of (a) Corpus luteum (b) Endometrium
2. In the given figure, give the name and functions of parts labeled A and B.



3. Give reason for the following:

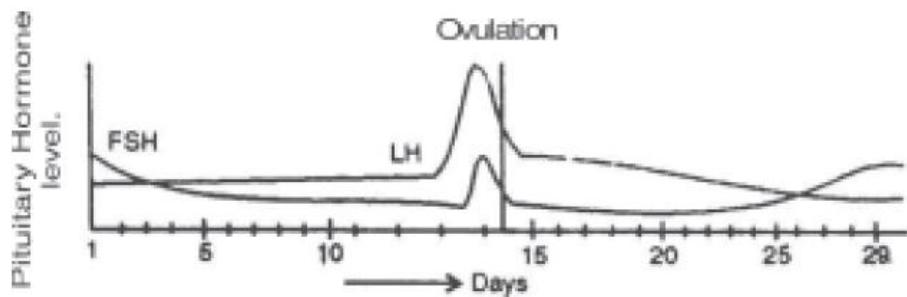
- (a) The first half of the menstrual cycle is called follicular phase as well as proliferative phase.
  - (b) The second half of the menstrual cycle is called luteal phase as well as secretory phase.

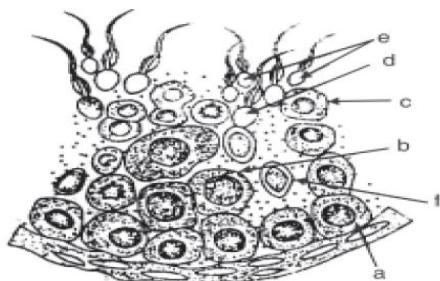
4. What is meant by L.H. Surge? Write the role of L.H.

5. Explain significance of the condition in which the testes remain suspended in scrotum outside the abdomen.

(3 MARKS)

6. (a) Read the graph given below. Correlate the ovarian events that take place in the human female according to the level of the pituitary hormone during the following day.



8. Study the above given figure :

- (j) Pick out and name the cells that undergo spermiogenesis.

- (ii) Name A and C cells.
- (iii) Give ploidy of B and E.
- (iv) What are the cells marked as 'F'? Mention their function.
- (v) Mention the type of cell division in A and B.

## **ANSWERS**

1. **Corpus luteum :** It secretes progesterone which prepares endometrium of uterus for implantation and normal development of foetus.  
**Endometrium :** It undergoes cyclic changes during menstrual cycle and prepares itself for implantation of blastocyst.
2. A = Trophoblast . Gets attached to endometrium and draws nutritive material secreted by uterine endometrium gland.  
B = Inner cell mass . Differentiates as Embryo.
3. (a) During this phase, primary follicles transform into Graafian follicle under FSH stimulation. Graafian follicles secrete estrogens which stimulate enlargement of Endometrium of uterus.  
(b) During this phase, Corpus luteum is fully formed and secretes large quantity of Progesterone.
4. Both LH and FSH attain a peak level about 14th day of menstrual cycle. Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge induces rupture of Graafian follicle and thereby the release of ovum (**ovulation**)
5. Refer text above.

### **SA-1 (3 MARKS)**

6. (a) (i) Gonadotropins and FSH increases  
(ii) LH attains peak level but FSH decreases  
(iii) LH and FSH level decreases  
(iv) LH remains low and FSH increases.  
(b) After 29th day there is a menstrual flow involving discharge of blood and cast off endometrium lining.
7. (i) Germinal epithelium have two types of cell. 1. Spermatogonium.  
2. Sertoli cells  
(ii) Leydig cells or Interstitial cells.

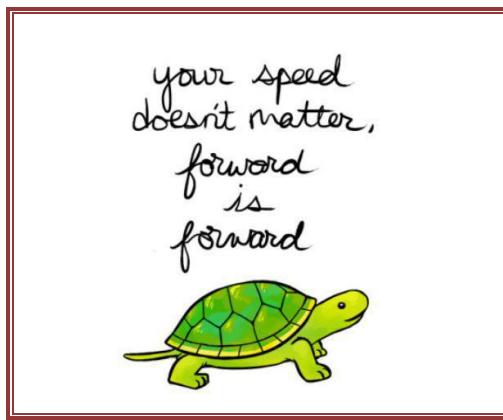
### **Functions**

Spermatogonium undergoes meiotic division leading to sperm formation.

**Sertoli cell :** Nourishes germ cells

**Leydig cell :** Synthesise and Secrete hormone androgen.

8. (i) .D. Spermatids = undergo spermiogenesis
- (ii) .A. = Spermatogonium; B = Primary spermatocyte
- (iii) .B. = Diploid E = Haploid
- (iv) .F. = Sertoli cells . Nutrition to germ cells
- (v) Mitosis in Cell .A., Meiosis in cell .B.



## Ch-4--Reproductive Health

### **MAJOR TASKS OF RCH PROGRAMME**

- i. Creating awareness among the people about reproduction related aspects.
- ii. Providing facilities and support to build up reproductively healthy society.
- iii. Creating awareness by govt. and non-govt. agencies using A/V and print media.
- iv. Introduction of sex education in school.
- v. Educating fertile couples and marriage age groups.

**Contraceptive methods-** To prevent unwanted pregnancies.

**1. Natural methods** work on the principle of avoiding chances of ovum and sperms meeting.

- Periodic abstinence-Couples avoid coitus from 10-17<sup>th</sup> day of menstrual cycle when ovulation could be expected.
- Coitus interruptus-Male partner withdraws penis from vagina just before ejaculation
- Lactational amenorrhoea-Ovulation and menstrual cycle do not occur during intense lactation, so chances of conception are less.

**2. Barrier methods:** ovum and sperms are prevented from physically meeting with the help of barriers. It includes use of condoms, diaphragms, cervical caps and vaults. Both the male and the female condoms are disposable, can be self-inserted and thereby gives privacy to the user. Use of condoms has increased in recent years due to its additional benefit of protecting the user from contracting AIDS.

**3. Intra-uterine devices-** IUDs increase phagocytosis of sperms within the uterus.

- i. **The non-medicated IUDs** (e.g., Lippes loop),
- ii. **Copper releasing IUDs** (CuT, Cu7, Multiload 375); Cu ions released suppress sperm motility and the fertilising capacity of sperms
- iii. **Hormone releasing IUDs** (Progestasert, LNG-20): The hormone releasing IUDs make the uterus unsuitable for implantation and the cervix hostile.

**4. Pills** having progestogen or progestogen-estrogen combination.

They inhibit ovulation and implantation as well as alter the quality of cervical mucus to prevent/ retard entry of sperms.

**Saheli –the new oral contraceptive** for the females contains a **non-steroidal preparation**. It is a ‘once a week’ pill with very few side effects and high contraceptive value.

**5. Surgical method-** Tubectomy in females(small part of fallopian tube removed) and vasectomy in males(small part of vas deferens removed)

2. **Sexually Transmitted Diseases(STD)-AIDS, Gonorrhoea, syphilis, Hepatitis-B, Trichomoniasis**

### **MEDICAL TERMINATION OF PREGNANCY (MTP)**

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

#### **Reasons for MTP**

1. to get rid of unwanted pregnancies
2. If continuation of the pregnancy could be harmful or even fatal either to the mother or to the foetus or both.

MTPs are considered relatively safe during the first trimester, i.e., upto 12 weeks of pregnancy.

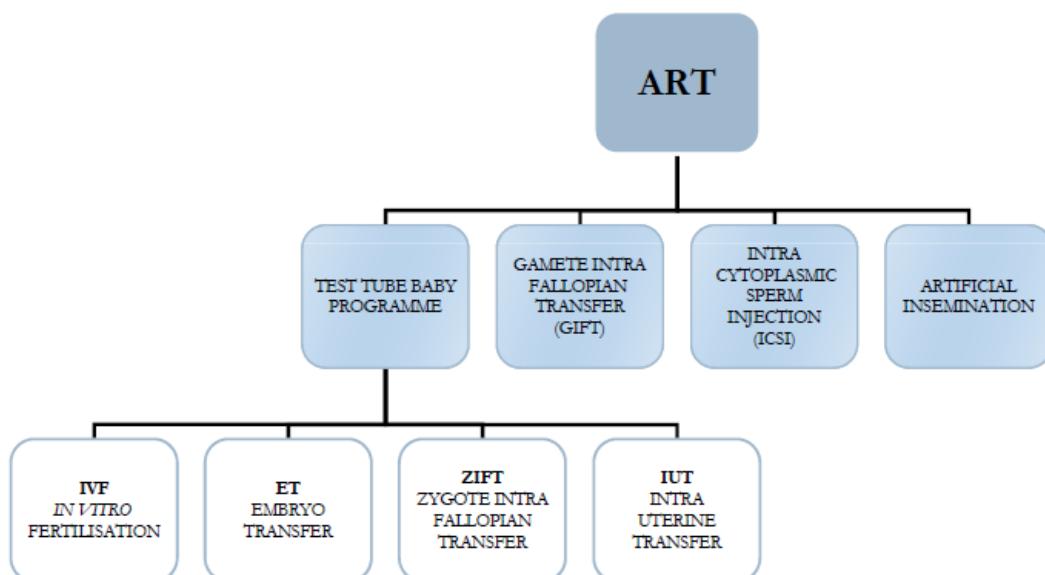
#### **Misuse of MTP**

1. Majority of the MTPs are performed illegally by unqualified quacks
2. The misuse of amniocentesis to determine the sex of the unborn child. Frequently, if the foetus is found to be female, it is followed by MTP

### **INFERTILITY**

A large no of couples all over India are infertile, i.e., they are unable to produce children in spite of Unprotected sexual co-habitation. The reasons for this could be many- physical, congenital, diseases, drugs, Immunological or even Psychological.

**Assisted Reproductive Technologies (ART) are special techniques that assist couples to have children.**



#### **1) In Vitro Fertilization (IVF)**

- a) It is the fertilization outside the body
- b) In this method, popularly known as test tube baby programme, ova from the wife / donor (female) and sperms from the husband / donor (male) are collected and are induced to form the zygote s in the lab.
- c) The zygote or early embryos could then be transferred into the fallopian tube (ZIFT - zygote intra fallopian transfer)

**2) Zygote intra fallopian transfer (ZIFT)**

The zygote with 8 blastomeres can be transferred into the fallopian tube.

**3) Gamete intra fallopian tube (GIFT)**

Transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce one

**4) Intra cytoplasmic sperm injection (ICSI)**

A sperm is directly injected into the ovum.

**5) Artificial Insemination (AI)**

Infertility cases either due to inability of the male partner to inseminate the female or due to very low sperms counts in the ejaculates could be corrected by artificial insemination.

In the technique, the semen collected either from the husband or a healthy donor is artificially introduced into the vagina or into the uterus (IUI - Intra Uterine Insemination) of the female.

**6) Adoption – can be done from orphanage / relatives****QUESTIONS FOR PRACTICE****2 mark questions**

1. What are the major tasks or objectives of Reproductive and Child Health Care (RCH) programmes?
2. What is an ideal contraceptive?
3. How do Intra-Uterine devices (IUDs) prevent conception? List any two ways?
4. ‘Saheli’ is an example of oral contraceptive- (i)Name the non-steroidal principle in it.  
(ii)How does it provide contraception.
5. During lactation chances of conception are almost zero. (i) Give the reason. (ii) Give the term used to describe the phenomenon?
6. Mention any four possible ill-effects of contraceptives?
7. Differentiate between ZIFT and GIFT
8. (i)Name the principle on which natural methods of Birth control work?  
(ii) What is periodic abstinence?

**3 mark questions**

9. What are the measures one has to take to prevent from contracting STDs?
10. Enumerate the complications that untreated STDs can lead to?

**5 mark question**

11. Mention the different ways in which people are made aware of the significance of reproductive and a reproductively healthy society?

**(Answers)**

1. i)-creating awareness among the people about various reproduction related aspects  
ii) Providing facilities and support for building up a reproductively healthy society
2. – user friendly
  - easily available
  - effective, reversible with no or least side effects.
  - non interfering with the sexual drive/desire and/or the sexual act of the user.
- 3.- By increasing phagocytosis of sperms with in the uterus.
  - By suppressing sperm motility and thereby the fertilizing ability.
  - By making the uterus unsuitable for implantation.

- By making the cervix hostile to sperms.

4. i) It contains the non-steroidal principle called Centchroman.

ii) It alters or inhibit ovulation and implantation and also modify the quality of cervical mucus to prevent or retard entry of sperms.

5. i) Ovulation does not take place

ii) Lactational amenorrhoea.

6. i) Nausea

ii) Abdominal pain

iii) Irregular menstrual bleeding.

iv) Breast Cancer

7. ZIFT – Zygote or embryo upto eight blastomeres is transferred into the fallopian tube.

GIFT – Transfer of an ovum collected from a donor female into another female, who cannot produce ova, but can provide suitable conditions for fertilisation and further development of the foetus upto parturition.

8. i) These methods work on the principle of avoiding chances of meeting between the gametes.

ii) It is the natural method of birth control in which the couple avoid or abstain from coitus from day 10 to 17<sup>th</sup> of the menstrual cycle, when ovulation is expected to occur and chances of fertilization are very high.

9. STDs can be prevented by:

i) Avoiding sex with unknown partner or multiple partners.

ii) Using condoms during coitus every time.

iii) seeking medical help in case of doubt and getting it completely cured.

10. i) Pelvic inflammatory Diseases(PID).

ii) Abortions.

iii) Stillbirths.

iv) Ectopic pregnancies.

v) Infertility.

vi) Cancer of the reproductive tract.

11. Family planning programmes now called RCH create awareness among people about reproduction related aspects.

- Audio-visual and print media give information.

- Govt. and Non-Govt. agencies have taken various steps to create awareness.

- Sex education teachers in schools have a major role in giving right information about reproduction related problems.

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**Study while others are sleeping, work while others are loafing, and dream while others are wishing.**

## Unit-Genetics and Evolution

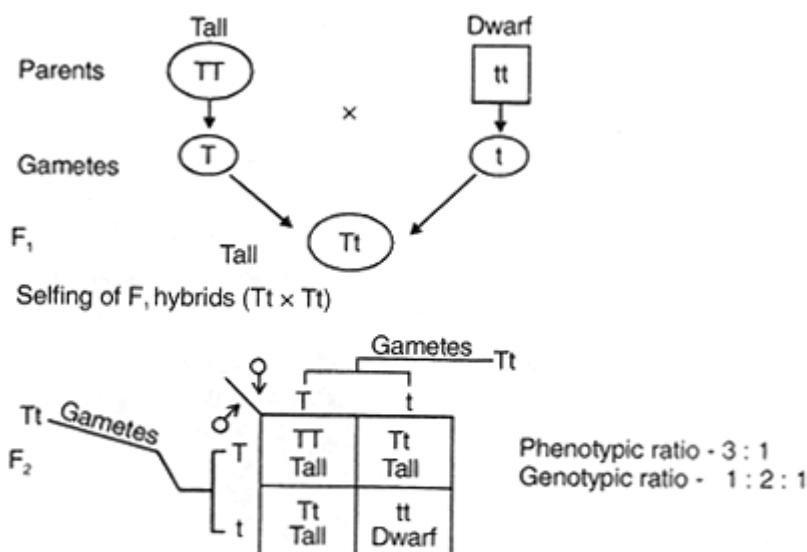
### Ch-5-Principles of inheritance and evolution

#### 1. Mendelian's laws of inheritance-

- Law of dominance-In a dissimilar pair of factors, one member of the pair dominates the other. This law is proved using a monohybrid cross.(page72 of NCERT)
- Law of segregation-According to this law factors of a pair segregate from each other such that a gamete receives only one of the two factors.
- Law of independent assortment-It states that when two pairs of traits are combined in a hybrid, segregation of one pair of characters is independent of the other pair of characters. Mendel explained it using a dihybrid cross.(page 79 of NCERT)

#### 2. Monohybrid cross-Cross between organisms differing in one trait.(page 72 of NCERT)

<b>MONOHYBRID PHENOTYPIC RATIO</b>	<b>3:1</b>
<b>MONOHYBRID GENOTYPIC RATIO</b>	<b>1:2:1</b>



#### 3. Dihybrid cross-Cross between organisms differing in two traits.(page 76 of NCERT)

<b>DIHYBRID PHENOTYPIC RATIO</b>	<b>9:3:3:1</b>
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4. **Test cross**-In such a cross dominant phenotype is crossed with the recessive parent to determine the genotypic composition of the dominant trait i.e. whether it is homozygous or heterozygous.(page 75 of NCERT)

**Monozygous Testcross Ratio**                   **1:1**  
**Dihybrid Testcross Ratio**                   **1:1:1:1.**

5. **MENDEL'S LAWS OF INHERITANCE**

1. **Law of Dominance**

In a dissimilar pair of factors one member of the pair dominates (dominant) the other (recessive).

2. **Law of Segregation**

The factors or alleles of a pair segregate from each other such that a gamete receives only one of the two factors.

3. **Law of independent assortment**

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

6. **Incomplete dominance**-When dominant character is not completely dominant when present in heterozygous condition. Ex-Flower color in dog flower (snapdragon or Antirrhinum sp.)page 76 of NCERT

**RED Flower x WHITE Flower ---> PINK Flower**

**RATIO: 1:2:1**

7. **Co-dominance**-When two dominant genes occur together and both are equally dominant. Ex- AB blood group:  $I^A I^B$ . (page 77 of NCERT).

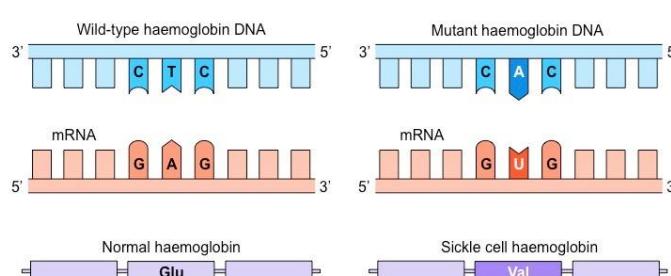
8. **Multiple alleles**- When more than two alleles control a character Ex: Blood group is controlled by three alleles  $I^A$ ,  $I^B$  and  $i$

9. **Sex determination-**

- **Male heterogamety**- Males produce two types of gametes  
XX-XY type in Drosophila, mammals including humans  
XX-XO type in grasshopper
- **Female heterogamety**-Females produce two types of gametes.  
ZW-ZZ type in birds and some fish.  
ZO-ZZ type in butterflies and moths

10. **Mendelian disorders**-Disorders due to mutation in a single gene. These are Haemophilia, Sickle cell anaemia and Phenylketonuria

11. **Sickle cell anaemia**



12. **Chromosomal disorders**-Disorders due to absence or excess of one or more chromosomes. These are

- **Down's syndrome (Trisomy)** - Due to an additional copy of chromosome no. 21. The affected individual is **short statured with small round head, furrowed tongue and partially open mouth. Palm is broad with characteristic palm crease. Physical, psychomotor and mental development is retarded**. Chromosome number is **47**

- **Klinefelter's syndrome(Trisomy)**- Due to an additional copy of X-chromosome. Such an individual has **overall masculine development**, however the **development of breast**, i.e., Gynaecomastia. Such individuals are **sterile**. Chromosome number is **47 (44+XXY)**
  - **Turner's syndrome(Monosomy)**- Due to absence of one of the X-chromosomes. Such females are sterile as ovaries are rudimentary, lack other secondary sexual characters. Chromosome number is **45 (44+XO)**

## Questions for practice

**(2 MARKS)**

- Identify the sex of organism as male or female in which the sex chromosome are found as  
(i) ZW in bird (ii) XY in *Drosophila* (iii) ZZ in birds. (iv) XO in grasshopper.
  - Mention two differences between Turner's syndrome and Klinefelter's syndrome.
  - The human male never passes on the gene for haemophilia to his son. Why is it so?

### **SA-I (3 MARKS)**

4. A woman with O blood group marries a man with AB blood group  
(i) work out all the possible phenotypes and genotypes of the progeny.  
(ii) Discuss the kind of dominance in the parents and the progeny in this

LA (5 MARKS)

5. A dihybrid heterozygous round, yellow seeded garden pea (*Pisum sativum*) was crossed with a double recessive plant.

  - (i) What type of cross is this?
  - (ii) Work out the genotype and phenotype of the progeny.
  - (iii) What principle of Mendel is illustrated through the result of this cross?

## ANSWERS

1. (i) Female; (ii) Male; (iii) Female (iv) Male
  2. Turner's Syndrome : The individual is female and it has 45 chromosomes i.e., one X chromosome is less.  
Klinefelter's Syndrome : The individual is male and has 47 chromosomes i.e., one extra X chromosome.
  3. The gene for haemophilia is present on X chromosome. A male has only one X chromosome which he receives from his mother and Y chromosome from father. The human male passes the X chromosome to his daughters but not to the male progeny (sons).
  4. (i) Blood group AB has alleles as  $I^A$ ,  $I^B$  and O group has ii which on cross gives the both blood groups A and B while the genotype of progeny will be  $I^A i$  and  $I^B i$ .  
(ii)  $I^A$  and  $I^B$  are equally dominant (co-dominant). In multiple allelism, the gene I exists in 3 allelic forms,  $I^A$ ,  $I^B$  and i.

<input type="checkbox"/>	(i)	It is a dihybrid test cross								
	(ii)	Parent	RrYy (Round Yellow)			rryy (Wrinkled green)				
		Gametes	R <sub>Y</sub>	R <sub>y</sub>	r <sub>Y</sub>	r <sub>y</sub>	X	r <sub>y</sub>		
		Gametes	RY	Ry	rY	ry				
F <sub>1</sub>	progeny	ry	RrYy Round, Yellow	Rryy Round and Green	rrYy Wrinkled Yellow	rryy Wrinkled, Green				
Phenotypic ratio			:	1	:	1	:	1	:	1
Genotypic ratio			:	1	:	1	:	1	:	1

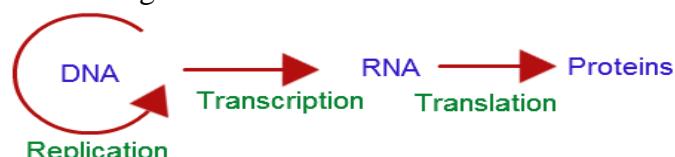
(iii) It illustrates the Principle of independent assortment.

**SUCCESS  
IS THE SUM OF  
SMALL EFFORTS,  
REPEATED  
DAY IN &  
DAY OUT.**

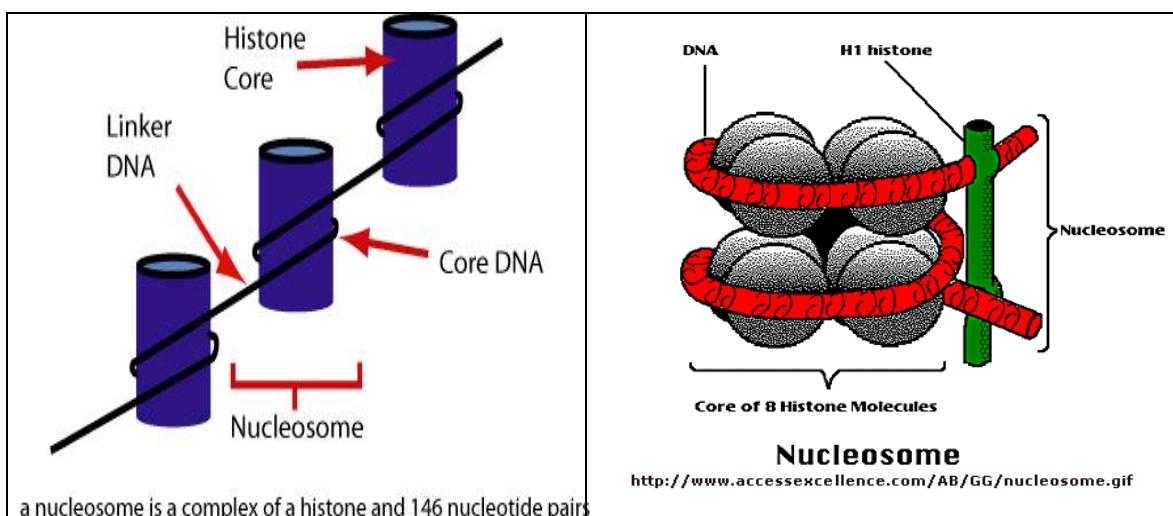
-R. Collier

### Ch-6-Molecular basis of inheritance

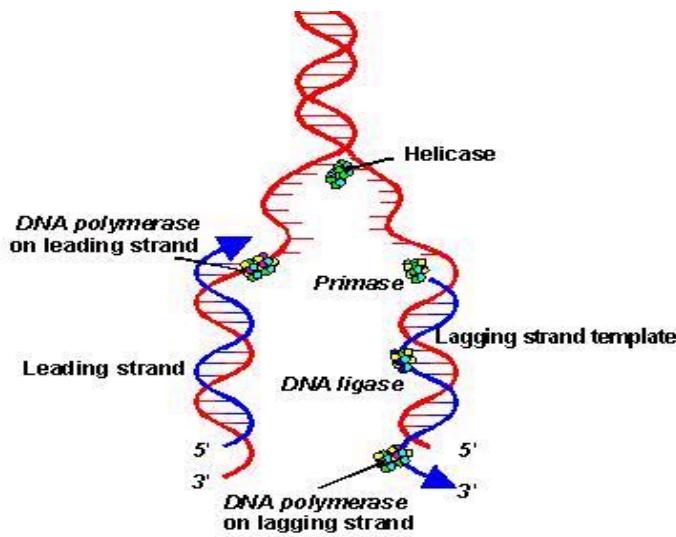
1. **Central dogma**-It means genetic information flows from DNA to RNA to Proteins



2. **Packaging of DNA helix**-The negatively charged DNA is wrapped around positively charged histone octamer to form nucleosome. Nucleosomes are repeating units on chromatin.

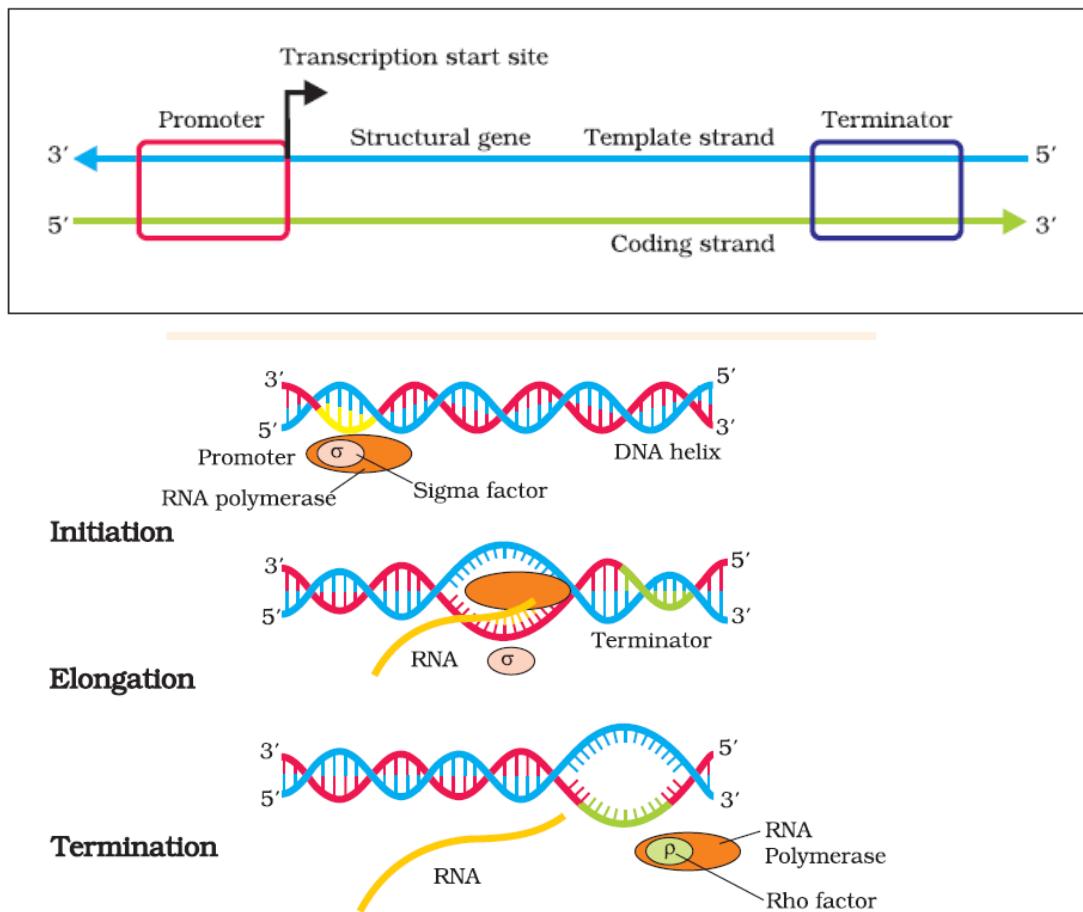


3. **Replication**-Formation of carbon copy of DNA by DNA itself by DNA polymerase.



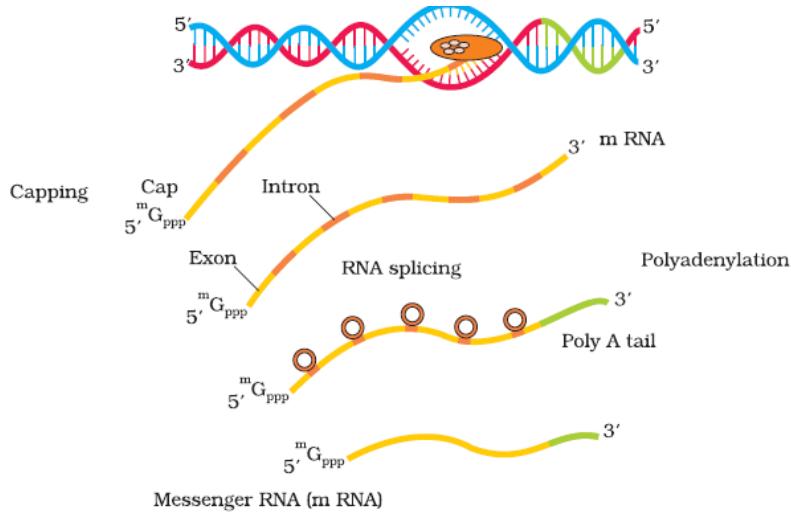
4. **Transcription**-It is the process of copying genetic information from one strand of DNA into RNA by RNA polymerase.

#### Structure of transcription unit

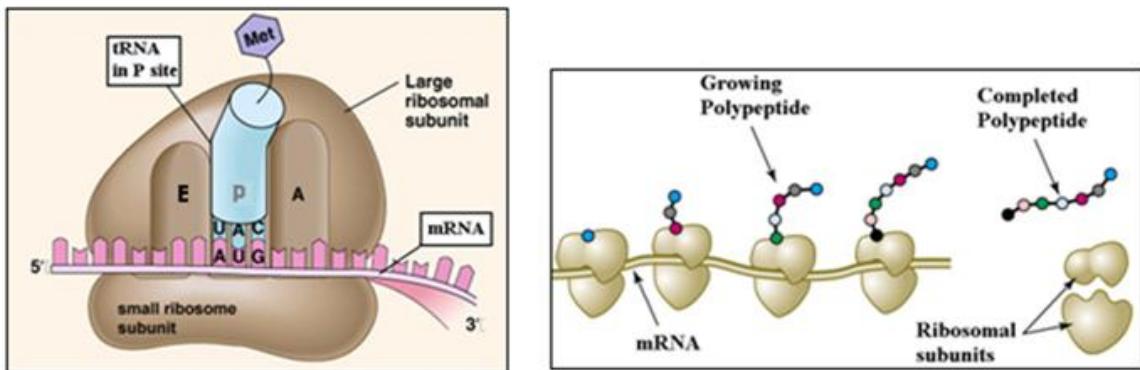


#### POST TRANSCRIPTIONAL EVENTS IN EUKARYOTES

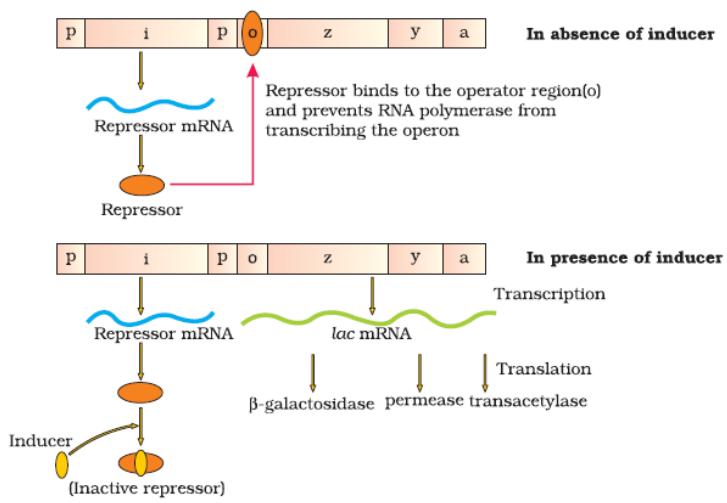
- Splicing:** Introns removed
- Capping:** Methyl guanosine triphosphate is added to the 5'-end of hnRNA.
- Tailing:** 200-300 Adenylate residues are added at 3'-end



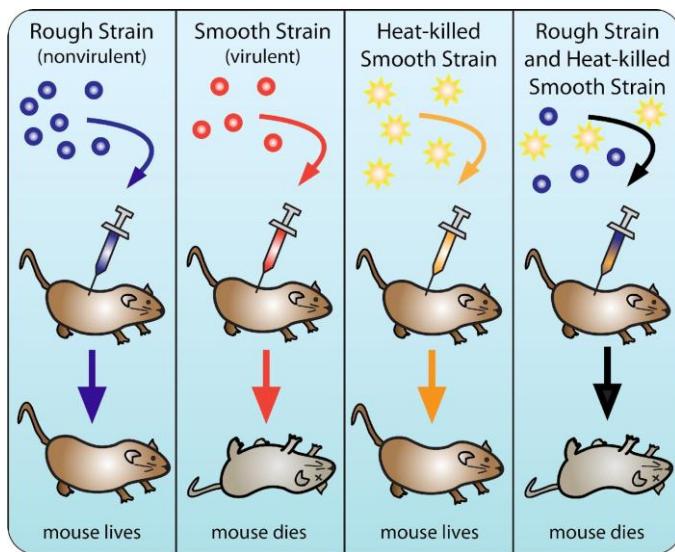
**Translation**-The process of polymerization of amino acids to form a polypeptide chain using genetic information stored in RNA



5. **Lac operon**- The **lac operon** (lactose operon) is an operon required for the transport and metabolism of lactose in *Escherichia coli*. The lac operon consists of **three structural genes**, and a **promoter**, a **terminator**, **regulator**, and an **operator**. The three structural genes are: **lacZ**, **lacY**, and **lacA**. Operon is switched on in the presence of lactose and switched off in the absence of lactose



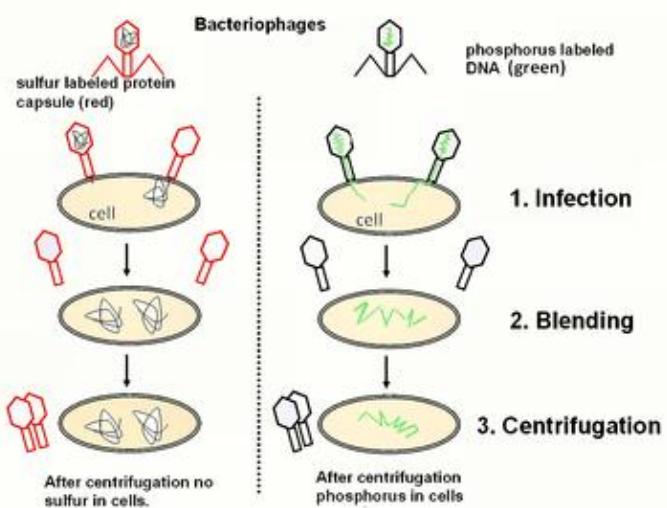
## 6. Various Experiments- a) Griffith's experiment ( Transforming Principle)



**A molecule that can act as a genetic material must fulfill the following criteria:**

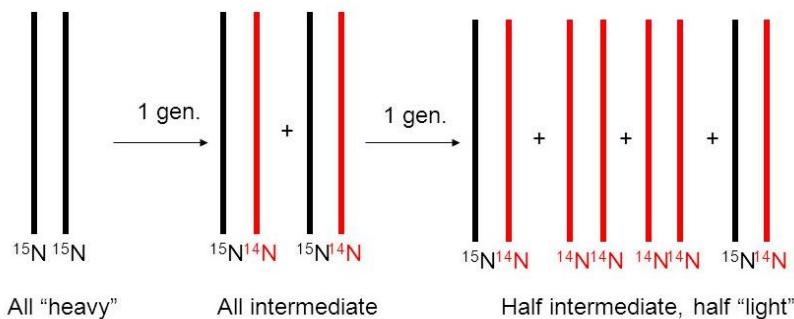
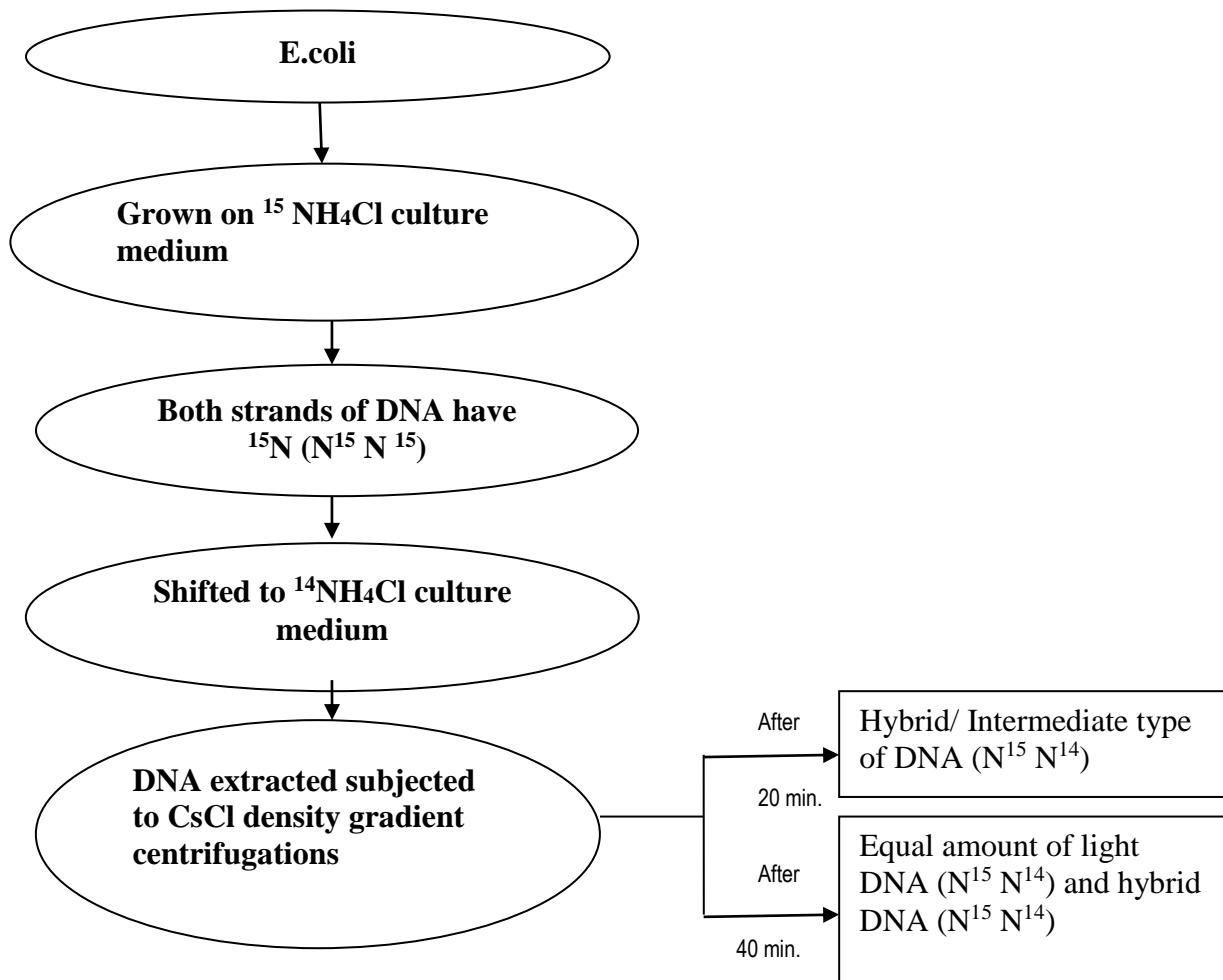
- It should be able to replicate.
- It should chemically and structurally be stable.
- It should provide the scope for slow changes (mutation) that are required for evolution.
- It should be able to express itself in the form of 'Mendelian Characters'.

## b) Hershey and Chase experiment to show DNA is the genetic material-

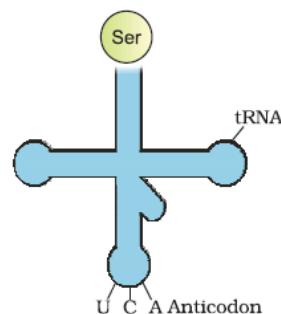


Hershey and Chase proved that the DNA from the bacteriophage entered into the bacteria shortly after the virus attaches to its host. Hershey and Chase concluded that DNA, not protein, was the genetic material.

c) Messelson and Stahl experiment to show semi-conservative nature of DNA replication-



**Structure of tRNA : Clover leaf structure**



## **Characteristics of genetic code**

- (i) The codon is triplet. 61 codons code for amino acids and 3 codons do not code for any amino acids, hence they function as stop codons.
- (ii) One codon codes for only one amino acid, hence, it is unambiguous and specific.
- (iii) Some amino acids are coded by more than one codon, hence the code is degenerate.
- (iv) The codon is read in mRNA in a contiguous fashion. There are no punctuations.
- (v) The code is nearly universal except in mitochondrial codons, and in some protozoans.
- (vi) AUG has dual functions. It codes for Methionine (met), and it also act as initiator codon.

## **HUMAN GENOME PROJECT**

Human Genome Project (HGP) was called a **mega project** because:

- a) cost of sequencing genome is approximately 9 billion US dollars.
- b) 3300 books with 1000 pages required and each page with 1000 letters.
- c) high speed computers required

## **Goals of HGP**

- (i) Identify all the approximately 20,000-25,000 genes in human DNA;
- (ii) Determine the sequences of the 3 billion chemical base pairs
- (iii) Store this information in databases;
- (iv) Improve tools for data analysis;
- (v) Transfer related technologies to other sectors, such as industries;
- (vi) Address the ethical, legal, and social issues (ELSI) that may arise from the project.

## **Salient Features of Human Genome**

- (i) The human genome contains **3164.7 million nucleotide bases**.
- (ii) The **average gene consists of 3000 bases**, but sizes vary greatly, with the largest known human gene being dystrophin at 2.4 million bases.
- (iii) The **total number of genes is estimated at 30,000**. Almost all (99.9 per cent) nucleotide bases are exactly the same in all people.
- (iv) The **functions are unknown for over 50 per cent of discovered genes**.
- (v) **Less than 2 per cent of the genome codes for proteins**.
- (vi) **Repeated sequences** make up very large portion of the human genome.
- (vii).Chromosome 1 has most genes (2968), and the Y has the fewest (231).
- (viii) Scientists have identified about 1.4 million locations where single base DNA differences (SNPs – **single nucleotide polymorphism**,('snips') occur in humans.

## **DNA Fingerprinting**

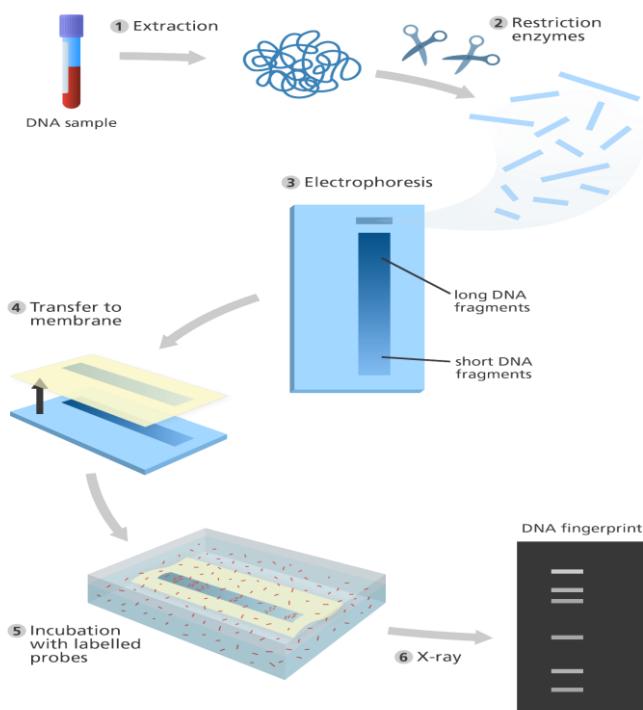
DNA fingerprinting is a method used to identify an individual from a sample of DNA by looking at unique patterns in their DNA.

The technique of DNA Fingerprinting was initially developed by **Alec Jeffreys**.

### **Steps involved in DNA fingerprinting**

- (i) isolation of DNA,
- (ii) digestion of DNA by restriction endonucleases,
- (iii) separation of DNA fragments by electrophoresis,
- (iv) transferring (blotting) of separated DNA fragments to synthetic membranes, such as nitrocellulose or nylon,
- (v) hybridisation using labelled VNTR probe, and

(vi) detection of hybridised DNA fragments by autoradiography.



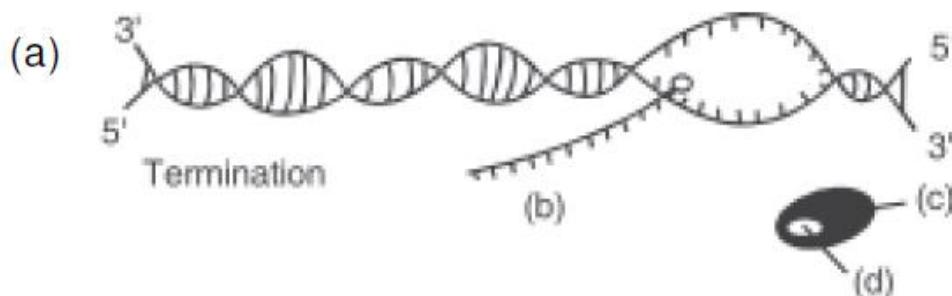
### APPLICATIONS OF DNA FINGERPRINTING

1. This procedure is mostly used in forensic to identify the criminals.
2. It is also used for the paternity test.

### QUESTIONS FOR PRACTICE

**(2 MARKS)**

1. The process of termination during transcription in a prokaryotic cell is being represented here. Name the label a, b, c and d.



2. Complete the blanks a, b, c and d on the basis of Frederick Griffith Experiment.

S Strain → inject into mice → (a)

R strain → inject into mice → (b)

S strain (heat killed) → inject into mice → (c)

S strain (heat killed) + R strain (live) → inject into mice → (d)

3. Give two reasons why both the strands of DNA are not copied during transcription.

4. Mention any two applications of DNA fingerprinting.

5. State the 4 criteria which a molecule must fulfill to act as a genetic material.

**(3 MARKS)**

6. Give points of difference between DNA and RNA in their structure/chemistry and function.

7. Explain how does the hnRNA becomes the mRNA.

OR

Explain the process of splicing, capping and tailing which occur during transcription in Eukaryotes.

8. Enlist the goals of Human genome project.

9. A tRNA is charged with the amino acid methionine.

(i) Give the anti-codon of this tRNA.

(ii) Write the Codon for methionine.

10. Illustrate schematically the process of initiation, elongation and termination during transcription of a gene in a bacterium.

**(5 MARKS)**

11. What is meant by semi conservative replication? How did Meselson and Stahl prove it experimentally?

12. What does the lac operon consist of? How is the operator switch turned on and off in the expression of genes in this operon? Explain.

13. State salient features of genetic code.

14. Describe the various steps involved in the technique of DNA fingerprinting.

**ANSWERS**

1. (a) DNA molecule (b) mRNA transcript (c) RNA polymers (d) Rho factor

2. (a) Mice die (b) mice live (c) mice live (d) mice die

3. (a) If both the strands of DNA are copied, two different RNAs (complementary to each other) and hence **two different polypeptides** will produce;

(b) The two complementary RNA molecules (produced simultaneously) would form a **double stranded RNA** rather than getting translated into polypeptides.

4. (i) To identify criminals in the forensic laboratory.

(ii) To determine the real or biological parents in case of disputes

5. Refer text above

6.

DNA	RNA
(i) Double stranded molecules	(i) Single stranded molecules
(ii) Thymine as pyrimidine base	(ii) Uracil as pyrimidine base
(iii) Pentose sugar is Deoxyribose	(iii) Sugar is Ribose
(iv) Quite stable and not very reactive	(iv) 2'-OH makes it reactive

7. Refer text above.

8. Refer text above.

9. (a) UAC (b) AUG

For questions 10, 11, 12, 13, and 14 refer text above

The whole world opened to me  
when I learned to read. ~

-Mary Mcleod Bethune

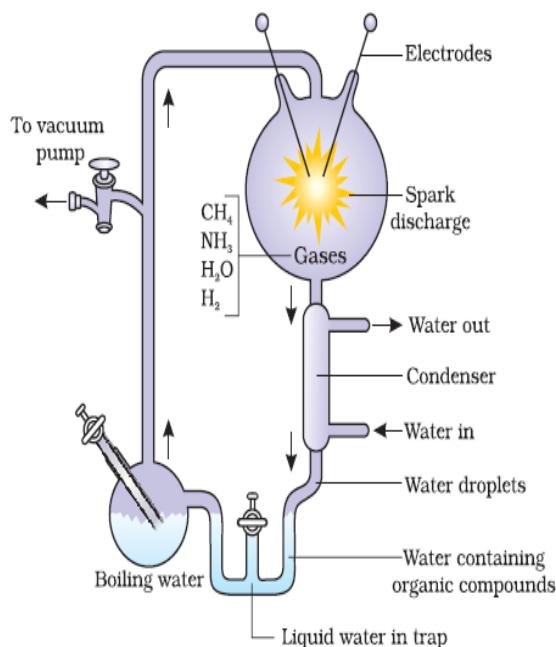


## Ch-7--Evolution

1. THEORY OF CHEMICAL EVOLUTION OF LIFE : Oparin and Haldane proposed that first life came from non-living organic molecules like RNA, protein, etc.

The conditions on primitive earth were- high temperature, volcanic storms, reducing atmosphere containing methane, ammonia, etc.

Miller and Urey provided experimental proof to this theory. They created similar environmental conditions in lab.



**Miller's experiment** – S.L. Miller experimentally proved that first form of the life have come from pre-existing non-living organic molecules.

### **1. Evidences of evolution**

**(a) Paleontological evidences**- The study of fossils called paleontology ,Fossils are the remains of past organisms preserved in sedimentary rocks or other media

#### **(b) Comparative morphological and anatomical evidences**

**(i) Homologous organs**-Organs which have similar anatomy and origin but differ in function. These show divergent evolution. Ex-

- Forelimbs of man, cheetah, whale, bat and bird

- Thorns of Bougainvillia and tendrils of cucurbita

**(ii) Analogous organs** –Organs which have similar functions but different anatomy

These are the result of convergent evolution. Ex-

- Wings of butterfly and bird
- Sweet potato and potato
- Eye of octopus and mammal
- Flippers of penguins and dolphins

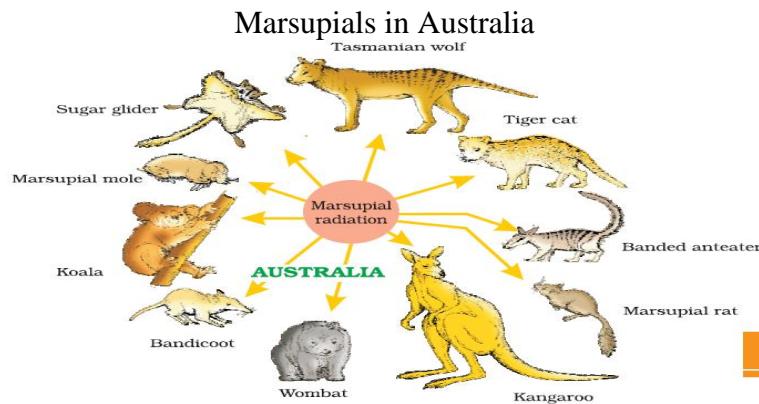
**(c) Biochemical evidences:** Diverse organisms have similar proteins and genes

which perform similar functions.

**(d) Biogeographical evidences**

2. **Adaptive radiation**-The process of evolution of different species in a geographical area starting from a point and literally radiating to other areas of geography.

**Examples:** Darwin finches



3. **Evolution by anthropogenic action( human action)**- Antibiotic resistant microbes, pesticide resistant pests, DDT resistant mosquitoes.
4. **Industrial Melanism** : It is an example of evolution by natural selection. In 1850's in England before industrialization, there were more white-winged moths on trees than dark-winged (melanised moths). During that time there was a thick growth of white lichens on the trees. White-winged moths could not be detected by the predators in the white background of lichens. In 1920, after industrialization, there were more dark-winged moths than white-winged in the same area. During this period, the tree trunks became dark due to industrial smoke and soot. Under this condition, white-winged moths were spotted by predators and dark-winged moths survived. Hence moths that can camouflage themselves i.e. hide in the background, survived. This showed that in a mixed population, those that can better adapt, survive and increase in population size. But no variant is completely wiped out.
5. **Theories of evolution-**
  - Darwin's theory- Branching descent and natural selection are the two key concepts of evolution.
  - Lamarck' theory- According to this theory, evolution of life forms occurred due to use and disuse of organs.

- Hugo deVries theory- Hugo deVries based on his work on evening primrose said that mutation causes evolution and hence called it saltation.

**6 Hardy Weinberg principle**-It states that allele frequencies in a population are stable and is constant from generation to generation

$$\text{Hardy Weinberg equation: } p^2 + 2pq + q^2 = 1$$

**7. Factors affecting Hardy Weinberg equilibrium:**

- Gene migration/ gene flow
- Genetic Drift
- Mutation
- Genetic Recombination
- Natural Selection

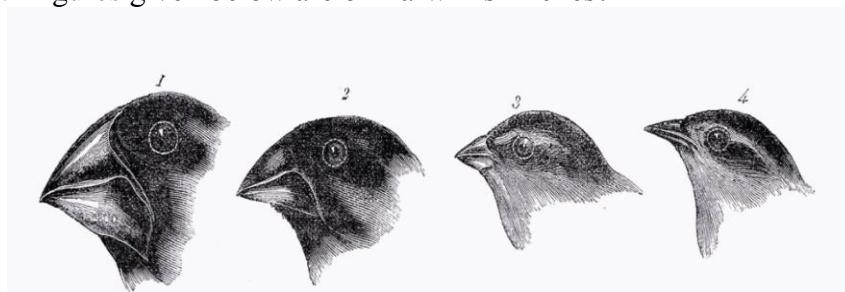
### **QUESTIONS FOR PRACTICE:**

**(2 MARKS)**

1. Explain Oparin-Haldane theory of chemical evolution of life.
2. Distinguish between convergent and divergent evolution giving one example of each.
3. What is adaptive radiation? Explain with an example

**(3 MARKS)**

4. Classify the following as examples of homology and analogy-
  - (i) Hearts of fish and crocodile
  - (ii) Wings of butterfly and birds
  - (iii) Eyes of Octopus and Mammals
  - (iv) Tubers of potato and Sweet potato
  - (v) Thorns of Bougainvillea and spines of Opuntia
  - (vi) Thorn of Bougainvillea and tendrils of cucurbits.
5. Stanley Miller and Harold Urey performed an experiment by recreating in the laboratory the probable conditions of the atmosphere of the primitive earth.
  - (i) What was the aim of the experiment?
  - (ii) In what forms was the energy supplied for chemical reactions to occur?
  - (iii) For how long was the experiment run continuously? Name two products formed.
6. Industrial Melanism in peppered moth is an excellent example of 'Natural selection. Justify the statement.
7. Figures given below are of Darwin's finches?



Variety of beaks of Darwin's finches.

- (a) Mention the specific geographical area where these were found.
- (b) Name and explain the phenomenon that has resulted in the evolution of such diverse species in the region.

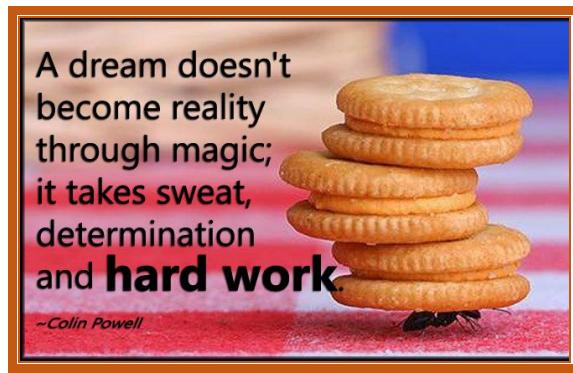
- (c) How did Darwin visit the particular geographical area?
8. Give examples to show evolution by anthropogenic action.

**(5 MARKS)**

9. (a) Differentiate between analogy and homology giving one example each of plant and animal respectively?  
(b) How are they considered as evidence in support of evolution?
10. Explain Darwinian Theory of evolution with the help of suitable example. State the two key concepts of the theory?

## ANSWERS

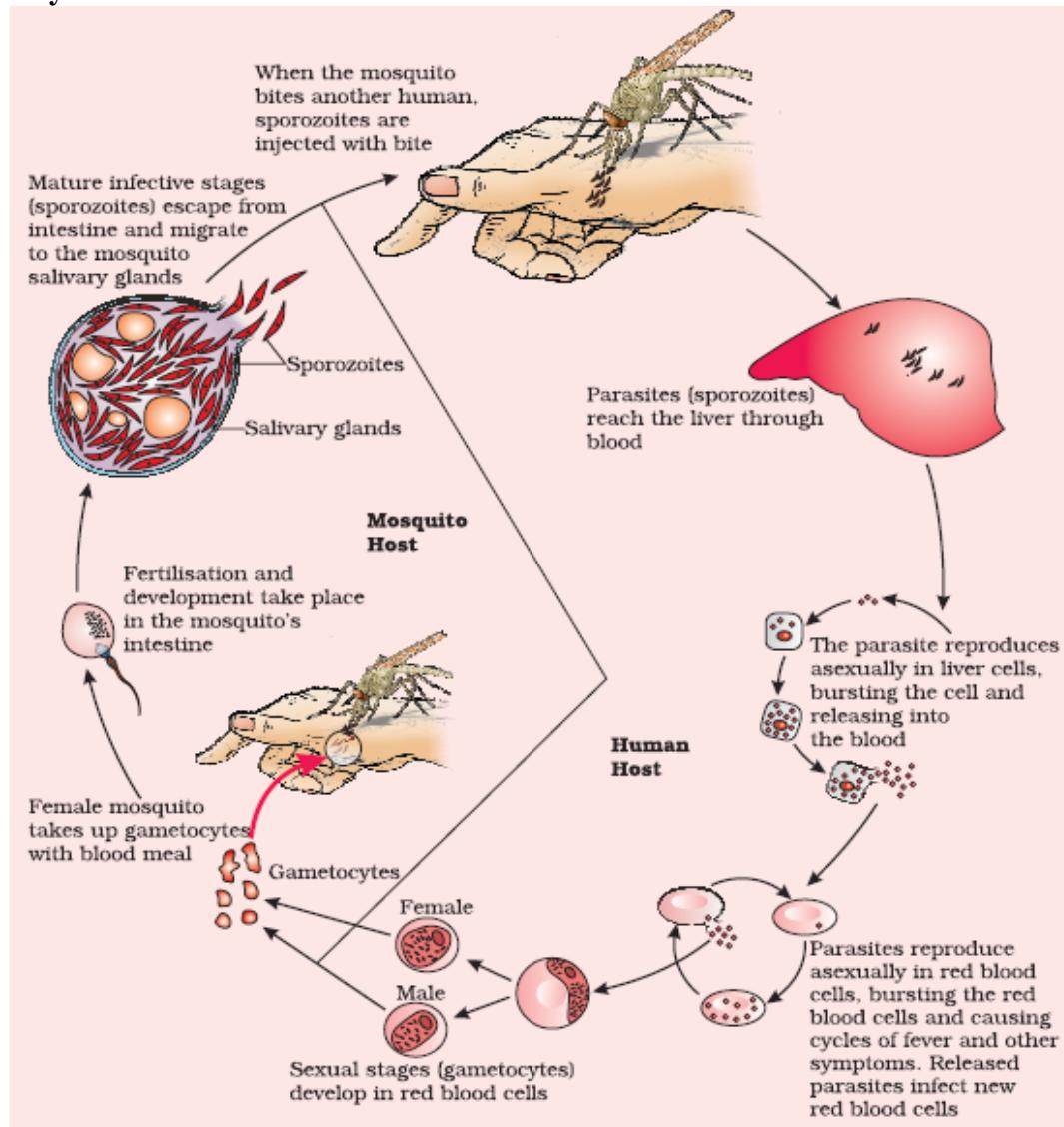
1. The first life form could have come from the pre-existing, non-living organic molecules (like RNA, Proteins, etc.) and the formation of life was preceded by chemical evolution.
2. Refer page 130, 131, NCERT Text book, Biology - XII
3. Refer page 133, NCERT book, Biology – XII
4. (i) Homology (ii) Analogy (iii) Analogy (iv) Analogy  
(v) Analogy (vi) Homology
5. (i) To prove Oparin's theory of origin of life.  
(ii) Electric discharge using electrodes.  
(iii) One week: Amino acids and Sugar.
6. Refer Page 131, NCERT Text book of class XII.
7. (a) Galapagos Island. (b) Adaptive radiation Refer page 133, NCERT book. (c) Through sea voyage in a sail ship called H.M.S. Beagle
8. Excess use of herbicides pesticides etc. has resulted in selection of resistant varieties in a much lesser time scale. Same is true for antibiotic or drug resistant microbes.
9. (a) Difference between homology and analogy and an example each of plant and animal kingdom.  
(b) Homology is based on divergent evolution whereas analogy on convergent evolution.
10. According to Darwin evolution took place by selection. Some organisms are better adapted to survive in another wise hostile environment. Survival of the fittest. Eg antibiotic resistance in bacteria.  
Key concepts of the theory are  
(a) Branching descent  
(b) Natural selection.



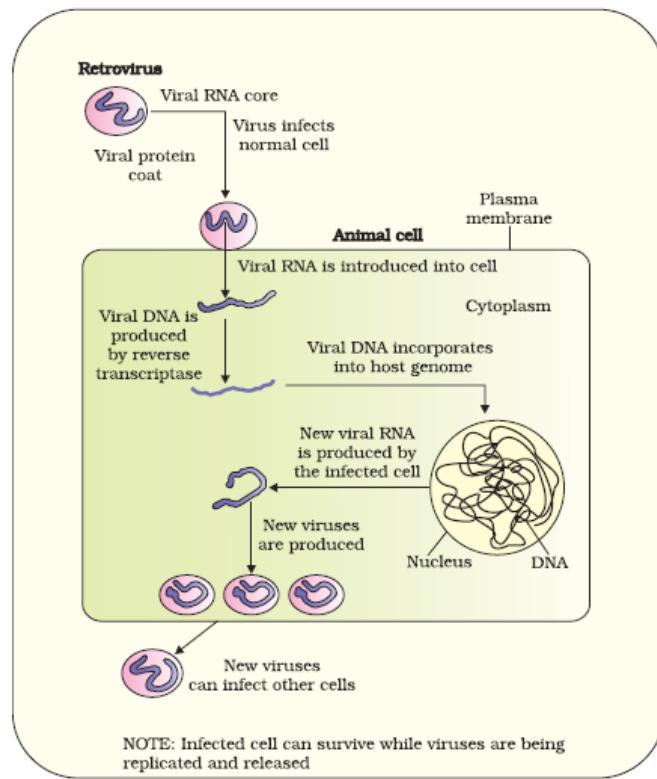
## Unit-Biology in human welfare

### Ch-8-Human health and diseases

#### 1. Life cycle of Plasmodium-



2. AIDS (Acquired Immuno Deficiency Syndrome) caused by HIV (Human Immunodeficiency Virus). It is a retrovirus i.e. has RNA as the genetic material. Replication of retrovirus



3

	Disease	Causative Agents	Symptoms
1.	Common cold	Rhinoviruses	Nasal congestion and discharge, sore throat, cough, headache, tiredness and hoarseness.
2	Typhoid	<i>Salmonella typhi</i>	sustained high fever, stomach pain, loss of appetite, constipation, headache.
3	Pneumonia .	<i>Streptococcus pneumoniae</i> and <i>Haemophilus influenzae</i>	fever, headache, cough, chills. and in severe cases finger nails may turn grey to bluish in colour.
4	Malaria	<i>Plasmodium P. malariae</i> <i>P. vivax</i> , <i>P. falciparum</i>	Yawning, tiredness, acute , headache, muscular pain, feeling of chillness and shivering, nausea and high temperatures
5	Amoebic dysentery	<i>Entamoeba histolytica</i>	Abdominal pain, cramps, stool with excess mucus and blood clots, constipation
6	Ringworm	<i>Microsporum epidermophyton</i> <i>Trichophyton</i>	Dry scaly lesions on skin, nails and scalp, itching and

7	Ascariasis	<i>Ascaris lumbricoides</i>	Anaemia, muscular pain, internal bleeding, insomnia, blockage of intestinal passage
8	Filariasis	<i>Wuchereria bancrofti</i> and <i>W. malayi</i>	fever, blockage of lymphatic Elephantiasis and vessels, enormous swelling of affected part viz. arm, footleg, mamma or scrotum

#### 4 Immunity-The ability of the host to fight the pathogens.

- Innate immunity-It is a non specific type of defence present at the time of birth. It consists of 4 types of barriers-
  - a) Physical barriers-skin, mucus coating if epithelium lining the respiratory, gastrointestinal and urogenital tract.
  - b) Physiological barrier-acid in stomach, saliva in mouth, tears from eyes
  - c) Cellular barriers-WBC's, macrophages
  - d) Cytokine barriers-Virus infected cells secrete proteins called interferons which protect non-infected cells from further viral infection.
- Acquired immunity-It is pathogen specific and is acquired by the person during its lifetime. It is characterized by memory.
- Active immunity-When a host is exposed to antigens, antibodies are produced in the host body itself.. Ex-Injecting microbes deliberately during immunization or pathogens entering the body during natural infection induce active immunity.
- Passive immunity-When readymade antibodies are directly given to protect the body against pathogens, it is called passive immunity. Ex-colostrum

**Autoimmunity**-When the body attacks self cells, it is called autoimmune disease. Ex-Rheumatoid arthritis, multiple sclerosis, Type I Diabetes Mellitus

**5 Lymphoid organs**-Organs where origin and/or maturation and proliferation of lymphocytes occur. Two types-primary and secondary

- a) Primary lymphoid organs-Bone marrow and thymus where immature lymphocytes differentiate into antigen-sensitive lymphocytes. B cells and T cells are formed in primary lymphoid organs.
- b) Secondary lymphoid organs-spleen, lymph nodes, tonsils, peyer's patches of small intestine and appendix. These are the site for interaction of lymphocytes with the antigen.

**6 Cancer**-In our body, cell growth and differentiation is highly controlled and regulated. In cancer cells, there is breakdown of these regulatory mechanisms. Normal cell show a property called contact inhibition by virtue of which contact with other cells inhibits their uncontrolled growth. Cancer cells appear to have lost that property.

**7 Drugs, their effects and sources**- The drugs which are commonly abused are opioids, cannabinoids and coca alkaloids.

Sr. No	Name of Drug	Source	Effects
1	Opioids	Poppy plant <i>Papaver somniferum</i>	Bind to specific opioid receptors present in our central nervous system and gastrointestinal tract.

<b>2</b>	<b>Cannabinoids</b>	<i>Cannabis sativa</i>	cardiovascular system
<b>3</b>	<b>Coca alkaloid or cocaine</b>	<i>Erythroxylum coca,</i>	It interferes with the transport of the neuro-transmitter dopamine. It has a potent stimulating action on central nervous system, producing a sense of euphoria and increased energy.

### **Allergies**

- The exaggerated response of the immune system to certain antigens present in the environment is called allergy.
- The substances to which such an immune response is produced are called allergens.
- The antibodies produced to these are of IgE type.
- Common examples of allergens are mites in dust, pollens, animal dander, etc.
- Symptoms of allergic reactions include sneezing, watery eyes, running nose and difficulty in breathing.
- Allergy is due to the release of chemicals like histamine and serotonin from the mast cells.
- The use of drugs like anti-histamine, adrenalin and steroids quickly reduce the symptoms of allergy.

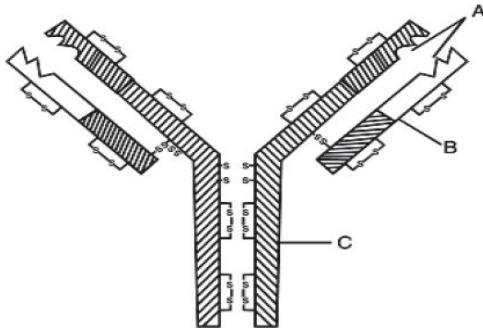
### **QUESTIONS FOR PRACTICE**

**(2 MARKS)**

1. Where are B-cells and T-cells formed? How do they differ from each other?
2. Given below are the pathogens and the diseases caused by them. Which out of these pairs is not correct matching pair and why?
  - (a) *Wuchereria* . Filariasis
  - (b) *Microsporum* . Ringworm
  - (c) *Salmonella* . Common Cold
  - (d) *Plasmodium* . Malaria
3. What would happen to the immune system, if thymus gland is removed from the body of a person?
4. Lymph nodes are secondary lymphoid organs. Describe the role of lymph nodes in our immune response.
5. What is the role of histamine in inflammatory response? Name few drugs which reduce the symptoms of allergy.

**(3 MARKS)**

1. What are Cannabinoids? From which plant Cannabinoids are obtained? Which part of the body is affected by consuming these substances?
2. In the figure, structure of an antibody molecule is shown. Observe it and Give the answer of the following questions.
  - (i) Label the parts A, B and C.
  - (ii) Which cells produce these chemicals?
  - (iii) State the function of these molecules.



3. Mention any three causes of drug abuse. Suggest some measures for the prevention and control of drug abuse.
4. A person shows unwelcome immunogenic reactions while exposed to certain substances.
- Name this condition.
  - What common term is given to the substances responsible for this condition?
  - Name the cells and the chemical substances released which cause such reactions.
5. What is innate immunity? List the four types of barriers which protect the body from the entry of the foreign agents.

**(5 MARKS)**

- Answer the following with respect to Cancer.

  - How does a cancerous cell differ from a normal cell?
  - Benign tumor is less dangerous than malignant tumor. Why
  - Describe causes of cancer.
  - mention two methods of treatment of the disease.

- The pathogen of a disease depends on RBCs of human for growth and reproduction. The person with this pathogen suffers with chill and high fever.

  - Identify the disease.
  - Name the pathogen.
  - What is the cause of fever?
  - Represent the life cycle of the pathogen diagrammatically.

- The immune system of a person is suppressed. He was found positive for a pathogen in the diagnostic test ELISA.

  - Name the disease, the patient is suffering from.
  - Which pathogen is identified by ELISA test?
  - Which cells of the body are attacked by the pathogen?
  - Suggest preventive measure of the infection.

**ANSWERS**

**(2 MARKS)**

- B-cells and T-cells are formed in bone marrow. B-cells produce antibodies but E-cells do not produce antibodies but help B-cells to produce them.
- Salmonella* : Common cold is not a matching pair.
- T-lymphocytes are developed and matured in thymus gland, Immune system will become weak on removal of thymus gland.
- Lymph nodes provide the sites for interaction of lymphocytes with the antigen. When the microorganisms enter the lymph nodes, lymphocytes present there are activated and cause the immune response.
- Histamine acts as allergy-mediator which cause blood vessels to dilate. It is released by mast cells. Antihistamine steroids and adrenaline quickly reduce the symptoms of allergy.

**(3 MARKS)**

1. . Cannabinoids are a group of chemicals which interact with Cannabinoid receptors present principally in the brain, Cannabinoids are obtained from the inflorescences of the plant *Cannabis sativa*. . The substances affect the cardiovascular system adversely
2. (a) A-Antigen binding site B-Light chain  
(b) B-lymphocytes.  
(c) Heavy Chain  
(d) Antibodies provide acquired immune response.

3. **Reasons to attract towards drug abuse :** Curiosity, peer pressure, escape from frustration and failure, family problems, false belief of enhanced performance.

**Preventive measures :**

- . Avoid undue peer pressure
- . Education and Counselling
- . Seeking help from parents and peers.
- . Looking for danger signs
- . Seeking professional and medical help

4. (a) Allergy

(b) Allergens

(c) Mast Cells . Histamine, Serotonin

5. Innate Immunity is non-specific type of defense that is present at the time of birth.

(i) **Physical Barriers :** Skin, mucous-coated epithelium or respiratory, digestive and urinogenital tract.

(ii) **Physiological Barriers :** Acidity of Stomach, lysozyme in saliva, tears, sweat.

(iii) **Cellular Barrier :** Macrophages, neutrophils, monocytes and natural killer lymphocytes..

(iv) **Cytokine Barriers :** Interferons produced by Viral infected cells, protect the non-infected cells from further Viral infection.

**(5 MARKS)**

1. (a) In normal cells, growth and differentiation is highly controlled and regulated (contact inhibition). The cancerous cells have lost the property of contact inhibition, hence continue to divide giving rise to masses of cells (tumors).  
(b) The benign tumor remains confined in the organ affected as it is enclosed in a connective tissue sheath and does not enter the metastatic stage.  
(c) Cancer may be caused due to carcinogens which are physical (radiations), chemicals (Nicotine, Aflatoxin, Cadmium oxide, Asbestos) and biological (viral oncogens).  
(d) Surgery, radiotherapy, Chemotherapy
2. (a) Malaria  
(b) Different species of Plasmodium viz P. vivax, P. Malariae and P. falciparum.  
(c) Malaria is caused by the toxins (haemozooin) produced in the human body by the malarial parasite. This toxin is released by the rupturing of RBCs.  
(d) Life cycle of Plasmodium : (diagram)
3. (i) AIDS (Acquired Immuno Deficiency Syndrome)  
(ii) HIV (Human Immunodeficiency Virus)  
(iii) Helper T-cells, macrophages, B-lymphocytes.  
(iv) **Preventive measures :**  
(a) People should be educated about AIDS transmission.  
(b) Disposable needles and syringes should be used  
(c) Sexual habits should be changed immediately  
(d) High-risk groups should be discouraged from donating blood.  
(e) Routine screening may be done.



## **Ch-9-Strategies for enhancement in food production**

1. **Inbreeding**-When breeding is between animals of the same breed, it is called inbreeding.
2. **Outbreeding**-When breeding is between animals of different breeds, it is called outbreeding.

### **Types of Out-breeding**

#### i) **Out-crossing:**

- This is mating of animals within the same breed, but having no common ancestors on either side of their pedigree up to 4-6 generations.
- The offspring of such a mating is known as out-cross.
- It is the best method for animals having low productivity in milk production, growth rate in beef cattle, etc.
- It helps to overcome inbreeding depression.

#### ii) **Cross-breeding:**

- In this method, superior males of one breed are mated with superior females of another breed.
- The desirable qualities of 2 different breeds are combined.
- The progeny hybrid animals may be used for commercial production or may be subjected to inbreeding and selection to develop new stable superior breeds.
- E.g. Hisardale (sheep) developed in Punjab by crossing Bikaneri ewes and Marino rams.

#### iii) **Interspecific hybridization:**

- It is the mating of male and female of two different species.
- In some cases, the progeny may combine desirable features of both the parents, and may be of considerable economic value. E.g. Mule (male ass X female horse).

3. **Inbreeding depression**-Continued inbreeding reduces fertility and productivity. This is called inbreeding depression
4. **MOET(Multiple Ovulation Embryo Transfer Technology):**
  - a) A cow is administered FSH-like hormone to induce super ovulation.
  - b) The animal is mated with bull or artificially inseminated.
  - c) The fertilised eggs with 8–32 cells are recovered non surgically and transferred to surrogate mothers.
  - d) The genetic mother is available for another round of super ovulation.

**By MOET we can improve the success rate of fertilisation during artificial insemination in animal husbandry programmes**

5. **Steps in plant breeding-**
  - a) Collection of variability

- b) Evaluation and selection of parents
- c) Cross hybridization among the selected parents
- d) Selection and testing of superior recombinants
- e) Testing, release and commercialization of new cultivars

**6 High yielding varieties of (i) Wheat - Sonalika, kalyan sona**

- (ii) Rice - IR-8, Taichung Native-1, Jaya, Ratna, Padma etc.
- (iii) Sugar Cane - A hybrid of *Saccharum barberi* and *S. officinarum*.

**7 Disease resistant Plants**

Crop	Variety	Resistance to diseases
Wheat	Himgiri	Leaf and stripe rust, hill bunt
Brassica	Pusa swarnim (Karan rai)	White rust
Cauliflower	Pusa Shubhra, Pusa Snowball K-1	Black rot and Curl blight black rot
Cowpea	Pusa Komal	Bacterial blight
Chilli	Pusa Sadabahar	Chilly mosaic virus, Tobacco mosaic virus and Leaf curl

**8 INSECT RESISTANT PLANTS**

Crop	Variety	Insect Pests
Brassica (rapeseed mustard)	Pusa Gaurav	Aphids
Flat bean	Pusa Sem 2, Pusa Sem 3	Jassids, aphids and fruit borer
Okra (Bhindi)	Pusa Sawani Pusa A-4	Shoot and Fruit borer

**9 SCP(Single Cell Protein)**Microbes are being grown on an industrial scale as good source of protein. Ex-Spirullina

**10 Tissue culture**-Regeneration of the whole plant from the explant is called tissue culture. This capacity to generate a whole plant from any cell is called totipotency.

**11 Biofortification of food**-Breeding crops with higher levels of vitamins and minerals or proteins and fats. Ex-wheat variety, Atlas 66 has high protein content.

**12 Somatic hybridization:** Protoplasts from two different varieties of plants (with desirable characters) are fused to get hybrid protoplasts. It can be grown to form a new plant called somatic hybrids. This process is called somatic hybridization. Protoplasts can be isolated after digesting the cell walls of single cells of plants by cellulase.

A protoplast of tomato has been fused with that of potato, to form new hybrid plants with the characteristics of tomato and potato

## **QUESTIONS FOR PRACTICE**

### **(2 MARKS)**

1. A new breed of sheep was developed in Punjab by crossing two different breeds of Sheep. Name the two breeds which were crossed and the new breed developed.
2. Study the table given below and fill in the blanks marked A, B, C and D

<i>S.No.</i>	<i>Crop</i>	<i>Crop Variety</i>	<i>Resistant to Disease</i>
<b>1</b>	Wheat	<i>Himgiri</i>	(A)
<b>2</b>	<i>Brassica</i>	(B)	White rust
<b>3</b>	(C)	<i>Pusa Komal</i>	Bacterial blight
<b>4</b>	Chilli	(D)	Chilly mosaic Virus, Tobacco mosaic Virus and leaf curl

3. Why are proteins synthesized from Spirulina called Single celled Proteins? What is the significance of such a protein?
4. Differentiate between inbreeding and outbreeding in animals.

### **(3 MARKS)**

1. What is micropropagation? Why are plants produced by this technique called somaclones? Name any two food plants which are produced on commercial scale using this method.
2. How can we improve the success rate of fertilisation during artificial insemination in animal husbandry programmes?
3. Biofortification is the most practical means to improve public health. Justify the statement with examples.
4. To which product, following products are related (a) Blue revolution (b) white revolution (c) Green revolution

### **(5 MARKS)**

1. Does apiculture offer multiple advantages to farmers? List its advantages, if it is located near a place of commercial flower cultivation. Name the most common species of bee which is reared in India.
2. What is somatic hybridisation? Describe the various steps in producing somatic hybrids from protoplasts. Mention any two uses of somatic hybridisation.

## **ANSWERS**

### **(2 MARKS)**

- 1 . By crossing Bikaneri ewes and Marino rams, the new breed Hisardale was developed.
- 2 A . Leaf and Stripe rust, hill bunt.  
B . *Pusa swarnim* (Karan rai).  
C . Cowpea  
D . *Pusa Sadabahar*
3. The protein rich food produced by microbes is called as single celled protein (SCP) Spirulina is a microorganisms which has more protein. It is a quick method of protein production because the growth rate of microbes is enormous. Hence, it provides a protein rich diet for human beings.

4. When breeding is between animals of the same breed, it is called inbreeding, while cross between different breeds is called out breeding.

**(3 MARKS)**

1. The method of producing many plants through tissue culture is called micropropagation.

The plants produced through micropropagation will be genetically identical to the original plant from which they were grown, hence are called somaclones.

Tomato, banana, apple are produced on commercial scale using this method.

2. The Multiple Ovulation Embryo Transfer (MOET) technology can improve the success rate of fertilisation. In the procedure, a cow is given hormonal treatment (FSH), so that more than one ova/eggs (6-8) are produced per cycle. After mating or artificial insemination the embryos at 8-32 celled stage, are transferred to different surrogate mother cows. This technology has been successfully used for cattle, sheep, rabbit, mares and buffaloes.
3. Biofortification is the plant breeding programme designed to increase Vitamins, minerals, higher proteins and healthier fat content in crops. This programme improves the quality of food products. It is required to prevent hidden hunger. Some of the examples of fortified crops are:

(i) **New hybrid of maize** : has twice the amount of amino acid lysine and tryptophan.

(ii) **Wheat** : Atlas 66, having a high protein content.

(iii) **Rice** : 5 times iron than the normal amount. IARI Delhi has released several crops which are rich in vitamins and minerals. Consumption of such biofortified food will vastly improve the public health.

4. (a) Fish production (b) Milk production (c) Crop production

**(5 MARKS)**

1. Apiculture or Bee-Keeping is the maintenance of hives of honeybees for the production of honey. Apiculture is beneficial for farmers in many ways. Honey bee also produces beeswax which is used in industries, such as in preparation of cosmetics and polishes of various kinds. If Bee keeping is practiced in any area the commercial flowers are cultivated, it will be beneficial in the following ways.

(i) Bees are pollinators of many crop species including flowering crops such as sunflower.

(ii) It improves the honey yield, because honeybees collect the nectar from flowers for making honey. *Apis indica* is the most common species which is reared in India.

2. **Somatic Hybridisation** : The process of fusing protoplasts of Somatic cells derived from different varieties or species of plants to produce a hybrid.

**Steps :**

(i) Removal of cell wall of fusing cells by digestion with a combination of pectinase and cellulase to form protoplasts.

(ii) Fusion between protoplasts of selected parents is induced by the use of poly ethylene glycol (PEG).

(iii) The resulted product is cultured on a suitable medium to regenerate cell walls.

(iv) The cells obtained begin to divide to produce plantlets called somatic hybrids.

**Uses/Applications :**

(i) Somaclonal variations can be created

(ii) varieties/species of plants which can not be sexually hybridised, they can be hybridised.

**I'M BUSY  
GETTING  
STRONGER.**



## Ch-10-Microbes in human welfare

### **Applications of microbes in household products-**

- a) LAB(Lactic acid bacteria) convert milk to curd and improves its nutritional quality by increasing vitamin B<sub>12</sub>. LAB also checks the growth of pathogens in stomach.
- b) Dough used for idli and dosa is fermented by bacteria
- c) Dough for making bread is fermented by baker's yeast, *Saccharomyces cerevisiae*
- d) Large holes in Swiss cheese are due to CO<sub>2</sub> production by bacterium *Propionibacterium sharmanii*.
- e) Roquefort cheese ripened by specific fungus growing on it.

### **Applications of microbes in industrial products-**

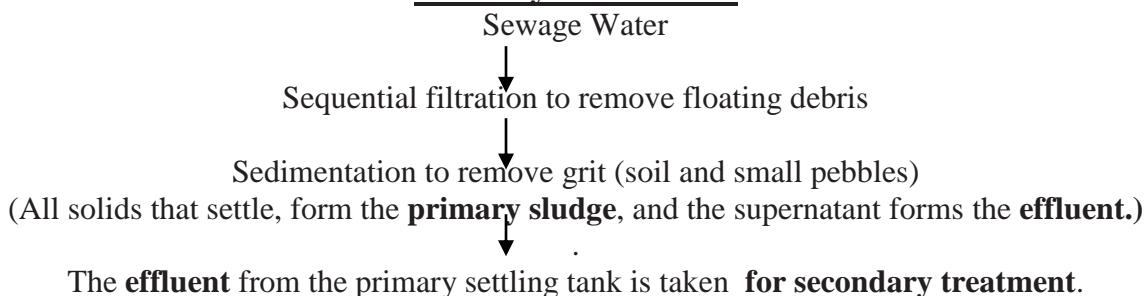
S.NO	MICROBE	APPLICATIONS
<b>FERMENTED BEVERAGES</b>		
1	<i>Saccharomyces Cerevisiae</i> (Brewer's yeast)	<ul style="list-style-type: none"> <li>a) Used for fermenting malted cereals and fruit juices, to produce ethanol.</li> <li>b) Wine and beer are produced without distillation</li> <li>c) Whisky, brandy and rum are produced by distillation of the fermented broth.</li> </ul>
<b>ANTIBIOTICS</b>		
2	<i>Penicillium notatum</i> (Fungus)	<p>Used for making antibiotic Penicillin. This antibiotic was extensively used to treat American soldiers wounded in World War II. Alexander Fleming while working on <i>Staphylococci</i> bacteria, once observed a mould growing in one of his unwashed culture plates around which <i>Staphylococci</i> could not grow. He found out that it was due to a chemical produced by the mould and he named it Penicillin after the mould <i>Penicillium notatum</i>. <b>However, its full potential as an effective antibiotic was established much later by Ernest Chain and Howard Florey.</b> Fleming, Chain and Florey were awarded the Nobel Prize in 1945, for this discovery</p>
<b>CHEMICALS</b>		
3	<i>Aspergillus niger</i> (a fungus)	Citric acid

4	<i>Acetobacter aceti</i> (a bacterium)	Acetic acid
5	<i>Clostridium butylicum</i> (a bacterium)	Butyric acid
6	<i>Lactobacillus</i> (a bacterium)	Lactic acid.
7	<i>Saccharomyces cerevisiae</i> (Yeast)	Commercial production of Ethanol
<b>ENZYMES</b>		
8	Lipases from Microbes	Lipases are used in detergent formulations and are helpful in removing oily stains from the laundry
9	Pectinases and Proteases from microbes	For clarification of bottled juices
<b>BIOACTIVE MOLECULES</b>		
10	<i>Streptococcus</i> (bacterium)	Streptokinase produced by the bacterium <i>Streptococcus</i> is used as a ' <b>clot buster</b> ' for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack.
11	<i>Trichoderma polysporum</i> (fungus)	<ol style="list-style-type: none"> <li>1. Produces cyclosporin A, that is used as an <b>immunosuppressive agent</b> in organ-transplant patients.</li> <li>2. Free-living fungi very common in the root ecosystems. They are effective <b>biocontrol agents</b> of several plant pathogens.</li> </ol>
12	<i>Monascus purpureus</i> (yeast)	<p>Produces Statins which is used as <b>blood-cholesterol lowering agents</b>.</p> <p>It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol</p>

### Microbes in sewage treatment

In primary treatment of sewage water there is physical removal of small and large particles through sedimentation and filtration. The sewage water is then subjected to secondary or biological treatment where aerobic microbes (called flocs consisting of masses of bacteria and fungus) grow and reduce the Biochemical Oxygen Demand(BOD). The effluent is then passed to settling tank where the bacterial flocs are allowed to sediment. The sediment is called activated sludge. Activated sludge is pumped into Anaerobic Sludge Digesters. Here anaerobic bacteria digest the floc and produce methane, carbon dioxide and hydrogen sulphide. These gases form the biogas.

### **Primary treatment :**



### **Secondary treatment or Biological treatment :**

Primary effluent is passed into large aeration tanks (constantly agitated mechanically and air is pumped into it).



Useful aerobic microbes grow into **flocs** (masses of bacteria associated with fungal filaments to form mesh like structures).



Microbes consume the major part of the organic matter in the effluent. This significantly reduces the **BOD (biochemical oxygen demand)** of the effluent.

**(BOD refers to the amount of the oxygen that would be consumed if all the organic matter in one liter of water were oxidised by bacteria.)**



The sewage water is treated till the BOD is reduced. (**The greater the BOD of waste water, more is its polluting potential.**)



Once the BOD of sewage or waste water is reduced significantly, the effluent is then passed into a **settling tank** where the bacterial 'flocs' are allowed to sediment. This sediment is called **activated sludge**.



A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum.



The remaining major part of the sludge is pumped into large tanks called **anaerobic sludge digesters**.



**Anaerobic bacteria**, digest the bacteria and the fungi in the sludge. During this digestion, bacteria produce a mixture of gases such as **methane, hydrogen sulphide and carbon dioxide**. These gases form **biogas** and can be used as source of energy as it is inflammable.

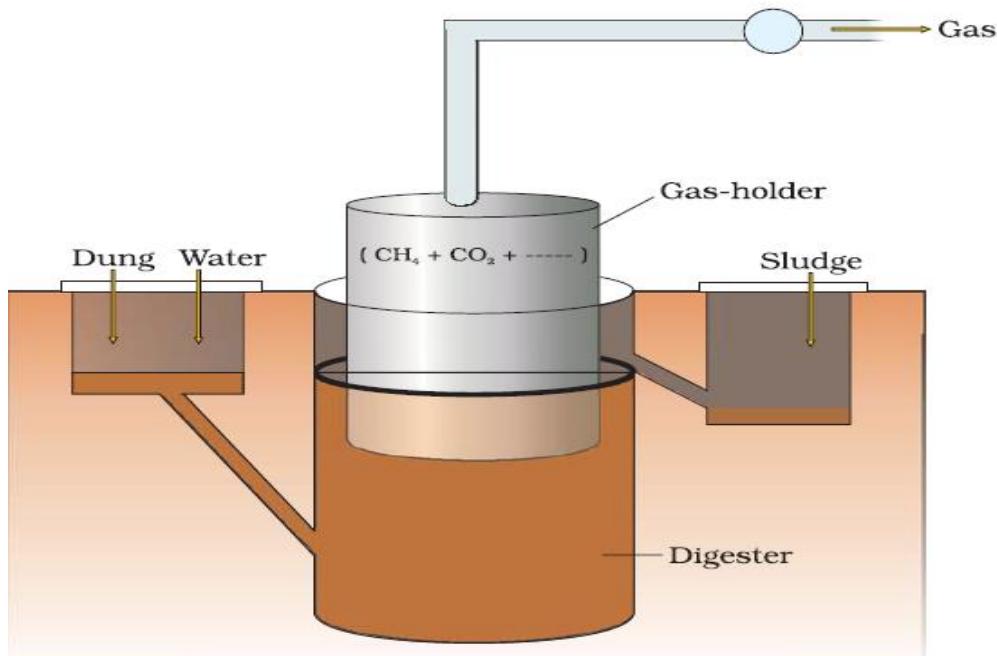


The effluent from the secondary treatment plant is generally released into natural water bodies like rivers and streams.

S.NO	PRIMARY SLUDGE	ACTIVATED SLUDGE
1	Produced during primary treatment of sewage water.	Produced during secondary treatment of sewage water.
2	Consists of grit (soil and small pebbles)	Consists of Bacterial 'Flocs' (masses of bacteria associated with fungal filaments to form mesh like structures).
3	It does not serve as an inoculum.	A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum.
4	Biogas is not formed from it.	Biogas is formed from it.

The Ministry of Environment and Forests has initiated **Ganga Action Plan** and **Yamuna Action Plan** to save these major rivers of our country from pollution. Under these plans, it is proposed to build a large number of sewage treatment plants so that only treated sewage may be discharged in the rivers.

### **Microbes in biogas production-**



**Microbes as biofertilisers-** Biofertilisers are the microbes which enrich the nutrient quality of the soil.

- Symbiotic association of fungus with plants is called mycorrhiza. Fungal partner absorbs phosphorus from soil and passes it to the plant. Such plants are also resistant to pathogens, tolerant to salinity and draught.
- Cyanobacteria like Anabaena, Nostoc and Oscillatoria in paddy fields serve as important biofertilisers.
- Symbiotic bacteria like Rhizobium can fix atmospheric nitrogen which is used by the plants.

### **QUESTIONS FOR PRACTICE**

#### **(2 MARKS)**

- Name two alcoholic drinks produced in each of the following ways.  
(i) by distillation and (ii) without distillation.

2. Lactic Acid Bacteria (LAB) is commonly used in the conversion of milk into curd. Mention any two other functions of LAB that are useful to humans.
3. How do mycorrhizae function as biofertilisers? Explain with example.
4. Cyanobacteria (Nostoc, Anabaena) are used as biofertilisers in certain crop fields. Name such one crop. Also, mention the names of two other microorganisms which perform the same function.
5. Which Ministry of Govt. of India had initiated Ganga Action Plan and Yamuna Action Plan? What are the objectives of these plans?

**(3 MARKS)**

1. Fill in the blanks spaces a, b, c, d, e, and f, given in the following table:

<i>S. No.</i>	<i>Name of Organism</i>	<i>Commercial Product</i>	<i>Application</i>
1	<i>Penicillium notatum</i>	Penicillium	(a)
2	(b)	Lactic acid	Making Curd.
3	<i>Streptococcus</i>	Clot buster enzyme	(c)
4	<i>Trichoderma polysporum</i>	(d)	Immuno suppressive agent
5	<i>Saccharomyces cerevisiae</i>	Ethanol	(e)
6	(f)	Swiss cheese	Food Product
7			
8			

2. . What is biochemical oxygen demand (BOD) test? At what stage of Sewage treatment this test is performed? BOD level of three samples of water labelled as A, B and C are 30 mg/ L, 10mg/L and 500 mg/L respectively. Which sample of water is most polluted?
3. . What are biofertilisers? A farmer is advised to add a culture of bacterium in the soil before sowing the crop. Name the bacterium in the culture. How is this bacterium useful to the crop?
- 4 . What are statins? Name the microorganism that produces this substance. How is it medically important?

**(5 MARKS)**

1. How does primary sludge differ from activated sludge? What type of changes in the sludge are carried out in anaerobic sludge digester? Give the composition of biogas produced in the sewage treatment plant.

## **ANSWERS**

**(2 MARKS)**

1. (i) Whisky, brandy, rum . by distillation  
(ii) Wine, beer . without distillation
2. . (i) LAB in human intestine synthesizes Vitamin B12.  
(ii) LAB in human stomach checks the growth of harmful microbes.
3. . Mycorrhiza are fungi associated with the roots of plants. Many members of genus Glomus form mycorrhiza. These fungal symbiont absorbs water and minerals like phosphorus from the soil and provide them to the plant.

4. Paddy (Rice Crop), *Rhizobium* and Azotobacter.
5. The Ministry of Environment and Forests. q The objective of Ganga Action Plan and Yamuna Action Plan is to save these rivers from pollution. It was proposed to build a large number of sewage treatment plants. So that only treated sewage may be discharged into these rivers.

**(3 MARKS)**

1. (i) to kill disease causing bacteria
- (b) Lactobacillus
- (c) remove clots from blood vessels
- (d) Cyclosporin A
- (e) Beverage/medicines
- (d) *Propionibacterium sharmanii*.

2. The BOD test measures the rate of uptake of oxygen by microorganisms in a sample of water.

Biological treatment or Secondary treatment

Sample .C. is most polluted because it has highest BOD level among the three samples of water.

3. Biofertilisers are organisms that enrich the nutrient quality of the soil.

Azotobacter/Azospirillum (free living)

This bacterium fixes atmospheric nitrogen into organic forms, which is used by the plants as nutrient.

- 4 Statins are cholesterol reducing agents.

They are produced by *Monascus purpureus* (Yeast)

They act by Competitively inhibiting the enzymes responsible for synthesis of cholesterol and are used as blood cholesterol lowering agents.

**(5 MARKS)**

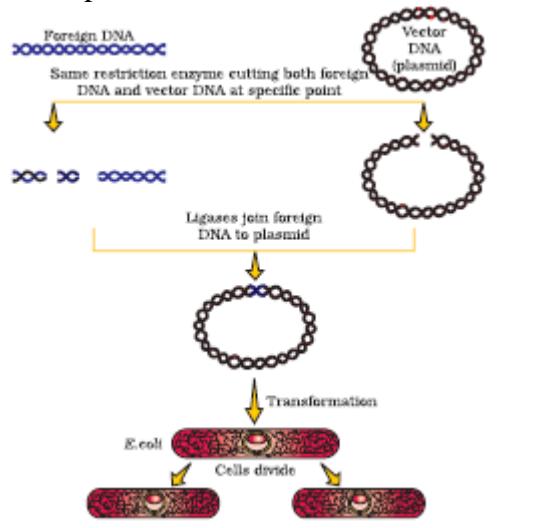
1. Primary sludge is all solids like soil, small pebbles that settle down in settling tank during primary treatment of sewage. Activated sludge is the sediment of bacterial flocs. in settling tank during biological treatment. Flocs are masses of bacteria held together by slime and fungal filaments. A part of activated sludge is used as inoculum in aeration tank and remaining is passed into a large tank called anaerobic sludge digester. In this tank, other kind of bacteria which grow anaerobically, digest the bacteria, fungi and biomass in the sludge. Biogas that produced in Sewage treatment plant is a mixture of methane, hydrogen and Carbon dioxide.

IF YOU  
*Believe*  
 IN YOURSELF  
*Anything*  
 IS POSSIBLE

## Unit-Biotechnology

### **Ch-11-Biotechnology-Principles and processes**

rDNA technology-Schematic representation



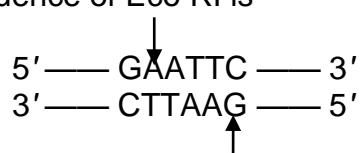
### **TOOLS OF rDNA Technology**

1. **Restriction enzymes**- These are the enzymes which cut the DNA into fragments. Two types-exonucleases and endonucleases
  - a) Exonucleases remove nucleotides from the end of the DNA.
  - b) Endonucleases cut the DNA at specific sequence called pallindromic sequence within the DNA. Restriction endonucleases are used in genetic engineering and called the '**molecular scissors**'. Pallindromic sequence for restriction endonuclease Eco R1 is



Pallindrome in DNA is a sequence of base pairs that reads same on two strands when orientation of reading is kept the same( 5'-3').

Eg. : Recognition sequence of Eco RI is



First restriction endonuclease isolated was Hind II

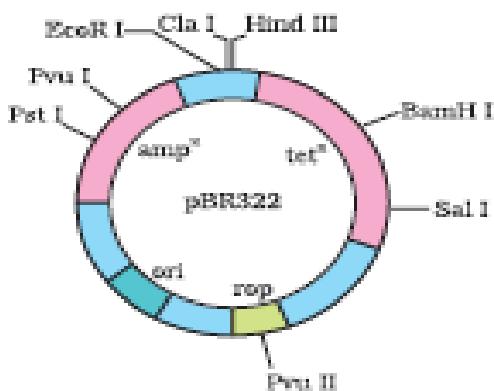
### CONVENTION FOR NAMING THESE ENZYMES

First letter of name comes from genus name, 2nd two letters from species of the prokaryotic cell from which they were isolated. Eg : Eco RI isolated from Escherichia coli RY13. R is the name of the strain i.e. RY 13. Roman number in Eco RI indicates the order in which the enzyme was isolated.

2. **Cloning vectors-** Vectors are the carriers of foreign gene. They are used to carry this foreign gene into the host. Cloning vectors used in rDNA technology are plasmids, bacteriophages, Ti plasmid of Agrobacterium tumefaciens (a bacterium ) in dicots, retroviruses for animals, pBR322 (Plasmid Boliver Rodriguez, named after the scientist) are commonly used vectors

#### Characters of a cloning vector-

- a) It should have **origin of replication** (ori).
- b) It should have a **selectable marker** which helps in identifying and eliminating non-transformants and selectively permitting the growth of transformants. The genes encoding resistance to antibiotics like ampicillin, tetracycline, etc are used as useful selectable markers for E.coli.
- c) It should have very few or single **recognition site** for restriction enzyme
- d) Diag. of pBR322

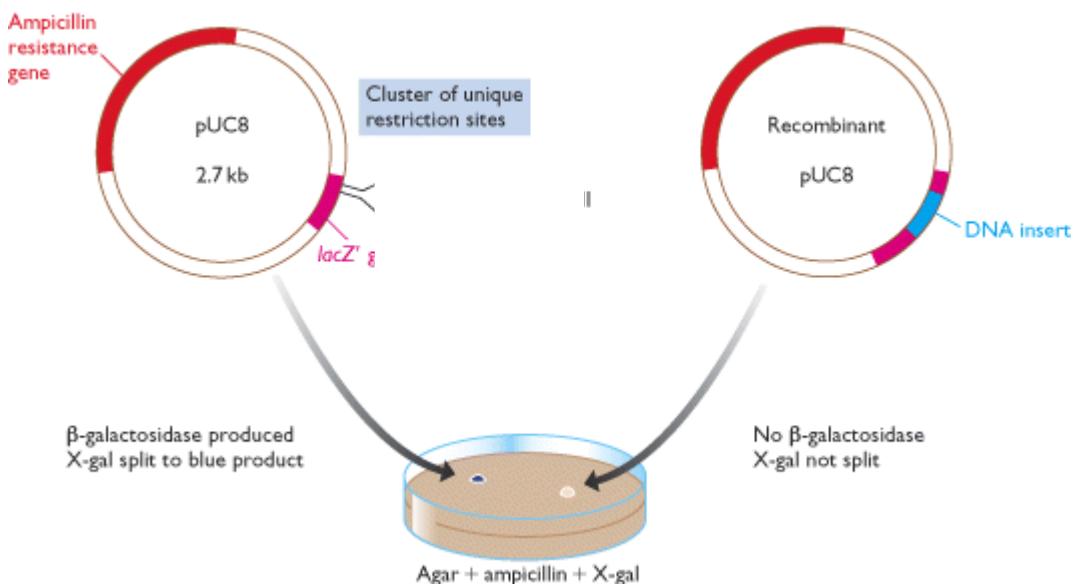


**Insertional inactivation** ; Inactivation of gene due to insertion of foreign DNA into it is called insertional inactivation.

**Example:** selectable marker in pUC8 plasmid is the Lac Z gene coding for  $\beta$ -galactosidase.

- I. If an *E. coli* with pUC8 plasmid is grown in a nutrient medium containing X-Gal (chromogenic substrate) then the  $\beta$ - galactosidase coded by Lac Z gene will digest X-Gal and produce a blue colored product which will make the bacterial colonies blue.
- II. If an alien DNA is inserted in the Lac Z gene, then it will be inactivated and it no more be producing  $\beta$ - galactosidase. This in turn will not metabolise X-Gal. So colorless colonies will be produced by such bacteria.

- III. We can easily identify colorless recombinant colonies from blue colored non-recombinant colonies.



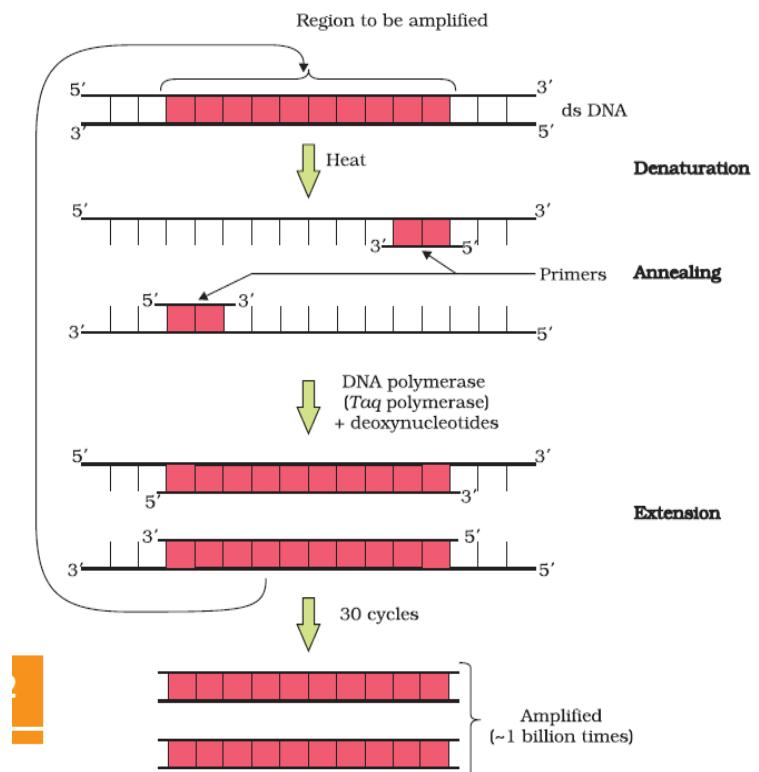
### 3 Competent Host :

- DNA being hydrophilic can not pass through the hydrophobic cell membrane. Bacterial cell is made competent by treating it with divalent ion i.e.  $\text{Ca}^{2+}$ . Then the rDNA is incubated with the cell on ice which is followed by a brief heat shock ( $42^0 \text{ C}$ ) and finally incubating it on ice. This creates pore in cell wall through which rDNA enters. This technique is called transfection.
- Microinjection** : rDNA directly injected into the nucleus of animal cell.
- Biolistics / Gene Gun**: Plant cells bombarded with high velocity microparticles of gold / tungsten coated with rDNA.
- Electroporation** : Electric current creates microscopic pores in host cell membrane through which foreign DNA enters.

### PROCESSES OF RECOMBINANT DNA TECHNOLOGY

Steps involved are :

- Isolation of genetic material DNA**: Bacterial/ plant/ animal cells treated with enzymes like lysosyme ( bacteria), cellulose ( plant cell), chitinase ( fungal cell) to remove cell walls.  
RNA removed by ribonuclease. Proteins removed by protease. Lipids removed by lipases. Other molecules removed by appropriate treatment.  
Purified DNA precipitates out after addition of chilled ethanol. Precipitated DNA removed by spooling. DNA appears to be a collection of fine threads in suspension.
- Cutting of DNA at specific locations**: Purified DNA molecules are incubated with restriction enzymes at optimal conditions. Cut DNA fragments are separated by gel electrophoresis. Then foreign DNA and vector DNA mixed with DNA ligase, thus forming rDNA.
- Amplification of gene of interest using PCR** (Polymerase Chain Reaction) technique:



Taq polymerase isolated from *Thermus aquaticus* is used in PCR because it can synthesis new DNA even at high temperatures.

4. Insertion of rDNA into host cell / organism and selection of recombinants using selectable markers: As discussed earlier.
5. Obtaining foreign gene product : Aim of rDNA technology is to produce desirable protein( foreign gene expresses to form protein)

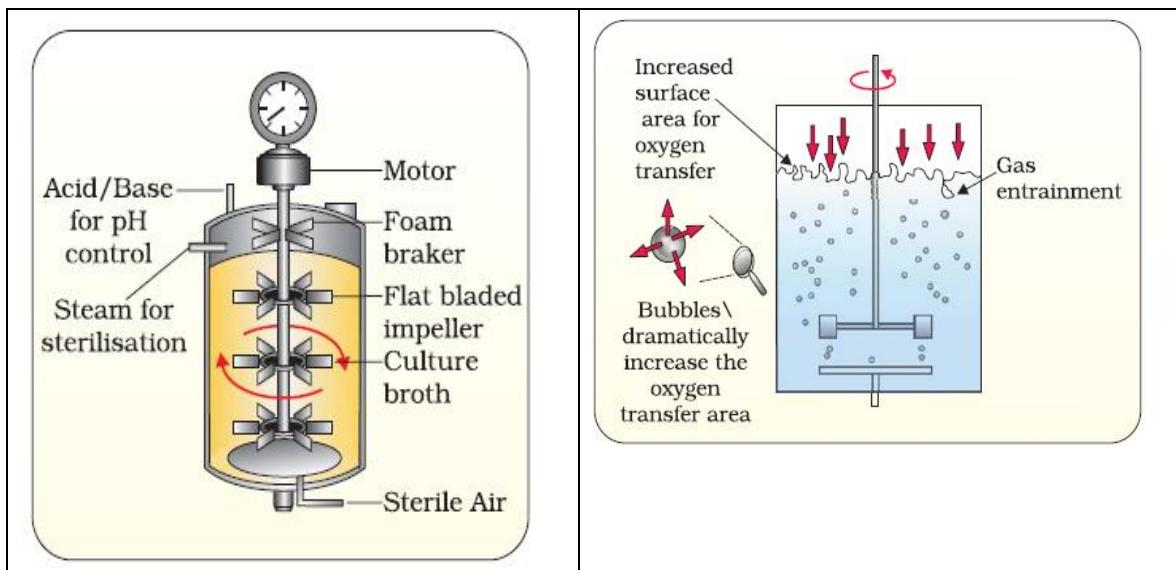
Cells having cloned genes of interest can be grown on a small scale in laboratory and desired protein is extracted and purified by different separation techniques.

The cells are cultured in special vessels called bioreactors. In bioreactors large volumes(100-1000 litres) of culture can be processed.

Bioreactor provides optimum growth conditions like temperature, pH, substrate, salts, vitamins and oxygen.

### **TYPES OF BIOREACTOR**

Simple stirred tank (curved base to facilitate mixing of contents)	Sparged stirred tank (Air is bubbled through the reactor)
--------------------------------------------------------------------	-----------------------------------------------------------



**6. Downstream processing:** Before marketing the product has to be passed through a series of processes :

- Separation and purification of product collectively called downstream processing.
- Addition of suitable preservative.
- Passed through clinical trials.
- Strict quality control testing.

#### **QUESTIONS FOR PRACTICE**

##### **(2 MARKS)**

- Name two main steps which are collectively referred to as downstream process. Why is this process significant?
- How does plasmid differ from chromosomal DNA?
- Mention two classes of restriction enzymes. Suggest their respective roles.
- In the given process of separation and isolation of DNA fragments, some of the steps are missing. Complete the missing steps .

A : Digestion of DNA fragments using restriction endonucleases

B : .....

C : Staining with ethidium bromide

D : Visualisation in U.V. light

E : .....

F : Purification of DNA fragments.

##### **(3 MARKS)**

- Since DNA is a hydrophilic molecule, it cannot pass through cell membranes. Name and explain the technique with which the DNA is forced into (ii) a bacterial cell (ii) a plant cell (iii) an animal cell.
- How will you obtain purified DNA from a cell?
- In recombinant DNA technology, vectors are used to transfer a gene of interest in the host cells. Mention any three features of vectors that are most suitable for this purpose.
- Why is *Agrobacterium*-mediated genetic engineering transformation in plants considered as natural genetic engineering?
- Observe the given sequence of nitrogenous bases on a DNA fragment and answer the following question .

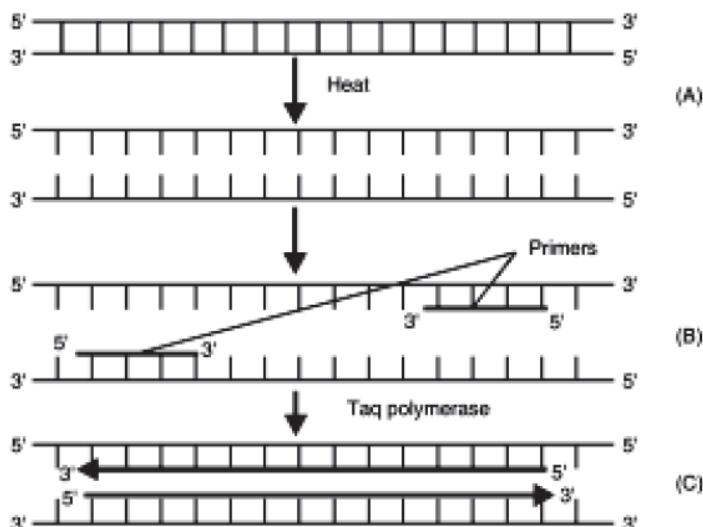
5' . CAGAATTCTTA . 3'

3' . GTCTTAAGAAT . 5'

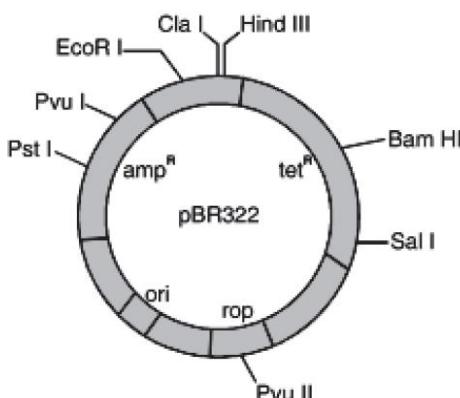
- (a) Name a restriction enzyme which can recognise this DNA sequence.  
(b) Write the sequence after digestion.  
(c) Why are the ends generated after digestion called sticky ends?  
6.. A selectable marker is used in the section of recombinants on the basis of their ability to produce colour in presence of chromogenic substrate.  
(a) Mention the name of mechanism involved.  
(b) Which enzyme is involved in production of colour?  
(c) How is it advantageous over using antibiotic resistant gene as a selectable marker?

**(5 MARKS)**

1. The development of bioreactors is required to produce large quantities of products.  
(a) Give optimum growth conditions used in bioreactors.  
(b) Draw a well labelled diagram of simple stirred . tank bioreactor.  
(c) How does a simple stirred . tank. bioreactor differ from sparged stirred . tank. bioreactor?  
2. In the given figure, one cycle of polymerase chain reaction (PCR) is shown.



- (a) Name the steps A, B and C.  
(b) Give the purpose of each of these steps.  
(c) State the contribution of bacterium *Thermus aquaticus* in this process.  
3. Study the figure of vector pBR322 given below in which foreign DNA is ligated at the Bam H1 site of tetracycline resistance gene.



Answer the following questions :

- (a) Mention the function of rop.

- (b) What will be the selectable marker for this recombinant plasmid and why?  
(c) Explain transformation

## ANSWERS (2 MARKS)

1. . Separation and Purification

This process is essential because before reaching into market, the product has to be subjected for clinical trial and quality control.

2.

**Plasmid DNA**

- (i) Circular DNA
- (ii) Occurs only in bacterial cells
- (iii) Used as Vector in rDNA technology

**Chromosomal DNA**

- (i) Linear DNA
- (ii) Occurs in nucleus of eukaryotic cells and bacterial cell.
- (iii) Not used as vector in rDNA technology.

3 Exonucleases and endonucleases

Exonucleases remove nucleotides from the ends of the DNA.

Endonucleases cut DNA at specific sites between the ends of DNA.

4 . B . Gel Electrophoresis

E . Elution

### (3 MARKS)

1. . (i) Chemical treatment and exposure to cold and high temp. ( $42^{\circ}\text{C}$ ) alternatively.  
(Bacterial cell)

(ii) Biolistics or gene gun. (Plant cell)

(iii) Micro-injection. (animal cell)

2. Cells are treated with appropriate enzymes to release DNA. Lysozyme (bacteria), cellulase (plant cells), chitinase (fungus). RNA and proteins are removed by treatment with ribonuclease and protease enzymes respectively.

3.. (ii) Have origin of replication(Ori)

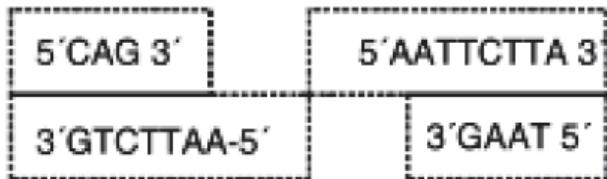
(ii) Have a selectable marker

(iii) Have at least one recognition site.

4. *Agrobacterium tumefaciens* is a pathogen in many dicot plants. It is able to deliver a piece of DNA (T.DNA) to transform normal plant cell into a tumor and directs these tumor cells to produce the chemicals required by pathogen.

5. (a) *EcoRI*

(b)



(c) These are named sticky ends, because they form hydrogen bonds with their complementary cut parts.

6.. (a) Insertional inactivation

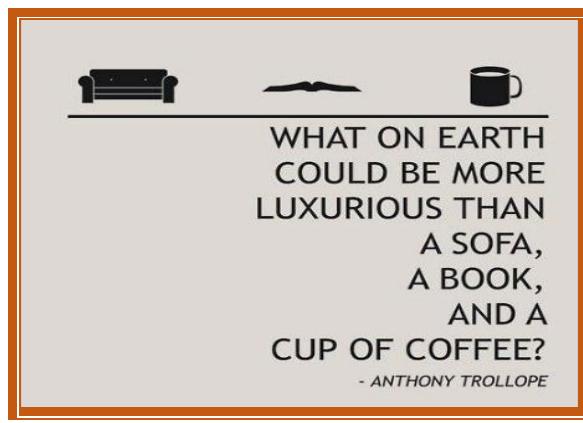
(b) b-galactosidase.

(c) Selection of recombinants due to inactivation of antibiotics requires simultaneous plating on two plates having different antibiotics

### (5 MARKS)

1. (i) Temperature, pH, substrates, salts, vitamins and oxygen.

- (ii) Diagram simple stirred.tank bioreactor
- (iii) The stirrer facilitates even mixing and oxygen availability throughout simple.stirred tank bioreactor, whereas in case of sparged stirred-tank bioreactor, air is bubbled throughout the reactor for proper mixing.
2. (A) **Denaturation** . Heat denatures DNA to separate complementary strands.
- (B) **Annealing** : Primers hybridises to the denatured DNA strands.
- (C) **Extension** : Extension of primers resulting in synthesis of copies of target DNA sequence. Enzyme Tag polymerase is isolated from the bacterium *Thermus aquaticus*. This enzyme induces denaturation of double stranded DNA at high temperature.
3. (a) .rop. codes for the proteins involved in the replication of plasmid (b) Selectable marker . ampicillin resistance gene. It will help distinguishing transformants from non-transformants after plating them on ampicillin containing medium.
- (c) Transformation . It is the phenomenon by which the DNA isolated from one type of cell and introduced into another type and is able to bring about some of the properties of former to the later.



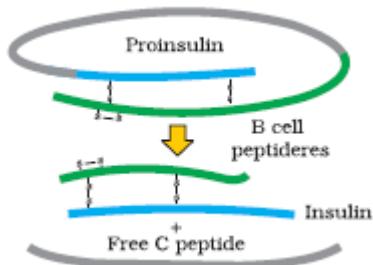
## Ch-12-Biotechnology and its applications

1. **Genetically modified organisms-** The plants, bacteria, fungi and animals whose genes have been altered by manipulation are called Genetically Modified Organisms. Its advantages to crops are-
  - a) Crops are more tolerant to abiotic stresses like cold, drought, etc.
  - b) Reduced dependence of crops on chemical pesticides.
  - c) Reduced post-harvest losses.
  - d) Increased efficiency of mineral usage by plants
  - e) Enhanced nutritional value of food.
2. **RNA interference-**This is the method of silencing of a specific mRNA due to a complementary double stranded RNA molecule that binds to and prevents the translation of the mRNA. This technique is used to make tobacco plants resistant to a nematode, Meloidegyne incognitia.
3. **Bt cotton-** Insecticidal protein produced by bacterium Bacillus thuringensis kill certain insects like lepidopterans(budworm,armyworm),coleopterans(beetles) and dipterans(flies, mosquitoes). The gene encoding this protein is called cry gene which is isolated from bacterium and introduced into crop plants like cotton. Such plants become resistant to insect pests.

This toxin protein doesn't kill the bacterium itself because it exist as inactive protoxin but once an insect ingest the inactive toxin, it is converted into an active form due to alkaline pH of the insect gut. The activated toxin binds to the surface of midgut epithelial cells and create pores that cause swelling and lysis and ultimately death of the insect.

### 4. **Applications of biotechnology in medicine-**

- a) **Genetically Engineered Insulin-** In 1983,an American company Eli Lilly prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of E.coli to produce insulin chains A and B separately. These A and B chains are extracted and combined by creating disulphide bonds to form human insulin.



- b) **Gene Therapy:** Collection of methods that allow correction of gene defect diagnosed in a child/ embryo. Correct genes inserted into the person cell/ tissue to treat the genetic disorder. This is called gene therapy.

**First gene therapy was given in 1990** to a four year old girl with Adenosine Deaminase Deficiency (ADA deficiency). The adenosine deaminase enzyme is required for production of immune response. The girl child lacked the gene which coded for this enzyme.

#### Cure of (ADA deficiency)

- I. Bone marrow transplantation
- II. Enzyme replacement therapy – Functional Adenosine Deaminase is periodically injected into the patient.
- III. Lymphocytes from the patients body are extracted and grown in a culture media. A functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes, which are subsequently returned to the patient. However, as these cells **are not immortal**, the patient requires periodic infusion of such genetically engineered lymphocytes.
- IV. However, if the gene isolate from marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure.

**The first three approaches of cure are not completely curative. The last approach is a permanent cure and called gene therapy.**

- c) **Molecular diagnosis of diseases**-using PCR technique, probe and ELISA
5. **Biopiracy**-It is the use of bioresources by multinational companies and other organizations without proper authorization from the countries and people concerned. Ex-In 1997,an American company got patent rights on Basmati rice. This new variety of Basmati had actually been derived from Indian farmer's varieties.

### **QUESTIONS FOR PRACTICE**

**(2 MARKS)**

1. . What are the two methods for correcting ADA deficiency in a child?
2. . Some crop plants are modified genetically by manipulating their genes. How are they made beneficial?
3. . GEAC is one of the organisation set up by Indian Government. Write its full form. Give its two objectives.
4. . Industrialised nations are exploiting the bioresources of under industrialised nations.. Justify the statement with a suitable example.

**(3 MARKS)**

1. . Some multinational companies and other organisations are using bioresources for commercial benefits, without proper authentication and compensation to concerned authorities.

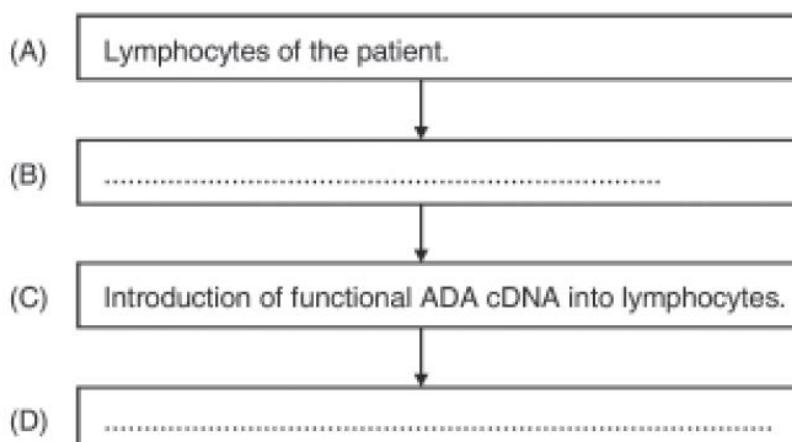
- (a) Give the term for this unauthorised act.  
 (b) Suggest any two ways to get rid of this.

2. A bacterium *Bacillus thuringiensis* produces a toxic protein named *cry c* protein that is lethal to certain insects but not to bacteria

- (a) Why this toxin does not kill the bacteria?  
 (b) What type of changes occur in the gut of insects on consuming this protein?  
 (c) How man has exploited this protein for his benefit?

**(5 MARKS)**

1. The clinical gene therapy is given to a 4 years old patient for an enzyme which is crucial for the immune system to function.



Observe the therapeutical flow chart and give the answer of the following:

- (a) Complete the missing steps (B) and (D)  
 (b) Identify the disease to be cured.  
 (c) Why the above method is not a complete solution to the problem?  
 (d) Scientists have developed a method to cure this disease permanently. How?

2. In the given figure, Form (A) and Form (B) represents different forms of a proteinaceous hormone secreted by pancreas in mammals.



- (a) What type of bonding is present between chains of this hormone?  
 (b) What are these form (A) and form (B). How these forms differ from each other?  
 (c) Explain how was this hormone produced by Eli Lilly, an American company, using rDNA technology.

**ANSWERS**

**(2 MARKS)**

1. Bone marrow transplantation having functional ADA enzyme and Enzyme replacement therapy.
2. More tolerant to abiotic stresses; pest resistant; reduction in post harvest losses; increased nutritional value of food.
3. GEAC . Genetic Engineering approval committee. Objectives of GEAC are

(i) To make decisions regarding validity of GM research.

(ii) Safety of introducing GMO for public use.

4 Industrialised nations are collecting and patenting the genetic resources of under industrialised country like India. An American Company got patent rights on Basmati rice.

Valuable biomolecules obtained from bioresources are patented and used for commercial purposes.

**(3 MARKS)**

1 . (a) Biopiracy

(b) (i) Benefits of bioresources should be shared between developed and developing nations  
(ii) Laws should be developed to prevent unauthorised exploitation of them bioresources.

2. (a) Produced in inactive form as Prototoxins.

(b) Prototoxin becomes active toxin in alkaline pH of gut of insects. Toxins bind to surface of midgut and cause perforation, swelling, lysis of cells ultimately leading to death.

(c) Specific Bt toxin genes isolated from *Bacillus thuringiensis* and incorporated into several crop plants such as cotton and corn which become pest resistant against certain insects.

**(5 MARKS)**

1. (a) Step (B) : Lymphocytes are grown in culture medium.

Step (D) : Infusion of genetically engineered lymphocytes into patients.

(b) Adenosine deaminase (ADA) deficiency.

(c) As genetically engineered lymphocytes are not immortal, the patient requires periodic infusion of cells.

(d) If the gene isolated from bone marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure.

2. (a) Disulphide bonds

(b) Form (A) . Proinsulin

Form (B) . Mature insulin.

Proinsulin contains an extra stretch called C . peptide which is absent in mature insulin.

(c) Eli Lilly company prepared two DNA sequences corresponding to A and B peptide chains of human insulin and introduced them in plasmid *E. coli* to produce insulin chains. Chains A and B were produced separately, extracted and combined by creating disulphide bonds to form insulin.

# Keep going.

Each step may get harder but  
don't stop. The view is  
beautiful at the top!



## Unit-Ecology

### Ch-13-Organisms and population

**Environment:** Is referred to as sum total of all the biotic and physical conditions which influence the organisms in term of survival and reproduction.

#### **Major Abiotic Factors**

- (i) Temperature
- (ii) Water
- (iii) Soil
- (iv) Light

#### **Responses to abiotic factors**

1. **Regulators** -Some organisms maintain homeostasis by physiological means which ensures constant body temperature, osmotic conc. etc. Such organisms are called regulators. Ex- All birds and mammals
2. **Conformers**- Organisms which cannot maintain a constant internal environment. Ex- reptiles, aquatic animals.
3. **Migration**-Temporary movement of organisms from the stressful habitat to a more hospitable area and returning when favorable conditions reappear. Eg. birds.
4. **Suspend**-Some organisms under unfavorable conditions slow down metabolic rate and pass through unfavorable conditions. Eg hibernation-winter sleep, aestivation-summer sleep, diapause zooplanktons,

#### **Population Attributes:**

**Population** is defined as the total number of individuals of a species in a particular geographical area which can interbreed amongst themselves to produce fertile off spring and function as a unit of biotic community.

#### **Characteristics of population;**

1. Population Size or Density number of individuals of a species per unit area or volume.
2. Birth or natality rate It is expressed as the number of births per 1000 individuals of a population in a year.
3. Death or mortality rate It is expressed as the number of deaths per 1000 individuals of a population per year.

4. Sex Ratio It is expressed as number of females per thousand males of a population in a given time..

### Growth models- Two growth models

- Exponential growth-When resources in the habitat are unlimited, each species has the ability to grow exponentially or geometrically. Such type of growth is called exponential growth.(graph page 230 of NCERT) It is represented by the following equation:

$$dN/dt = (b-d)x n$$

Let  $(b-d) = r$ , then

$$dN/dt = rN$$

where  $r$  is the ‘intrinsic rate of natural increase’

$N$  is the population size

$b$  is the birth rate

$d$  is the death rate

Integral form of above equation is  $N_t = N_0 e^{rt}$

Where  $N_t$  = Population density after time  $t$

$N_0$ = Population density after time zero

$e$  = the base of natural logarithm

$r$  = intrinsic rate of natural increase.

- Logistic growth- A population growing in a habitat with limited resources show initially a lag phase, followed by phases of acceleration and deceleration and finally stable when the population density reaches the carrying capacity. It results in a sigmoid curve. This type of population growth is called Verhulst-Pearl Logistic Growth. (graph page 230 of NCERT). It is represented by the following equation:

$$dN/dt = rN(K-N/ K)$$

where  $N$  = Population density at time  $t$

$r$  = intrinsic rate of natural increase

$K$  = Carrying capacity

Out of these growth models, logistic growth model is considered more realistic one because resources are never unlimited.

5. **Carrying capacity**- A given habitat has enough resources to support a maximum possible number, beyond which no further growth is possible. This is called carrying capacity of that habitat.
6. **Population interactions**-In any natural habitat, there is always interaction of populations of two different species. This interaction may be beneficial, detrimental or neutral to one of the species or both. These interactions are as follows:

- Predation:In this, one species preys upon other species. So one of them is benefited and other is harmed. Predators play important roles in ecosystem:
  - a) Keep prey population under control.
  - b) Biological control methods used in agricultural pest control are based on the ability of the predator to check prey population.
  - c) Maintain species diversity in a community by reducing the intensity of competition among competing prey species.

Defence mechanisms in plants against herbivory- For plants herbivores are the predators. a) morphological defences- thorns in Acacia, Cactus; b)chemical defences- Calotropis produces poisonous cardiac glycosides. That's why cattle or goats don't browse on it.

- Competition- Fitness of species is lowered in the presence of other species. Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one will be eliminated eventually. This is true only if resources are limiting otherwise not.

Competitive Release- A species, whose distribution is restricted to a small geographical area because of the presence of competitively superior species, is found to expand its distributional range when the competitive species is experimentally removed.

- Parasitism- Parasitic mode of life ensures free boarding and lodging. One species benefited and other is harmed. Parasites have evolved special adaptations like loss of sensory organs, presence of adhesive organs or suckers, loss of digestive system and high reproductive capacity. Ex- ectoparasites like lice on humans, cuscuta on hedge plants; endoparasites like sheep liver fluke, tapeworm in humans; brood parasitism in birds( crow incubates the eggs of cuckoo).
- Commensalism- One species benefits and other one neither harmed nor benefited. Ex- orchid growing as an epiphyte on a mango branch, barnacles growing on the back of a whale, cattle egret and grazing cattle, sea anemone and clown fish( fish gets protection due to stinging cells of sea anemone, but sea anemone derives no benefit.)
- Mutualism- Both the interacting species benefited. Ex- lichens( mutualism between algae and fungi), mycorrhizae( mutualism between fungus and roots of higher plants), plant-pollinator relationship.

Sexual deceit- The Mediterranean orchid Ophrys employs sexual deceit to get pollinated by bee. One petal of its flower resembles female bee in size, color and markings. The male bee is attracted to it, 'pseudocopulates' with the flower, pollens attach to its body. When the same bee pseudocopulates with another flower, it transfers pollen to it and thus pollinates the flower. Here co-evolution operates. If the female bee's color patterns change during evolution, pollination success will be reduced unless the orchid flower co-evolves to maintain resemblance of its petal

### **QUESTIONS FOR PRACTICE**

**(2 MARKS)**

- 1.Mention the attributes which a population has but not an individual Organism.
- 2.What are the four ways through which the living organisms respond to abiotic factors?
- 3Why do clown fish and sea anemone pair up? What is this relationship called?
- 4.Name two basic type of competition found amongst organisms? Which one of them is more intense and why?

**(3 MARKS)**

- 5.How do snails,seeds,bear,zooplanktons,fungi and bacteria adapt to conditios unfavourable for their survival?
- 6Name the type of interaction seen in each of the following cases
  - (a)Ascaris worm living in the intestine of human beings
  - (b)Wasp pollinating fig inflorescence
  - (c) Orchid living on the branch of mango tree
  - (d)Mycorrhizae living on the roots of higher plants.
    - (e) Algae and fungi in lichens
    - (f) Egrets with cattle

7.(a)A parasite has to adapt to be able to live in the host. Write the various parasitic adaptations?

b)What is special about interaction between koel and cuckoo?

8. (a)Explain any two defence mechanisms plants evolved against their predators.

(b)How does predation differ from parasitism?

**(5MARKS)**

9. (a) State how the constant internal environment is beneficial to organisms? (b) Explain any three alternatives by which organisms beat unfavourable conditions?

10.Why are herbivores considered similar to predation in the ecological concept? Explain.

11.Differentiate between

- (i)Mutualism and Competition
- (ii)Commensalism and Ammensalism

**ANSWERS**

1The attributes that populations but not individuals possess are

- a)Population density
- b)Mortality
- c)population growth
- d)Natality
- e)Sex ratio
- f)Age distribution.

2Regulate,Conform,Migrate and Suspend

3.The interaction between clown fish and sea anemone is called commensalism.Sea anemone is unaffected but clown fish protected due to stinging tentacles of sea anemone.

4.Interspecific and Intraspecific competition

Intraspecific competition is more severe as requirements of individuals is same.

5 Snail---aestivation

Seeds---dormancy

Bear---Hibernation

Zooplankton---Diapause

Fungi----spore

Bacteria---cyst/spore

6. Parasitism

Mutualism

Commensalism

Mutualism

Mutualism

Commensalism

7. Page 235 NCERT last para

8. Page 234 NCERT 1<sup>st</sup> para

9. Page 224 and 225 NCERT

10. and 11 Page 235,236 and 237 of NCERT

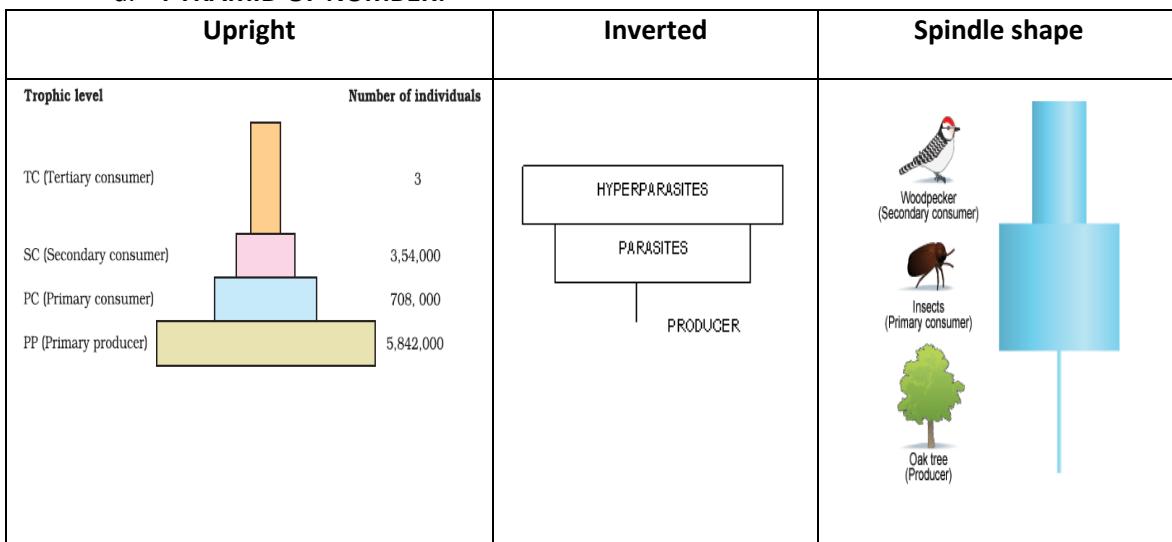
**SMILE AND LET  
EVERYONE KNOW  
THAT TODAY,  
YOU'RE A LOT  
STRONGER THAN  
YOU WERE  
YESTERDAY.**

### **Ch-14- Ecosystem**

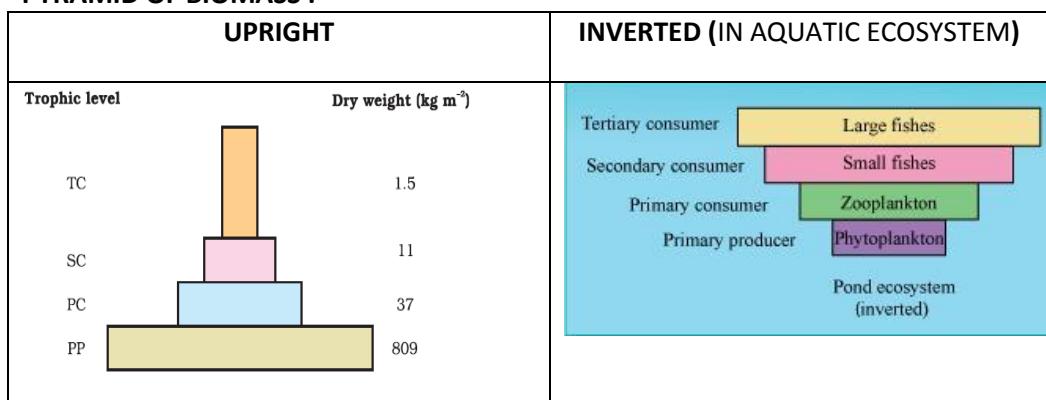
1. **Productivity**-The rate of biomass production is called productivity. It is expressed in terms of  $\text{g}^{-2}\text{yr}^{-1}$  or  $(\text{kcal m}^{-2}) \text{ yr}^{-1}$ . Two types: primary and secondary
  - **Primary productivity:** The amount of biomass produced per unit area over a time period by plants during photosynthesis is called primary productivity.
    - a. **Gross primary productivity:** The rate of production of organic matter during photosynthesis is called gross primary productivity.
    - b. **Net primary productivity:** Gross primary productivity minus respiration losses (R) by the plant is called net primary productivity(NPP) i.e.  $\text{GPP}-\text{R} = \text{NPP}$
  - **Secondary productivity:** Rate of formation of new organic matter by consumers is called secondary productivity.
2. **Decomposition:** The process of breakdown of complex organic matter into inorganic substances like  $\text{CO}_2$ , water and nutrients by the decomposers is called decomposition. It involves following steps:
  - **Fragmentation:**It is the process of breakdown of detritus into smaller particles by the detritivores (e.g., earthworm). **Detritus** means the dead plant remains like leaves, bark, flowers and dead remains of animals including faecal matter.
  - **Leaching:** Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.
  - **Catabolism:** Bacterial and fungal enzymes degrade detritus into simpler inorganic substances.
  - **Humification:** Formation of a dark colored amorphous substance called humus that is highly resistant to microbial action and decomposes at a very slow rate.
  - **Mineralisation:**It is the further degradation of humus by some microbes to release inorganic nutrients.
3. **Grazing food chain:** It starts with the producers
4. **Detritus food chain:** It starts with dead organic matter.

## 5. ECOLOGICAL PYRAMID

### a. PYRAMID OF NUMBER:

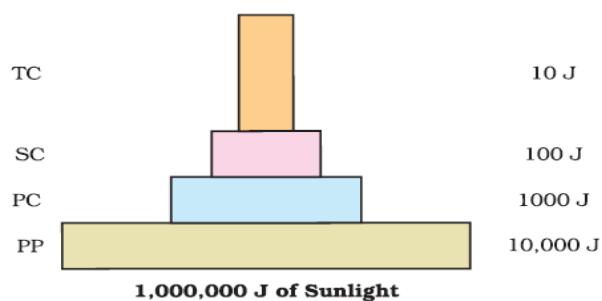


### b. PYRAMID OF BIOMASS :



### c. PYRAMID OF ENERGY:

Always upright according 10% law



6. **Ecological succession:** The gradual and predictable change in the species composition of a given area is called ecological succession. During succession, one species colonise an area whereas other species decline and even disappear.

Succession is of two types: primary and secondary. **Primary succession** starts where no living organisms ever existed like bare rock, newly cooled lava, newly created pond. **Secondary succession** starts in area that lost all the living organisms that existed there like abandoned farmlands, burned forests,

flooded lands, etc. Secondary succession is faster than primary succession because some soil or sediment is present during secondary succession.

6.

<p><b>Hydrarch succession:</b> Succession of plants in water.</p> <p><b>Pioneer species</b> which invades water is <b>phytoplankton</b>. They are replaced by submerged plant stage, free floating plant stage, reed swamp stage, marsh meadow stage, scrub stage and finally <b>climax community of forest</b>.</p>	<p>The diagram shows a sequence of seven stages of plant succession in water. 1. Phytoplankton: A small patch of green phytoplankton on the water surface. 2. Reed-swamp stage: A dense stand of tall, thin reeds growing in shallow water. 3. Submerged plant stage: Various submerged aquatic plants like hydrilla and water hyacinth. 4. Marsh-meadow stage: Dense growth of emergent plants like sedges and grasses. 5. Submerged free floating plant stage: Free-floating plants like water lettuce and duckweed. 6. Scrub stage: Small shrubs and trees like willow and cattails. 7. Forest: A mature forest dominated by large trees like eucalyptus and pine.</p>
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7. **Xerarch succession:** Succession of plants on rocks. Pioneer species is lichens followed by bryophytes, pteridophytes, herbs, shrubs and finally climax community of forest.
8. **Ecosystem services:** The products of ecosystem processes is called ecosystem services, for ex. Forest ecosystem purify air and water, control floods, pollinate crops, etc.

### **QUESTIONS FOR PRACTICE**

**(2 marks)**

1. Differentiate between primary succession and secondary succession.
2. Name the four functional aspects of an ecosystem.
3. How is productivity, gross productivity, net primary productivity and secondary productivity interrelated?
4. List the three parameters used for constructing ecological pyramids. Describe any one instance where the pyramid may look inverted.
5. Name the pioneer and climax species in a water body and a barren rock.

**(3MARKS)**

6. Name any four ecosystem services. Who gave the price tags on nature's life support services? Which is the most important ecosystem service provider?
7. Differentiate between Hydrarch and a xerarch succession.
8. What is the effect on decomposition rate if: –
  - a) Detritus is rich in lignin and chitin
  - b) Detritus is rich in nitrogen and sugars

### (5MARKS)

9. Detrivores like earthworm are involved in the process of decomposition of dead plants and animals. Describe the different steps involved in the process of decomposition .

### ANSWERS

1.Primary Succession begins in an area where no living organisms ever existed.Establishment of a biotic community is very slow Eg newly cooled lava,barren rocks

Secondary succession begins in an area where biotic communities have been destroyed..It is a faster process.Eg abandoned farmland,burnt forest.

2.Functional aspects of an ecosystem are

- Productivity
- Decomposition
- Energy flow
- Nutrient cycle

3.Productivity is the rate of biomass production

$$GPP-R=NPP=1$$

Where NPP is biomass available to consumers for secondary production.

4.The three parameters used are

- (i)Biomass
- (ii)Number
- (iii)Energy

The pyramid of number in a tree ecosystem may look inverted where number of consumers are numerous depending on a single producer.

5. In a water body phytoplanktons-----forest or tree

On a barren rock Lichens-----forest or tree

6. Forest (ecosystem) purify water and air

- Mitigate Droughts and floods
- Nutrient cycling
- Generate fertile soil
- Provide habitat for wildlife
- Pollinate flower
- Maintain Biodiversity
- Provide aesthetic, cultural & spiritual values
- Robert Constanza gave price tags to ecosystem services.
- Most important ecosystem services provider : Soil formation.

7.Hydarch Succession : Starts in water proceeds from hydric (aquatic) to mesic (neither dry nor wet) situations.

Xerarch succession : Starts on barren rock Proceeds from Xeric (dry) conditons.

8. a) Decomposition rate is slower  
b) Decomposition rate is faster.

9.The dead remains of plants and animals called detritus undergo decomposition and are converted into simpler substances. The steps of this process are :

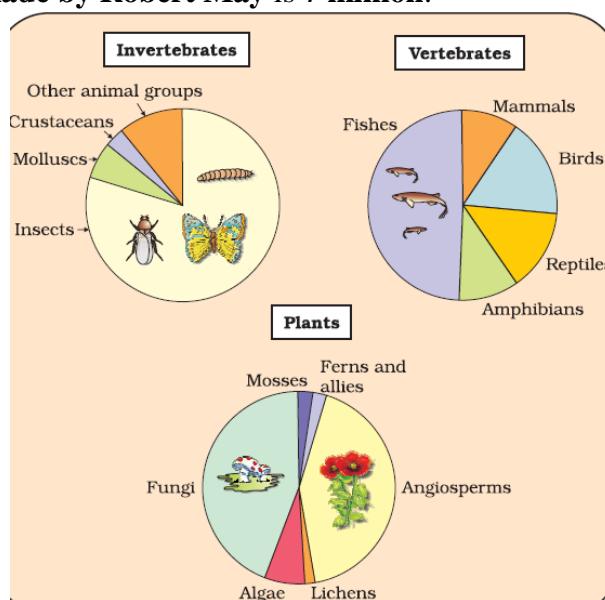
- (i) Fragmentation : Breakdown of detritus into smaller pieces by detritivores like earthworm.
- (ii) Leaching : Water soluble inorganic nutrients go down into soil horizon and get precipitated as unavailable salts.

- (iii) Catabolism : Bacterial and fungal enzymes degrade detritus into simpler inorganic substances.
- (iv) Humification : It leads to accumulation of dark coloured amorphous substance called humus which is highly resistant to microbial action so decomposes at slow rate and is rich in nutrients.
- (v) Mineralization: Humus is further degraded by some microbes and release of inorganic nutrients occurs.



## Ch-15-Biodiversity and conservation

1. **Biodiversity** is the term popularized by the sociobiologist **Edward Wilson**
2. **LEVELS OF BIODIVERSITY (TYPES OF BIODIVERSITY)**
  - (i) **Genetic diversity:** The genetic variation shown by the medicinal plant **Rauwolfia vomitoria** growing in different Himalayan ranges might be in terms of the potency and concentration of the active chemical (**reserpine**) that the plant produces. India has more than **50,000 genetically different strains of rice**, and **1,000 varieties of mango**.
  - (ii) **Species diversity:** For example, the **Western Ghats have greater amphibian species diversity than the Eastern Ghats**.
  - (iii) **Ecological diversity:** At the ecosystem level, India, for instance, with its **deserts, rain forests, mangroves, coral reefs, wetlands, estuaries, and alpine meadows** has greater ecosystem diversity than a Scandinavian country like Norway.
3. According to the IUCN (2004), the total number of plant and animal species described so far is more than 1.5 million
4. Total number of species on earth: Some extreme estimates range from 20 to 50 million, but **sound estimate made by Robert May** is **7 million**.



### NO ESTIMATES FOR NUMBER OF PROKARYOTES ON EARTH

Biologists are not sure about how many prokaryotic species there might be because

- a) **Conventional taxonomic methods** are not suitable for identifying microbial species.
- b) Many species are simply **not culturable** under laboratory conditions.

- c) If we accept **molecular criteria**, then their diversity alone might run into **millions**.

**What is so special about tropics that might account for their greater biological diversity?**

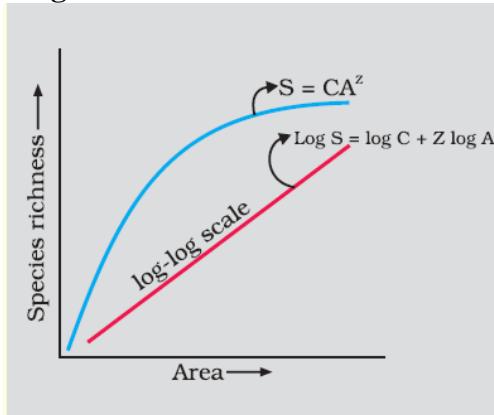
Ecologists and evolutionary biologists have **proposed various HYPOTHESES**;

- (a) **Tropical latitudes** have remained **undisturbed for millions of years**
- (b) **Tropical environments** are less seasonal, relatively more constant and predictable.
- (c) There is **more solar energy in the tropics**

5. **Species-area relationship:** On a **logarithmic scale**, the relationship is a **straight line** described by the equation

$\log S = \log C + Z \log A$  where  $S$ = Species richness,  $A$ = Area,  $Z$  = slope of the line (regression coefficient),  $C$  = Y-intercept

The value of  $Z$  lies in the range of 0.1 to 0.2, regardless of the taxonomic group or the region



Shape of graph: **Rectangular hyperbola**.

6. **David Tilman's long-term ecosystem experiments:** Tilman found that **plots with more species** showed **less variation in total biomass** and had **higher productivity**.

7. **THE 'RIVET POPPER HYPOTHESIS'** by Stanford ecologist **Paul Ehrlich**.

In an airplane (ecosystem) all parts are joined together using thousands of **rivets** (species). If every passenger traveling in it starts **popping a rivet** to take home (causing a species to become extinct), the plane becomes dangerously weak over a period of time. Furthermore, which rivet is removed may also be critical. Loss of rivets on the wings (key species that drive major ecosystem functions) is obviously a **more serious threat to flight safety** than loss of a few rivets on the seats or windows inside the plane.

#### 8. **Loss of Biodiversity**

The IUCN Red List (2004) documents the extinction of **784 species** (including 338 vertebrates, 359 invertebrates and 87 plants) in the **last 500 years**.

9. Some examples of **recent extinctions** include the **dodo (Mauritius)**, **quagga (Africa)**, **thylacine (Australia)**, **Steller's Sea Cow (Russia)** and **three subspecies (Bali, Javan, Caspian) of tiger**.

10.

S.No.	<b>Five episodes of mass extinction</b>	<b>Sixth Extinction</b>
1	In pre-human times	Due to human activities
2.	Slower rate	100 to 1,000 times faster than Five episodes of mass extinction

11. **Causes of biodiversity losses (Evil quartet):**

- a) Habitat loss and fragmentation: Amazonian Rain forest cut and cleared for soyabean cultivation or converted into grassland
- b) Over-exploitation: extinction of Steller's sea cow
- c) Alien species invasion like Parthenium, water- hyacinth. The recent **illegal introduction** of the **African catfish *Clarias gariepinus*** for aquaculture purposes is posing a threat to the **indigenous catfishes in our rivers**.  
The **Nile perch** introduced into **Lake Victoria** in east Africa led eventually to the **extinction** of an ecologically unique assemblage of **more than 200 species of cichlid fish** in the lake.
- d) Co-extinctions: for ex. When a host fish becomes extinct, parasites also become extinct.

## 12. Reasons to conserve biodiversity :

- a) Narrowly utilitarian arguments: Humans derive many economic benefits from nature-food, firewood, fibre, industrial products and products of medicinal importance.
- b) Broadly utilitarian arguments: balance atmospheric gases, pollination, aesthetic pleasures.
- c) Ethical arguments: Philosophically or spiritually, we need to realize that every species has an intrinsic value.

## 13. Conservation of biodiversity:

### a) In situ conservation: On site conservation.

- 1. **Biosphere reserves**(14), national parks(90), and sanctuaries(448) in India.

### 2. Biodiversity hotspots: critieria for hotspot

- a) regions with very high levels of species richness
- b) regions with endemism( species confined to that region and not found anywhere else).

Initially biodiversity hotspots were 25 in number but now it is 34 in the world. **Three of them in our country**-Western Ghats and Sri Lanka, Indo-Burma and Himalaya.

- 3. **Sacred grooves** in Aravalli Hills of Rajasthan, Khasi and Jantia Hills in Meghalaya.

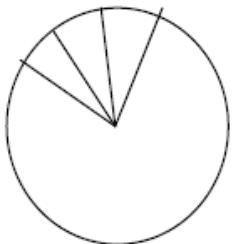
### b) Ex situ conservation: Off site conservation.

Threatened animals and plants are taken out of their natural habitat and placed in special setting where they can be protected and given special care. Zoological parks, botanical gardens and wildlife safari parks, pollen banks, seed banks.

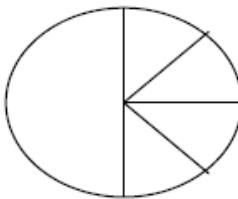
## Questions for practice

1. Reserpine is obtained from a plant found in Himalayan ranges. Name the plant.
2. What is the approximate no of plant and animal species described so far by IUCN (2004) report?
3. Western Ghats have greater amphibian species diversity than Eastern Ghats. Why?
4. Which type of graph curve is obtained when species richness is plotted against area?
5. Who proposed rivet popper hypothesis? Describe this hypothesis briefly.
6. Name a few weeds that have invaded our crop fields as alien species. Why these have become uncontrollable?
7. Which type of organism are prone to co extinction and why?
8. Categorize the following into in-situ and ex-situ approaches of biodiversity conservation.
  - i) Botanical gardens ii) Wild life sanctuaries iii) Gene bank
  - iv) Biosphere reserves v) Sacred forests/lakes vi) Pollen banks

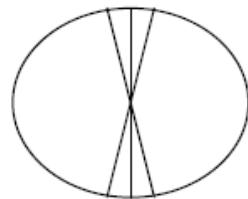
- vii) Tissue culture viii) Cryo-preservation
9. Since the origin of life on earth and evolution there have been 5 episodes of mass extinction, but the current rate of extinction is 100-1000 times. What are the main causes of high extinction rate and how is it going to harm human beings
  10. The invasion of alien species is responsible for extinction of the indigenous species. Give 2 examples to support this statement.
  11. If a species of fish becomes extinct, all those parasites, specific to that fish also face extinction. Which of the major cause describe as “the evil Quartet’s is being accounted?
  12. Categorize the followings statement into narrowly utilitarian, broadly utilitarian and ethical reason:-  
 i) Every species in biodiversity has an intrinsic value even if it not of value to us.  
 ii) Human beings derive a number of economic benefits like food, fiber etc from biodiversity.  
 iii) Biodiversity provides ecosystem services which can not be given price tag. Justify your categorization also.
  13. Western Ghats, Indo-Burma and Himalaya are three hot spots of India. Why these places are named so? What are the criteria of determining hot spots?
  14. What is depicted by the following representation of species diversity? Why these estimates do not give any figure-for prokaryotes.



(a)



(b)



(c)

#### (Answers)

1. Rawolfia vermitoria
2. Slightly more than 1.5 million.
3. Western Ghats get more rainfall and have tropical rain forest.
4. Rectangular hyperbola.
5. Paul Ehrlich proposed rivet Popper Hypothesis.  
Ecosystem is like an airplane whose parts are connected with rivets(species). If popping of rivets or extinction of species takes place beyond certain limit it will effect the flight safety means ecological balance.
6. Parthenium, Lantana and Eichornia are three alien species. These have become uncontrollable because these are not a part of any food chain.
7. The organisms, which are linked to each other obligatory, are prone to coextinction. For example parasites will become extinct with the extinction of their host. With the loss of pollinators the plant species will also become extinct.
8. (i) Exsitu (ii) Insitu (iii) Exsitu (iv) Insitu (v) Insitu (vi) Exsitu (vii) Exsitu (viii) Exsitu
9. Human activities are the basic cause for it  
Causes – 4 major causes (The evil Quartet along with suitable examples of each:-  
 (i) Habitat loss and fragmentation-decline in covered forest area from 14% to 6%.

- (ii) Overexploitation- extinction of Steller's sea cow
- (iii) Alien species invasion-Nile perch introduction into Lake Victoria resulted in extinction of 200 species cichlid fish.
- (iv) Co-extinction coevolved plant pollinator mutualism.

Harms: (a) Decline in plant production.  
(b) Lower resistance to environmental perturbations, like drought.  
(c) Increased variability in certain ecosystem processes such as plant productivity, water use etc.

10. (i) Nile perch introduced into Lake Victoria resulted in extinction of 200 species of cichlid fish

(ii) Parthenium and Eicchornia posed threat to our native species.

11. Co-extinction as extinction of one invariably leads to extinction of the other.

12. (i) Ethical

(ii) Narrowly utilitarian

(iii) Broadly utilitarian

13. Regions with high level of species richness, high degree of endemism

14. These represent global biodiversity of (a) invertebrates (b) vertebrates (c) plants.

Conventional taxonomic methods are not suitable for identifying microbial species; many species are simply not cultural lab conditions.



## Ch-16-Environmental issues

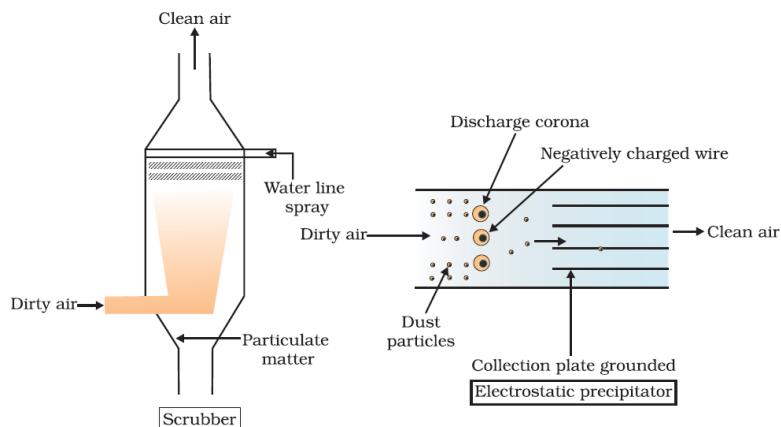
### 1. Air pollution :

Causes: Automobile exhaust, thermal power plants, smelters, deforestation, etc.

Control: a) **Electrostatic precipitator** in industries can remove **99% of particulate**

matter from exhaust. It has electrode wires maintained at several thousands volt. It releases a corona of electrons which attach to dust particles giving a net -ve charge. Collecting plates attract the charged particles.

b) **Scrubber:** Exhaust is passed through a spray of water and lime. Gases like **SO<sub>2</sub>** are removed.



Case Study of Delhi: In 1990s, Delhi ranked 4<sup>th</sup> among the 41 most polluted cities of the world. Under the directives of Supreme Court all the buses of Delhi were converted to run on CNG by the end of 2002. Bharat Stage IV norms currently applicable in Delhi.

#### Advantages of CNG over petrol and diesel:

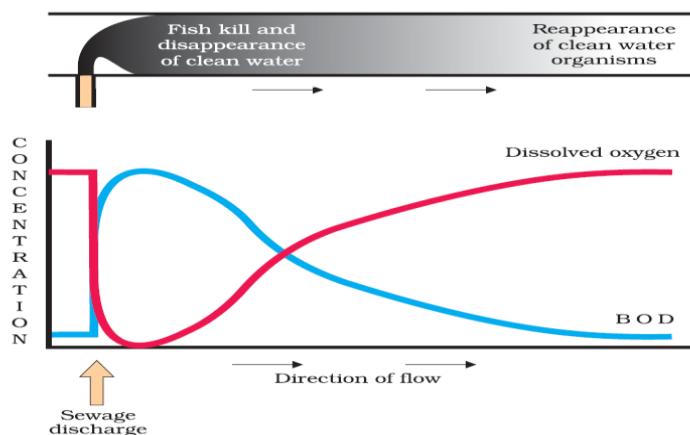
- d) CNG burns most efficiently
- e) It is cheaper
- f) Very little of it is left unburnt.
- g) It cannot be adulterated or stolen by thieves like petrol or diesel.

**Catalytic converters:** Catalytic converters, having metals : platinum-palladium and rhodium, are fitted into automobiles for reducing emission of poisonous gases. It converts unburnt hydrocarbons, carbon monoxide and nitric oxide into harmless gases. **Motor**

vehicles equipped with catalytic converter should use unleaded petrol because lead in the petrol inactivates the catalyst.

## 2. Water pollution: Due to domestic sewage, industrial wastes, cropfield run off.

- **Biochemical Oxygen Demand(BOD):** Amount of the oxygen that would be consumed if all the organic matter in 1liter of water were oxidized by bacteria. **The greater the BOD of wastewater, more is its polluting potential**

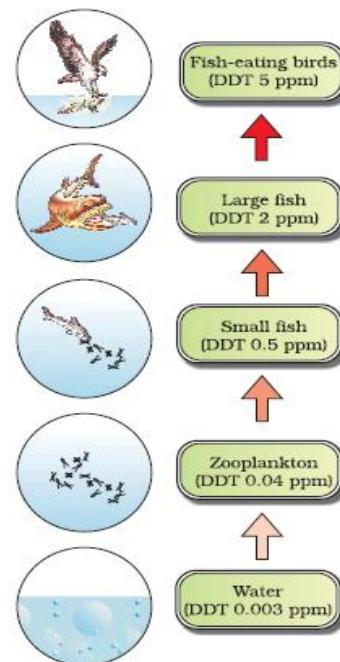


- **Algal bloom:** Presence of large amount of nutrients like nitrogen and phosphorus in water causes excessive growth of planktonic algae, called an algal bloom. It causes deterioration of water quality and fish mortality.

•

**Biomagnification:** It refers to increase in concentration of the toxicant at successive trophic levels. It happens because toxic substance accumulated by an organism cannot be metabolized or excreted and is thus passed on to the next higher trophic level.  
Ex: mercury and DDT accumulation.

**Higher concentrations of DDT** disturb **calcium metabolism** in **birds**, which causes **thinning of eggshell** and there **premature breaking**, thus causing **decline in bird population**



**Figure 16.5 Biomagnification of DDT in an aquatic food chain**

- **Eutrophication:** It is the natural ageing of a lake by biological enrichment of its water with nutrients like nitrogen and phosphorus which encourages growth of aquatic organisms. As the lake's fertility increases, plant and animal life also increases and organic remains get deposited at lake bottom.

With time lake becomes shallower and warmer, marsh plants invade the lake, finally converting it into land.

- **Cultural or Accelerated eutrophication:** Pollutants from man's activities like effluents from industries and homes radically accelerate the ageing process in lakes, thus causing accelerated eutrophication.
- **Case study of integrated wastewater treatment:** In Arcata(California), townspeople and biologists started a citizens group called Friends of the Arcata Marsh(FOAM). This group created an integrated wastewater treatment process within a natural system. The cleaning occurs in 2 stages-  
(a) **sedimentation, filtering and chlorination** of wastewater.  
(b) biologists developed a series of **6 connected marshes over 60 hectares of marshland**. As the wastewater flows through the marshes, it gets purified by the plants, algae, fungi and bacteria of that area.

3. **Case study of remedy for plastic waste:** Ahmed Khan of Bangalore realized that plastic waste was a real problem. His company developed Polyblend, a fine powder of recycled modified plastic. He proved that blends of polyblend and bitumen, when used to lay roads increased road life thrice. By this technique, more than 40 kms of road in Bangalore has already been laid.

4. **Electronic wastes(e-wastes):** It constitutes irreparable computers and other electronic goods. They are buried in landfills or incinerated. E-wastes generated in developed countries are exported to developing countries like India, China and Pakistan, where metals like **copper, iron, silicon, nickel and gold** are recovered during recycling. Recycling exposes workers to toxic substances of e-wastes.

5. **Case study of organic farming:** Integrated organic farming is a cyclical, zero-waste procedure, where waste products from one process are cycled in as nutrients for other processes. Ramesh Chandra Dagar, a farmer in Sonipat, Haryana includes bee-keeping,

dairy management, water harvesting, composting and agriculture in a chain of processes which support each other.

6. **Radioactive wastes(nuclear wastes):** two problems related to this are - (a) accidental leakage (b) safe disposal of radioactive wastes. Radiations cause mutations, cancer. Nuclear wastes first concentrated to reduce volume, then kept for 50-100 years in small ponds near nuclear power plants so that there is considerable decay of radioactivity. Then they are stored in shielded containers and buried within the rocks, 500m deep below the earth.

7. **Greenhouse effect:** It is a natural phenomenon which is responsible for heating of earth's surface and atmosphere. Due to it, average temperature of is  $15^{\circ}\text{C}$ . Greenhouse

gases are carbon dioxide, methane, CFC's and  $\text{N}_2\text{O}$ . These gases absorb infrared radiations from the earth, and emit it again towards earth. The cycle continues till the earth's surface has no long wave radiations to emit. (Diag. page 281 of NCERT)

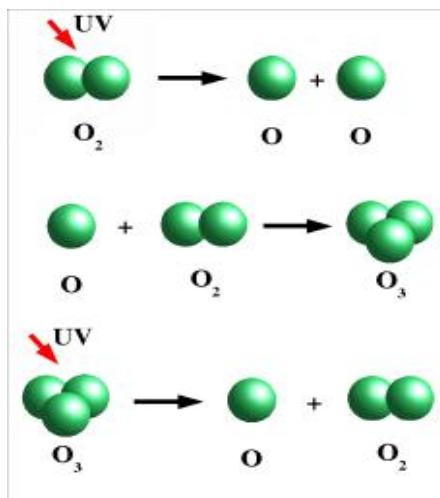
Increase in level of greenhouse gases has led to considerable heating of earth leading to global warming. This has resulted in melting of polar ice caps and rise in sea level that can submerge many coastal areas.

Control of Global warming: reduce the use of fossil fuels, reduce deforestation, planting trees and checking population explosion

8. **Ozone layers( $\text{O}_3$ ):** 'Bad ozone' formed in troposphere harms plants and animals.

'Good ozone' is found in stratosphere which protects us by absorbing UV rays from the sun. Ozone thickness is measured in Dobsons units(DU).

9. **Formation of ozone layer:** Ozone gas is continuously formed by the action of UV rays on molecular oxygen, and also degraded into molecular oxygen in the stratosphere. There should be a balance between production and degradation of ozone in the stratosphere.



But balance has been disrupted by the CFC's which are used as refrigerants. CFC's reach stratosphere, where UV rays act on them releasing Cl atoms. Cl atoms act as catalysts in converting O<sub>3</sub> to O<sub>2</sub>. This has resulted in formation of ozone hole over Antarctica.

10. **Snowblindness:** UV-B rays from sun damage DNA and cause mutations. It causes skin cancer. In human eye, cornea absorbs UV-B rays resulting in its inflammation, called snowblindness cataract. It permanently damages the cornea.

11. **Deforestation:** It is the conversion of forested areas to non-forested areas mainly due to human activities like Slash and burn agriculture or Jhum cultivation in north-east India. In this, farmers cut forests and burn plant remains. Ash is used as fertilizer and land used for farming or cattle grazing. After cultivation, area left for several years to allow its recovery. The farmers then move to other areas and repeat this process.

With increasing population and repeated cultivation, the land is not given enough time to recover, resulting in deforestation.

Consequences of deforestation: increased CO<sub>2</sub> concentration, loss of biodiversity, disturbs water cycle, causes soil erosion, desertification, etc.

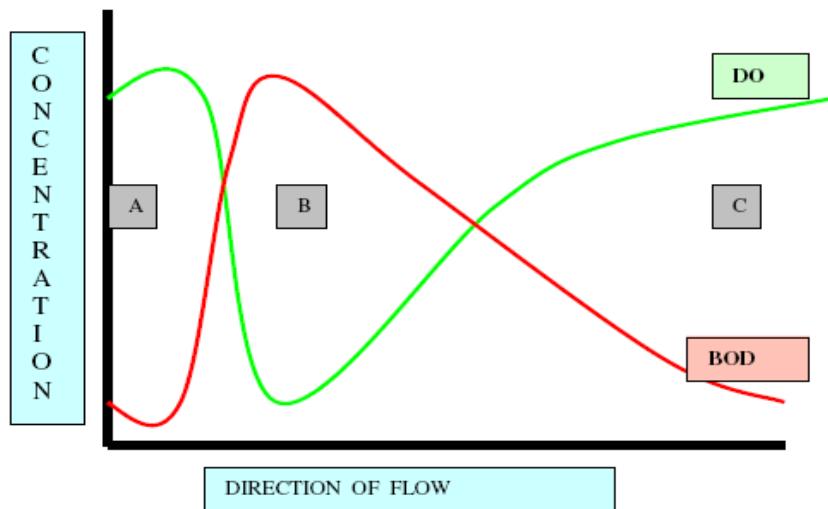
12. **Case study of people's participation in conservation of forests:** In 1731, the king of Jodhpur(Rajasthan) asked his minister to arrange wood for constructing a new palace. A Bishnoi woman Amrita Devi showed courage by hugging a tree and asking king's men to cut her first before cutting the tree. To her tree was more important than her own life. Sadly, king's men cut down the tree along with her. Her 3 daughters and hundreds of Bishnois followed her, and thus lost their lives saving trees.

The Government of India has recently started the Amrita Devi Bishnoi Wildlife Protection Award for individuals or communities from rural areas that have shown extraordinary courage and dedication in protecting wildlife.

**Chipko Movement of Garhwal Himalayas:** In 1974, local women showed enormous bravery in protecting trees from the axe of contractors by hugging them.

### **QUESTIONS FOR PRACTICE**

1. Motor vehicles fitted with catalytic converter must use unleaded petrol. Why?
2. Name a few metals used in catalytic converter.
3. Mention any four adverse effects of noise pollution on human health.
4. A few years ago, scientists trying to study the cause of decreasing population of pelicans in Michigan lake in America, found that egg shells of these birds have become thin due to accumulation of certain toxic chemical in their body through aquatic food chain.
  - (a) Name this process of accumulation of harmful chemical.
  - (b) Name the chemical.
  - (c) Why that particular chemical accumulated?
5. Mohan while traveling through industrial area saw that small ponds are covered with algal bloom.
  - (i) Name the process, which will be followed after algal bloom in the pond.
  - (ii) What is the cause of this?
  - (iii) How it is going to affect the ponds of the area.
6. (a) What do you understand by e-waste?
  - (b) How e-waste is dealt with in developing countries like India?
  - (c) What is the draw back of improper handling of e-waste?
7. Ramesh Chander Dagar, a farmer from Sonipat, has created Haryana Kisan Welfare Club with a membership of 5000 farmers.
  - (i) Name the method of farming practiced by farmers.
  - (ii) What is the meaning of the term used.
  - (iii) What are advantages of this farming technique.
8. What are two, very serious, inherent problems associated with the use of nuclear energy?
9.
  - (i) How UV rays are harmful for living organisms?
  - (ii) UV-B in high doses causes inflammation of cornea. Name this disease.
  - (iii) Name the units in which thickness of ozone layer is measured?
  - (iv) Describe briefly how CFC causes loss of ozone layer leading to ozone hole?
  - (v) Which international treaty proposes to reduce the emission of Ozone depleting chemicals.
10. Study the graph below and answer the following questions.



- (i) Define BOD .What does it indicate?  
 (ii) Compare the quality of water at point A and C.  
 (iii) How water quality can be improved. .  
 11. In the figure above sewage is discharged at point A.  
 (i) What will be the effect on fishes at point A? Why?  
 (ii) Compare BOD at points A and C. Give reason.  
 (iii) Compare DO at B and C.

### ( Answers )

1. Lead in the petrol inactivates catalysts.
2. Platinum, palladium and rhodium.
3. Sleeplessness, increased heart rate, altered breathing pattern and stress.
4.
  - (a) Bio-magnification.
  - (b) DDT
  - (c) DDT is a non biodegradable chemical which is not metabolized by enzymes.
5. (i) Eutrophication.  
 (ii) Mixing of water polluted with high conc. of N, S and P.  
 (iii) It will kill all the living organism of pond causing destruction and ageing of pond.
6. (i) E-waste is waste generated by irreparable computers and other electronic goods.  
 (ii) Metals like Cu, Fe, Si, Ni and Au are recovered manually by workers due to absence of specific recycling facilities in developing countries.  
 (iv) Workers are exposed to toxic substances present in it.
7.
  - (i) Integrated Organic farming.
  - (ii) Most of the farming techniques like agriculture, dairy, poultry, Fishery and bee keeping is practiced together on same piece of land with out use of chemicals.
  - (iii) High productivity, low cost, multiple products, proper waste management, no use of costly fertilizers and pesticides, minimizing environmental damage and sustainability are its advantages.
8. .
  - a. Accidental leakage as in Chernobyl incident

- b. Safe disposal of radioactive waste.
- 9.
- a. UV- B damages DNA causing harmful and fatal mutations in living organisms.
  - b. Snow blindness cataract.
  - c. Dobson Units (DU)
  - d. CFCs under the effect of UV rays release free Cl ions, which combine with O<sub>2</sub> thus these cause hindrance in O<sub>3</sub> formation at low temperature in upper atmosphere.
  - e. Montreal Protocol (1987)
10. (i) Biological Oxygen Demand. It indicates presence of sewage in water.  
(ii) At A water is polluted. At C clean water.  
(iii) Treatment of water
11. (i) Fishes will die as DO utilized for decomposition of sewage .  
(ii) BOD –more required for decomposition at A ,  
At C ---BOD nil as no organic matter.  
(iii) DO at B is little as it is utilized for decomposition, while at C –substantial amount present as dissolved from air .