LIBERTY PAPER SET

STD. 12 : Biology

Full Solution

Time : 3 Hours **ASSIGNTMENT PAPER 8**

Part A

1. (B) **2.** (B) **3.** (B) **4.** (B) **5.** (C) **6.** (A) **7.** (B) **8.** (D) **9.** (D) **10.** (A) **11.** (B) **12.** (C) **13.** (D) **14.** (D)
15. (B) **16.** (C) **17.** (B) **18.** (B) **19.** (B) **20.** (B) **21.** (D) **22.** (C) **23.** (C) **24.** (B) **25.** (C) **26.** (A) **27.** (D)
28. (A) **29.** (D) **30.** (A) **31.** (B) **32.** (C) **33.** (B) **34.** (C) **35.** (D) **36.** (D) **37.** (B) **38.** (A) **39.** (B) **40.** (B)
41. (A) **42.** (A) **43.** (B) **44.** (B) **45.** (D) **46.** (A) **47.** (B) **48.** (B) **49.** (A) **50.** (B)

Part B

Section A

➢ **Write the answer of the following questions : (Each carries 2 Mark)**

1.

➥ Seeds in general are the products of fertilisation, but in a few flowering plants such as some species of Asteraceae and grasses a special mechanism, to produce seeds without fertilisation, called apomixis have evolved.

⇛ Thus, apomixis is a form of asexual reproduction that mimics sexual reproduction.

➥ Types : There are several ways of development of apomictic seeds.

➥ (i) Recurrent agamospermy :

⇛ In some species, the diploid egg cell is formed without reduction division and develops into the embryo without fertilisation.

➥ (ii) Adventive embryony :

⇛ More often, as in many citrus and mango varieties some of the nucellar cells surrounding the embryo sac start dividing, protrude into the embryo sac and develop into the embryos.

⇛ In such species each ovule contains many embryos. Occurrence of more than one embryo in a seed is referred to as polyembryony.

2.

➥ (i) True fruits :

⇛ Develop only from the ovary.

⇛ In most plants, by the time the fruit develops from the ovary, other floral parts degenerate and fall off.

➥ (ii) False fruits :

⇛ The thalamus also contributes to fruit formation.

⇛ Can be observed in a few species such as apple, strawberry, cashew, etc.

3.

➥ Surgical Method of sterilisation :

➥ Surgical methods, also called sterilisation, are generally advised for the male/female partner as a terminal method to prevent any more pregnancies.

➥ Surgical intervention blocks gamete transport and thereby prevent conception.

(1) Vasectomy :

➥ Sterilisation procedure in the male is called ‘vasectomy’.

➥ In vasectomy, a small part of the vas deferens is removed or tied up through a small incision on the scrotum.

(2) Tubectomy :

➥ Sterilisation procedure in female, is called tubectomy.

➥ In tubectomy, a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through vagina.

➥ These techniques are highly effective but their reversibility is very poor.

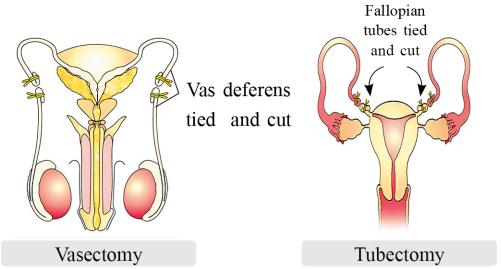
➥ It needs to be emphasised that the selection of a suitable contraceptive method and its use should always be undertaken in consultation with qualified medical professionals.

➥ One must also remember that contraceptives are not regular requirements for the maintenance of reproductive health.

➥ In fact, they are practiced against a natural reproductive event, i.e., conception/pregnancy. One is forced to use these methods either to prevent pregnancy or to delay or space pregnancy due to personal reasons.

➥ No doubt, the widespread use of these methods has a significant role in checking uncontrolled growth of population.

➥ However, their possible ill-effects like nausea, abdominal pain, breakthrough bleeding, irregular menstrual bleeding or even breast cancer, though not very significant, should not be totally ignored.



Vasectomy Tubectomy

4.

- The principle of immunisation or vaccination is based on the property of 'memory' of the immune system.
- In vaccination, a preparation of antigenic proteins of pathogen or inactivated/weakened pathogen (vaccine) are introduced into the body.
- The antibodies produced in the body against these antigens would neutralise the pathogenic agents during actual infection .
- The vaccines also generate memory - B and T-cells that recognise the pathogen quickly on subsequent exposure and overwhelm the invaders with a massive production of antibodies.
- If a person is infected with some deadly microbes to which quick immune response is required as in tetanus, we need to directly inject the preformed antibodies, or antitoxin (a preparation containing antibodies to the toxin).
- Even in case of snakebites, the injection which is given to the patients, contains preformed antibodies against the snake venom. This type of immunisation is called passive immunization.
- Recombinant DNA technology has allowed the production of antigenic polypeptides of pathoges in bacteria or yeast.
- Vaccines produced using this approach allow large scale production and hence greater availability for immunisation, e.g., hepatitis B vaccine produced from yeast.

5.

- (a) Co-dominance
- Co-dominance is a phenomenon in which two alleles express themselves independently when present together in an organism.
- Example : ABO Blood Group
- It is the inheritance in which both alleles of a gene are expressed in a hybrid. E.g. ABO blood grouping inhuman.
- ABO blood groups are controlled by the gene I.
- This gene controls the production of sugar polymers (antigens) that protrude from plasma membrane of RBC.
- The gene I has three alleles I^A, I^B & i.
- I^A and I^B produce a slightly different form of the sugar while allele i doesn't produce any sugar.
-

Allele from Parent 1	Allele from Parent 2	Genotype of offspring	Blood types of offspring
I^A	I^A	$I^A I^A$	A
I^A	I^B	$I^A I^B$	AB
I^A	i	$I^A i$	A
I^B	I^A	$I^A I^B$	AB
I^B	I^B	$I^B I^B$	B
I^B	i	$I^B i$	B
i	i	$i i$	O

- When I^A and I^B are present together, they both express their own types of sugars. This is due to co-dominance.

6.

- Prior to the work of Oswald Avery, Colin MacLeod and Maclyn McCarty (1933-44), the genetic material was thought to be a protein.
- They worked to determine the biochemical nature of 'transforming principle' in Griffith's experiment.
- They purified biochemicals (proteins, DNA, RNA, etc.) from the heat-killed S cells to see which ones could transform live R cells into S cells.
- They discovered that DNA alone from S bacteria caused R bacteria to become transformed.
- They also discovered that protein-digesting enzymes (proteases) and RNA-digesting enzymes (RNases) did not affect transformation, so the transforming substance was not a protein or RNA.
- Digestion with DNase did inhibit transformation, suggesting that the DNA caused the transformation.
- They concluded that DNA is the hereditary material, but not all biologists were convinced.

7.

- The size of a population for any species is not a static parameter. It keeps changing with time, depending on various factors including food availability, predation pressure and adverse weather.
- In fact, it is these changes in population density that give us some idea of what is happening to the population – whether it is flourishing or declining.
- Whatever might be the ultimate reasons, the density of a population in a given habitat during a given period, fluctuates due to changes in four basic processes, two of which (natality and immigration) contribute to an increase in population density and two (mortality and emigration) to a decrease.

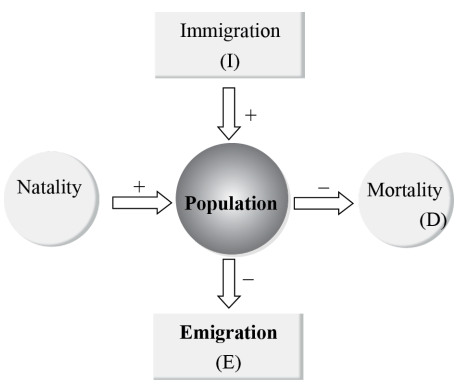
  (i) Natality refers to the number of births during a given period in the population that are added to the initial density.

  (ii) Mortality is the number of deaths in the population during a given period.

  (iii) Immigration is the number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration.

  (iv) Emigration is the number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration.
- So, if N is the population density at time t, then its density at time t + 1 is

  $Nt + 1 = Nt + [(B + I) – (D + E)]$
- Population density will increase if the number of births plus the number of immigrants (B + I) is more than the number of deaths plus the number of emigrants (D + E).
- Under normal conditions, births and deaths are the most important factors influencing population density, the other two factors assuming importance only under special conditions.
- For instance, if a new habitat is just being colonized, immigration may contribute more significantly to population growth than birth rates.



8.

➥ There are three types of pyramids :

- Pyramid of number
- Pyramid of biomass
- Pyramid of energy

9.

➥ In general, loss of biodiversity in a region may lead to

(a) decline in plant production,

(b) lowered resistance to environmental perturbations such as drought and

(c) increased variability in certain ecosystem processes such as plant productivity, water use, and pest and disease cycles.

10.

➥ (f) Primary productivity and Secondary productivity

➥

Primary productivity	**Secondary productivity**
Primary production is defined as the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis.	Secondary productivity is defined as the rate of formation of new organic matter by consumers.
It depends upon green plants.	It depends upon heterotrophs.
It has two types: gross primary productivity and net primary productivity.	It has no types.
It is in a large amount.	It is in a small amount.

11.

➥ Barrier Method.

➥ In barrier methods, ovum and sperms are prevented from physically meeting with the help of barriers. Such methods are available for both males and females.

(i) Condoms :

➥ Condoms are barriers made of thin rubber/ latex sheath that are used to cover the penis in the male or vagina and cervix in the female, just before coitus so that the ejaculated semen would not enter into the female reproductive tract.

➥ This can prevent conception.

➥ 'Nirodh' is a popular brand of condom for the male.

➥ Use of condoms has increased in recent years due to its additional benefit of protecting the user from contracting STIs and AIDs.

➥ Both the male and the female condoms are disposable, can be self-inserted and thereby gives privacy to the user.

(ii) Diaphragms, cervical caps and vaults :

➥ Diaphragms, cervical caps and vaults are also barriers made of rubber that are inserted into the female reproductive tract to cover the cervix during coitus.

➥ They prevent conception by blocking the entry of sperms through the cervix.

➥ They are reusable.

➥ Spermicidal creams, jellies and foams are usually used alongwith these barriers to increase their contraceptive efficiency.

12.

➥ Competition might evolve mechanisms that promote co-existence rather than exclusion.

➥ One such mechanism is 'resource partitioning'. If two species compete for the same resource, they could avoid competition by choosing, for instance, different times for feeding or different foraging patterns.

Section B

➢ **Write the answer of the following questions : (Each carries 4 Mark)**

13.

➥ (i) Promoter

(1) It initiates the process of transcription.

(2) It provides the binding site for RNA polymerase.

➥ (ii) tRNA

(1) It reads the genetic code of messenger RNA.

(2) During translation it carries a specific ribosome to mRNA to initiate the process.

➥ (iii) Exons

(1) It is the coding sequence of DNA that transcribes proteins.

(2) In between the long sequence of axons introns are present which disappear in the mature one.

14.

➥ In a given population one can find out the frequency of occurrence of alleles of a gene or a locus.

➥ This frequency is supposed to remain fixed and even remain the same through generations.

➥ Hardy-Weinberg principle stated it using algebraic equations.

➥ This principle says that allele frequencies in a population are stable and is constant from generation to generation.

➥ The gene pool (total genes and their alleles in a population) remains a constant. This is called genetic equilibrium.

➥ Sum total of all the allelic frequencies is 1. Individual frequencies, for example, can be named p, q etc.

➥ In a diploid, p and q represent the frequency of allele A and allele a.

➥ $p^2 + 2pq + q^2 = 1$. This is a binomial expansion of $(p + q)^2$.

Where : p^2 - Frequency of individuals with genotype AA.

q^2 - Frequency of individuals with genotype aa.

2pq - Frequency of individuals with genotype Aa.

➥ When frequency measured, differs from expected values, the difference (direction) indicates the extent of evolutionary change.

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

15.

➥ Innate immunity is non-specific type of defence, that is present at the time of birth. This is accomplished by providing different types of barriers to the entry of the foreign agents into our body. Innate immunity consist of four types of barriers. These are —

(i) Physical barriers : Skin on our body is the main barrier which prevents entry of the micro-organisms. Mucus coating of the epithelium lining the respiratory, gastrointestinal and urogenital tracts also help in trapping microbes entering our body.

(ii) Physiological barriers : Acid in the stomach, saliva in the mouth, tears from eyes–all prevent microbial growth.

(iii) Cellular barriers : Certain types of leukocytes (WBC) of our body like polymorpho-nuclear leukocytes (PMNL-neutrophils) and monocytes and natural killer (type of lymphocytes) in the blood as well as macrophages in tissues can phagocytose and destroy microbes.

(iv) Cytokine barriers : Virus-infected cells secrete proteins called **interferons** which protect non-infected cells from further viral infection.

16.

- One could be free of these infections by following the simple principles given below :
  (i) Avoid sex with unknown partners/multiple partners.
  (ii) Always use condoms during coitus.
  (iii) In case of doubt, one should go to a qualified doctor for early detection and get complete treatment if diagnosed with disease.

17.

- Antibiotics are chemical substances which is produced by microbes. It kills pathogenic microbes or slow down their growth.
- This chemicals are called antibiotics.
  (anti=opposite, bio= life)
  e.g. Penicillin is the first discovered antibiotic.
- Discovery :
  - Alexander Fleming while working on *staphylococci* bacteria , once observed a mould growing in one of his unwashed culture plated around which staphylococci 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 penicillium notatum.
  - This antibiotic was extensively used to treat American soldiers wounded in world war II
  - Fleming, chain and flory were awarded the Nobel prize in 1945, for this discovery.

18.

- In addition to these uses, GM has been used to create tailor-made plants to supply alternative resources to industries, in the form of starches, fuels and pharmaceuticals.

19.

- The production of biomass is called productivity.
- Primary productivity :
  - A constant input of solar energy is the basic requirement for any ecosystem to function and sustain.
  - Primary production is defined as the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis.
  - It is expressed in terms of weight (gm^{-2}) or energy (k cal m^{-2}).
  - It is expressed in terms of $gm^{-2}\ yr^{-1}$ or (k cal m^{-2}) yr^{-1} to compare the productivity of different ecosystems.
  - It can be divided into gross primary productivity (GPP) and net primary productivity (NPP).
    (a) Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis.
    (b) Net primary productivity
  - A considerable amount of GPP is utilised by plants in respiration. Gross primary productivity minus respiration losses (R), is the net primary productivity (NPP).

    $GPP - R = NPP$
- Secondary productivity :
  - Net primary productivity is the available biomass for the consumption to heterotrophs (herbivores and decomposers).
  - Secondary productivity is defined as the rate of formation of new organic matter by consumers.

20.

- This is the most important cause driving animals and plants to extinction.
- The most dramatic examples of habitat loss come from tropical rain forests.
- Once covering more than 14 per cent of the earth's land surface, these rain forests now cover no more than 6 per cent. They are being destroyed fast.
- The Amazon rain forest it is so huge that it is called the 'lungs of the planet'.

- The Amazon rain forest is the place of harbouring probably millions of species and is being cut and cleared for cultivating soya beans or for conversion to grasslands for raising beef cattle.
- Besides total loss, the degradation of many habitats by pollution also threatens the survival of many species.
- When large habitats are broken up into small fragments due to various human activities, mammals and birds requiring large territories and certain animals with migratory habits are badly affected, leading to population declines.
- When alien species are introduced unintentionally or deliberately for whatever purpose, some of them turn invasive, and cause decline or extinction of indigenous species.
- The Nile perch introduced into Lake Victoria in east Africa eventually led to the extinction of an ecologically unique assemblage of more than 200 species of cichlid fish in the lake.
- The environmental damage caused and threat posed to our native species by invasive weed species like carrot grass (Parthenium), Lantana and water hyacinth (Eicchornia).
- The recent illegal introduction of the African catfish Clarias gariepinus for aquaculture purposes is posing a threat to the indigenous catfishes in our rivers.

21.

- In-vitro fertilisation (IVF) is an assisted reproductive technology (ART) where an egg and a sperm are fertilised outside a woman's body in a laboratory. It is a process that is used to overcome infertility and support surrogacy.
- It was first successfully performed in 1978, when IVF gave birth to Louis Brown. Lesley Brown, his mother, had been facing infertility issues since 9 years when she took help from Patrick Steptoe and Robert Edwards at Dr Kershaw's Cottage Hospital in Royton, Oldham, England.
- Find a well-labelled and simple diagram of IVF below.
- **Procedure**
- The five steps of in-vitro fertilisation are as follows:
- 1. Stimulation / Superovulation
- Normally, a woman produces one egg per month. But for IVF procedures, doctors give drugs to women to produce several eggs in a month. These eggs are examined from time to time to pick the healthiest one in the next step.
- 2. Retrieval of Egg and Sperm Preparation
- The eggs are retrieved from the female by a procedure known as transvaginal oocyte retrieval. An oocyte selection is performed to select the egg that has the highest chance of fertilisation. The sperms are extracted from semen by removing inactive cells and seminal fluid in a process called sperm washing.
- 3. Egg Fertilisation
- The female egg and male sperm are incubated together for fertilisation. The sperm generally enters the egg and insemination is carried out, but in cases where sperm motility is low, the sperm is directly injected into the egg.
- 4. Embryo Development
- The fertilised egg divides to form an embryo. The embryo divides by cleavage to form a blastocyst (after 5-6 days of incubation).
- 5. Embryo Transfer
- The embryo is transferred to the uterus after 5-6 days of active division. The number of embryos that are transferred depends on the age of women and any other health concerns if present. The embryos are transferred through a tube-like apparatus called a catheter which goes up through her cervix and vagina into the womb. The embryo then sticks to the uterine lining and results in pregnancy.

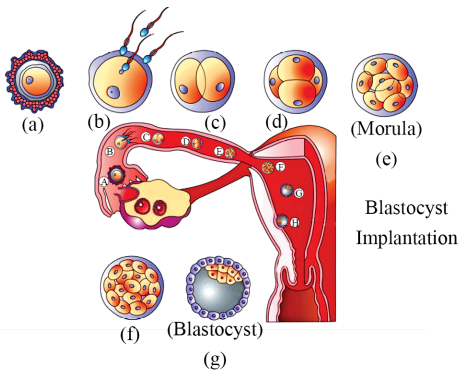
Section C

Write the answer of the following questions : (Each carries 4 Mark)

22.

- Immediately after implantation, the inner cell mass (embryo) differentiates into an outer layer called ectoderm and an inner layer called endoderm.
- A mesoderm soon appears between the ectoderm and the endoderm.
- These three layers give rise to all tissues (organs) in adults.
- The inner cell mass contains certain cells called stem cells which have the potency to give rise to all the tissues and organs.
- The human pregnancy lasts 9 months.

- In human beings, after one month of pregnancy, the embryo's heart is formed. The first sign of growing foetus may be noticed by listening to the heart sound carefully through the stethoscope.
- By the end of the second month of pregnancy, the foetus develops limbs and digits.
- By the end of 12 weeks (first trimester), most of the major organ systems are formed, for example, the limbs and external genital organs are well-developed.
- The first movements of the foetus and appearance of hair on the head are usually observed during the fifth month.
- By the end of about 24 weeks (end of second trimester), the body is covered with fine hair, eye-lids separate, and eyelashes are formed.
- By the end of nine months of pregnancy, the foetus is fully developed and is ready for delivery.



- The zygote is formed at the ampulla-isthmus junction of the fallopian tube when the union of secondary oocyte and spermatozoa occurs. The zygote undergoes various divisions and changes before it reaches the uterus for implantation.
- The figure shows the various stages of development of a zygote as it passes through the oviduct and uterus:

  (a) The zygote divides into a two-celled stage via division or 1st cleavage while the zygote is still in the isthmus of the oviduct.

  (b) Several more mitotic divisions or cleavages occur in the 2 celled stage to form a 2, 4, 8 and finally a 16-celled stage of the zygote. The 16 celled stage is called the morula and various cells formed after cleavage are called blastomeres.

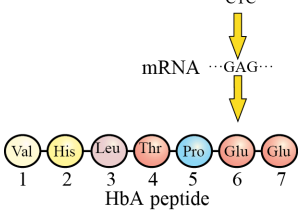
  (c) Morula then changes into a blastocyst after a few more divisions and this stage contains a fluid filled cavity in the embryo. The blastomeres become arranged and line up into an outer layer of cells called the trophoblast and an inner mass of cells. The fluid filled cavity is called blastocoel.

  (d) Implantation of the embryo occurs at this blastocyst stage by the help of trophoblast layer which embeds itself into the uterine endometrium.

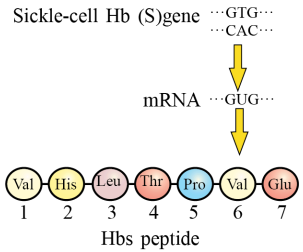
23.

- Sickle-cell anaemia : This is an autosome linked recessive trait that can be transmitted from parents to the offspring when both the partners are carrier for the gene (or heterozygous).
- The disease is controlled by a single pair of allele, Hb^A and Hb^S. Out of the three possible genotypes, only homozygous individuals for Hb^S (Hb^SHb^S)show the diseased phenotype.
- Heterozygous (Hb^AHb^S) individuals appear apparently unaffected but they are carrier of the disease as there is 50 per cent probability of transmission of the mutant gene to the progeny, thus exhibiting sickle-cell trait.
- The defect is caused by the substitution of Glutamic acid (Glu) by Valine (Val) at the sixth position of the beta globin chain of the haemoglobin molecule
- The substitution of amino acid in the globin protein results due to the single base substitution at the sixth codon of the beta globin gene from GAG to GUG.
- The mutant haemoglobin molecule undergoes polymerisation under low oxygen tension causing the change in the shape of the RBC from biconcave disc to elongated sickle-like structure.

➥ Normal Hb (A)gene ···GAG···
···CTC···



➥ Sickle-cell Hb (S)gene ···GTG···
···CAC···



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

24.

➥ The technique of DNA Fingerprinting was initially developed by Alec Jeffreys. He used a satellite DNA as probe that shows very high degree of polymorphism.

➥ It was known as Variable Number of Tendem Repeats (VNTR).

➥ The technique, as used earlier, involved Southern blot hybridisation using radiolabelled VNTR as a probe. It included

(i) isolation of DNA,

(ii) digestion of DNA by restriction endonucleases,

(iii) seperation of DNA fragments by electrophoresis,

(iv) transferrring (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 fragmenents by autoradiography. A schematic representation of DNA fingerprinting is shown in Figure.

➥ The VNTR belongs to a class of satellite DNA referred to as mini-satellite. A small DNA sequence is arranged tandemly in many copy numbers.

➥ The copy number varies from chromosome to chromosome in an individual.

➥ The numbers of repeat show very high degree of polymorphism. As a result the size of VNTR varies in size from 0.1 to 20 kb. Consequently, after hybridisation with VNTR probe, the autoradiogram gives many bands of differing sizes.

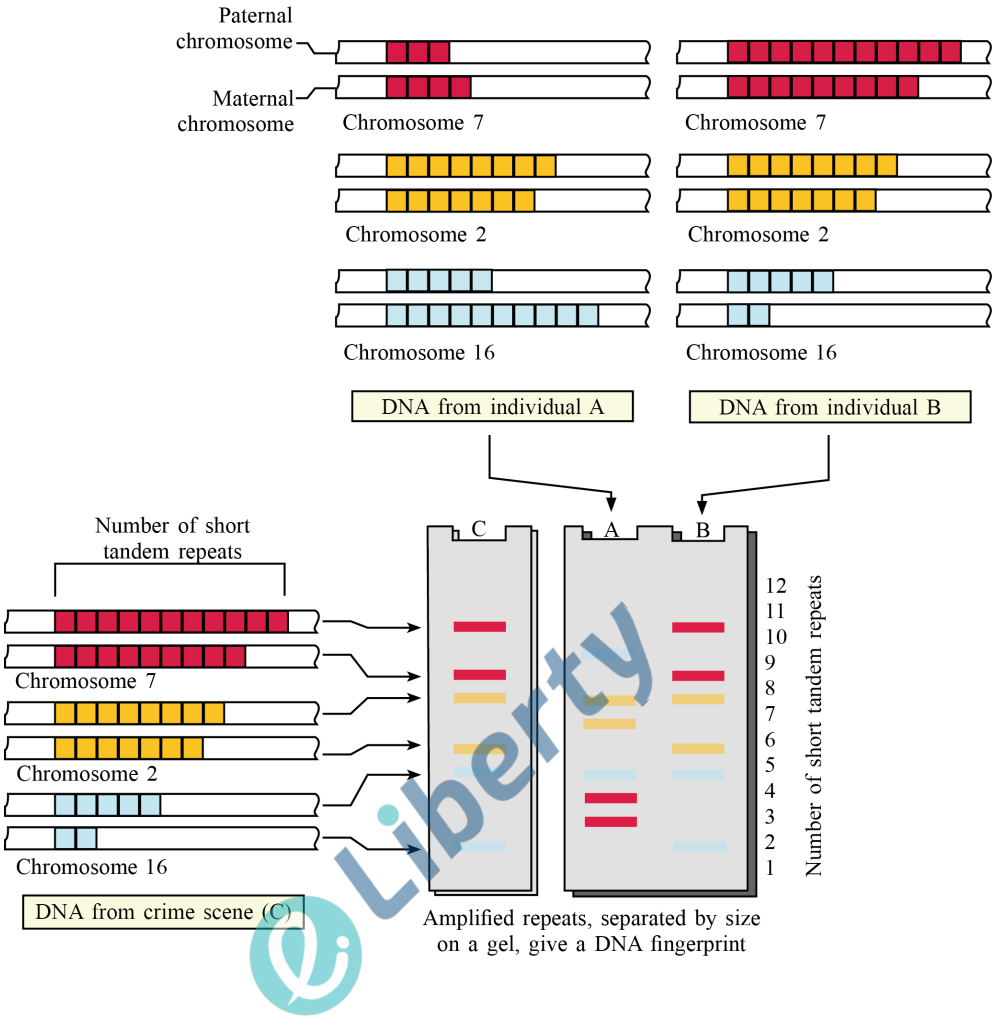
➥ There bands give a characteristic pattern for an individual DNA.

➥ It differs from individual to individual in a population except in the case of monozygotic (identical) twins.

➥ The sensitivity of the technique has increased by use of polymerase chain reaction (PCR).

➥ Consequently, DNA from a single cell is enough to perform DNA fingerprinting analysis. In addition to application in forensic science, it has much wider application, such as in determining population and genetic diversities.

➥ Currently, many different probes are used to generate DNA fingerprints.



25.

- Innate immunity is non-specific immunity, which is present at the time of birth.
- 1) Physical barrier :
  - Our skin is the main physical barrier that prevents the entry of microorganisms.
  - Mucous membrane lining the respiratory tract, gastrointestinal tract and urinary tract also helps to prevent germs from entering the body.
- 2) Physiological barrier :
  - Acid in the stomach, saliva in the mouth, tears in the eyes etc. inhibit the growth of pathogens.
- 3) Cellular Barrier :
  - Some white blood cells [WBCs] in our body, such as polymorphonuclear leukocytes and natural killer cells, a type of lymphoid cell in the blood, can feed on and destroy microbes.
- 4) Cytokine barrier :
  - Virus-infected cells secrete proteins called interferons, which protect other uninfected cells from virus infection.

26.

- In the year 1963, the two enzymes responsible for restricting the growth of bacteriophage in *Escherichia coli* were isolated.
- One of these added methyl groups to DNA, while the other cut DNA.
- The later was called restriction endonuclease.

- The first restriction endonuclease–Hind II, whose functioning depended on a specific DNA nucleotide sequence.
- Hind -II was isolated and characterised five years later.
- It was found that Hind II always cut DNA molecules at a particular point by recognising a specific sequence of six base pairs.
- This specific base sequence is known as the recognition sequence for Hind II.
- Besides Hind II, today we know more than 900 restriction enzymes that have been isolated from over 230 strains of bacteria each of which recognise different recognition sequences.
- Nomenclature :
  - The convention for naming these enzymes is the first letter of the name comes from the genus and the second two letters come from the species of the prokaryotic cell from which they were isolated.

    e.g., EcoRI
  - It comes from Escherichia coli RY 13.
  - In EcoRI, the letter 'R' is derived from the name of strain.
  - Roman numbers following the names indicate the order in which the enzymes were isolated from that strain of bacteria.
- TYPES :
  - Restriction enzymes belong to a larger class of enzymes called nucleases. These are of two kinds.

    (a) Exonucleases

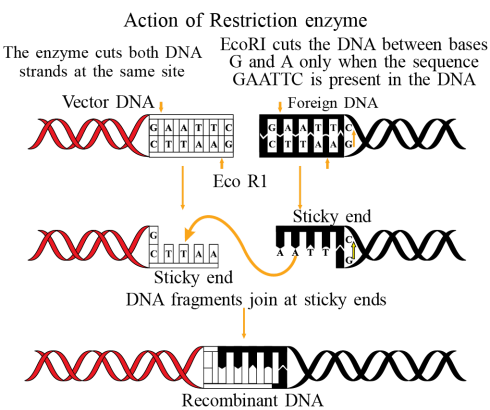
    (b) Endonucleases.

    (1) Exonucleases remove nucleotides from the ends of the DNA.

    (2) Endonucleases make cuts at specific positions within the DNA.
- Each restriction endonuclease functions by 'inspecting' the length of a DNA sequence.
- Once it finds its specific recognition sequence, it will bind to the DNA and cut each of the two strands of the double helix at specific points in their sugar -phosphate backbones.
- PALINDROMIC SEQUENCE :
  - Each restriction endonuclease recognises a specific palindromic nucleotide sequences in the DNA.
- The palindrome in DNA is a sequence of base pairs that reads same on the two strands when orientation of reading is kept the same. For example, the following sequences reads the same on the two strands in 5' → 3' direction. This is also true if read in the 3' → 5' direction.

  5' —— GAATTC —— 3'

  3' —— CTTAAG —— 5'
- Mechanism of action :
- Restriction enzymes cut the strand of DNA a little away from the centre of the palindrome sites, but between the same two bases on the opposite strands.
- This leaves single stranded portions at the ends.
- There are overhanging stretches called sticky ends on each strand.



- When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of 'sticky-ends' and, these can be joined together using DNA ligases.

➥ Unless one cuts the vector and the source DNA with the same restriction enzyme, the recombinant vector molecule cannot be created.

➥ Restriction endonucleases are used in genetic engineering to form 'recombinant' molecules of DNA, which are composed of DNA from different sources/genomes.

27.

➥ Double Fertilization :

- Double fertilization is a remarkable process unique to flowering plants (angiosperms). It involves the intricate dance of male and female gametes, resulting in the formation of both a zygote and an endosperm. Here's how it unfolds:

➥ Syngamy (Fusion of Male Gamete with Egg):

- Pollination occurs when pollen grains reach the stigma of a flower via the style.
- Within the ovule, two sperm cells from the pollen tube enter the synergid cell.
- One of these sperm cells fuses with the egg cell, forming a diploid zygote. This fusion is called syngamy.
- The zygote will eventually develop into the embryo of the seed.

➥ Triple Fusion (Fusion of Male Gamete with Polar Nuclei):

- Simultaneously, the second sperm cell fuses with the two polar nuclei present in the central cell of the female gametophyte (megagametophyte).
- This fusion results in a triploid (3n) structure called the primary endosperm nucleus (PEN).
- Since it involves the fusion of three haploid nuclei, we call it triple fusion.
- The primary endosperm nucleus will later develop into the endosperm, which serves as a nutrient-rich tissue for the developing embryo.

➥ Significance of Double Fertilization :

- Seed Formation : The zygote (2n) formed during syngamy develops into the embryo, while the ovule matures into a seed.
- Fruit Development : The ovary tissues surrounding the ovule transform into a fleshy fruit that encloses the seed.
- Nutrient-Rich Endosperm : The endosperm, derived from triple fusion, provides essential nutrients to the growing embryo.
- Restoration of Diploid State : By combining the haploid male and female gametes, double fertilization restores the diploid state in the plant.
- In summary, double fertilization ensures successful seed production, nourishment for the embryo, and the eventual development of fruits. It's a beautifully orchestrated process that underscores the complexity and adaptability of angiosperms.