LIBERTY PAPER SET

STD. 12 : Biology

Full Solution

Time : 3 Hours **ASSIGNTMENT PAPER 12**

Part A

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

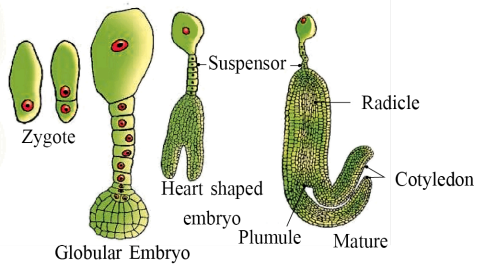
Part B

Section A

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

1.

➥ Embryo develops at the micropylar end of the embryo sac where the zygote is situated.



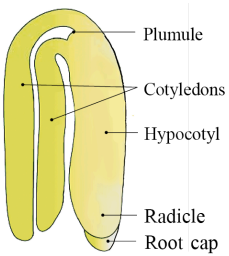
➥ Most zygotes divide only after certain amount of endosperm is formed. This is an adaptation to provide assured nutrition to the developing embryo.

➥ Though the seeds differ greatly, the early stages of embryo development (embryogeny) are similar in both monocotyledons and dicotyledons.

➥ Figure depicts the stages of embryogeny in a dicotyledonous embryo. The zygote gives rise to the proembryo and subsequently to the globular, heart-shaped and mature embryo.

➥ Dicotyledonous embryo :

➥ A typical dicotyledonous embryo, consists of an embryonal axis and two cotyledons.

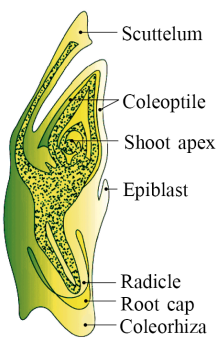


(i) Epicotyl : The portion of embryonal axis above the level of cotyledons is the Epicotyl, which terminates with the plumule or stem tip.

(ii) Hypocotyl : The cylindrical portion below the level of cotyledons is Hypocotyl that terminates at its lower end in the radicle or root tip. The root tip is covered with a root cap.

➥ Monocotyledonous embryo :

➥ Embryos of monocotyledons possess only one cotyledon.



(i) Scutellum : In the grass family the cotyledon is called scutellum that is situated towards one side (lateral) of the embryonal axis.

(ii) Coleorrhiza : At its lower end, the embryonal axis has the radical and root cap enclosed in an undifferentiated sheath called Coleorrhiza.

(iii) Coleoptile : The portion of the embryonal axis above the level of attachment of scutellum is the epicotyl. Epicotyl has a shoot apex and a few leaf primordia enclosed in a hollow foliar structure, the Coleoptile.

2.

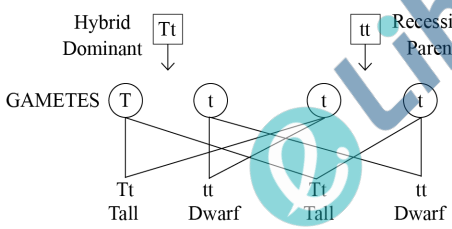
- Barrier Method.
- In barrier methods, ovum and sperms are prevented from physically meeting with the help of barriers. Such methods are available for both males and females.

(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.
- **Saheli :**
- 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.
- Developed by Central Drug Research Institute (CDRI) - Lucknow.

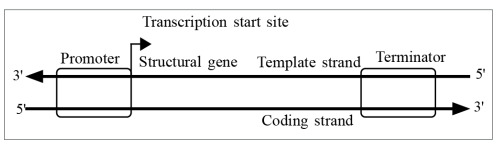
3.

- A cross between a plant with known genotype and the recessive parent is called as a test cross.



- A test cross is used to determine the genotype of the unknown plant. (i.e. whether the plant is homozygous 1 : 1 ratio of Dominant : Recessive, then the unkown plant is heterozygous.
- However, if the progeny are all dominant, then the unknown plant is homozygous.

4.



5.

- Natural resources are finite, their size is constant except for seasonal variations.
- Members of a population, though outwardly similar, show differences in characteristics.
- Most of the variations are hereditary.
- If this is the reality and if every organism reproduces at the maximum rate then theoretically the population will grow like explosives and it is equally true that realistically the population size is limited.
- It means that there is competition for resources.
- Some were able to survive and thrive at the expense of others, while some could not be promoted.

6.

- Water borne diseases :
- Cholera, Typhoid, Amoebiasis, Ascariasis etc.
- Measures to prevent spread :
  - Reservoirs, pools, cess pools, tanks etc. should be periodically cleaned and kept clean.
  - Purification of waste water through sewage plant.
  - Chlorination of water and use as drinking water.

7.

- Sewage treatment plant contains mainly two steps :
- (1) Primary treatment :
  - Primary treatment steps basically involve physical process during which removal of particles- large and small is done from the sewage.
  - For this process, filtration and sedimentation is done repeatedly.
  - This treatment is less expensive and comparatively simple process.
- (2) Secondary treatment (biological treatment):
  - This is a biological process in which organic matter is decomposed by microbes.
  - Here, by using aerobic and anaerobic microbes, organic matter is decomposed. This process is complex and expensive.

8.

- Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources can not co-exist indefinitely and the competitively inferior one will be eliminated eventually.
- This may be true if resources are limiting, but not otherwise. More recent studies do not support such gross generalisations about competition.

9.

- (iv) Perisperm and pericarp
-

	Perisperm	Pericarp
(i)	Part of a seed.	Part of a fruit.
(ii)	Usually dry.	Dry or fleshy.
(iii)	Present in only a few seeds	Found in all the fruits.
(iv)	Non-functional in seed.	Protects the fruit and helps in nutrition and dispersal.

10.

- 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.

11.

- This is the interaction in which one species benefits and the other is neither harmed nor benefited.
- An orchid growing as an epiphyte on a mango branch, and barnacles growing on the back of a whale benefit while neither the mango tree nor the whale derives any apparent benefit.
- The cattle egret and grazing cattle in close association, a sight you are most likely to catch if you live in farmed rural areas, is a classic example of commensalism.
- The egrets always forage close to where the cattle are grazing because the cattle, as they move, stir up and flush out insects from the vegetation that otherwise might be difficult for the egrets to find and catch.
- Another example of commensalism is the interaction between sea anemone that has stinging tentacles and the clown fish that lives among them. The fish gets protection from predators which stay away from the stinging tentacles. The anemone does not appear to derive any benefit by hosting the clown fish.

12.

- 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.

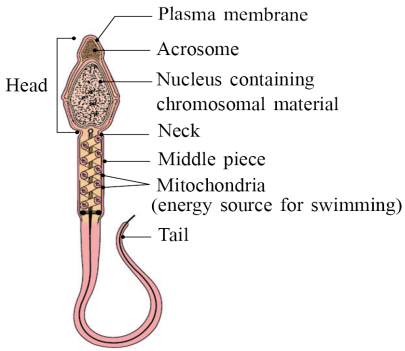
Section B

➢ **Write the answer of the following questions : (Each carries 3 Mark)**

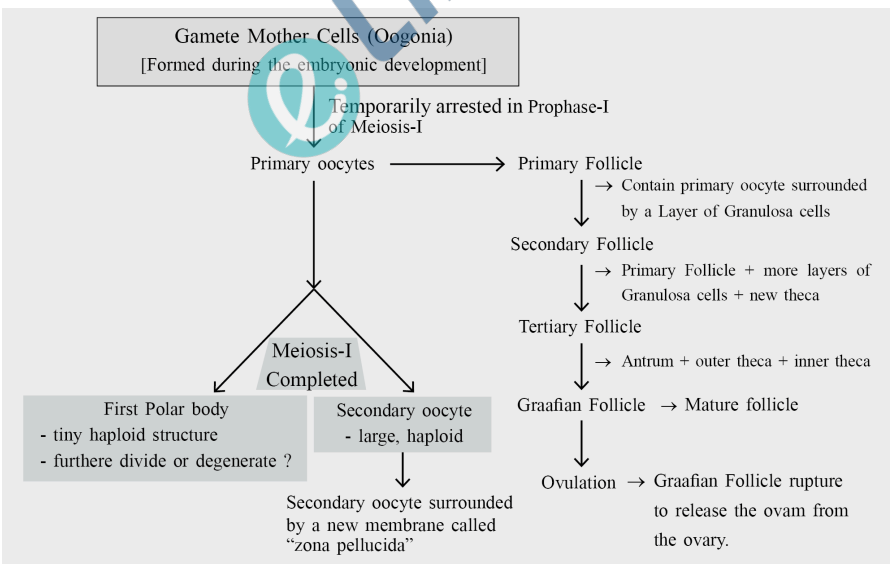
13.

- RNA was the first genetic material.
- There is now enough evidence to suggest that essential life processes (such as metabolism, translation, splicing, etc.), evolved around RNA.
- RNA used to act as a genetic material as well as a catalyst (there are some important biochemical reactions in living systems that are catalysed by RNA catalysts and not by protein enzymes).
- But, RNA being a catalyst was reactive and hence unstable.
- Therefore, DNA has evolved from RNA with chemical modifications that make it more stable.
- DNA being double stranded and having complementary strand further resists changes by evolving a process of repair.

14.



- The structure of a sperm is a microscopic structure composed of a head, neck, a middle piece and a tail.
- A plasma membrane envelops the whole body of sperm.
- The sperm head contains an elongated haploid nucleus, the anterior portion of which is covered by a cap-like structure, acrosome.
- The acrosome is filled with enzymes that help fertilisation of the ovum.
- The middle piece possesses numerous mitochondria, which produce energy for the movement of tail that facilitate sperm motility essential for fertilisation.
- The human male ejaculates about 200 to 300 million sperms during a coitus of which, for normal fertility, at least 60 per cent sperms must have normal shape and size and at least 40 per cent of them must show vigorous motility.
- Sperms released from the seminiferous tubules, are transported by the accessory ducts. Secretions of epididymis, vas deferens, seminal vesicle and prostate are essential for maturation and motility of sperms.
- The seminal plasma along with the sperms constitute the semen.
- The functions of male sex accessory ducts and glands are maintained by the testicular hormones (androgens).



15.

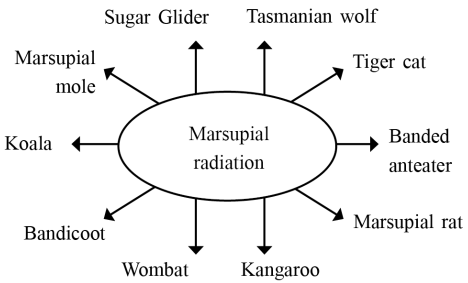
- The process of development of different species starting from one point of a given geographical area to other geographical habitats is called adaptive radiation.

Darwin finch

- Darwin Finch is an excellent example of this type of phenomenon.
- Darwin saw several species of finches across the Galapagos Islands.
- He speculated that all species had evolved on the island by themselves.
- Along with other features of the original finches (seed eating), their beaks may have evolved for other forms that made them insectivorous and herbivorous finches.

Australian marsupials

- Another example is the Australian marsupial.
- Most marsupials were different from each other.
- They evolved from a common set of ancestors, but they all evolved on the Australian island continent.
- When more than one adaptive diffusion occurs in a geographical area (representing different habitats) it is called convergent evolution.
- Mammals of Australia marsupials (E.g.:- the wolf and the Tasmanian wolf) show a similar evolution.



Placental mammals	Australian Marsupials
Mole	Marsupial mole
Ant eater	Numbat (Ant eater)
Mouse	Marsupial mouse
Lemur	Spotted cuscus
Flying squirrel	Flying phalanger
Bobcat	Tasmanian tiger cat
Wolf	Tasmanian wolf

16.

- (i) Avoid undue peer pressure - Every child has his/her own choice and personality, which should be respected and nurtured. A child should not be pushed unduly to perform beyond his/her threshold limits; be it studies, sports or other activities.
- (ii) Education and counseling - Educating and counseling him/her to face problems and stresses and to accept disappointments and failures as a part of life. It would also be worthwhile to channelise the child's energy into healthy pursuits like sports, reading, music, yoga and other extracurricular activities.
- (iii) Seeking help from parents and peers
  - Help from parents and peers should be sought immediately so that they can guide appropriately.
  - Help may even be sought from close and trusted friends. Besides getting proper advice to sort out their problems, this would help youth to vent their feelings of anxiety and guilt.
- (iv) Looking for danger signs - Alert parents and teachers need to look for and identify the danger signs discussed above.
  - Even friends, if they find someone using drugs or alcohol, should not hesitate to bring this to the notice of parents or teachers in the best interests of the person concerned. Appropriate measures would then be required to diagnose the malady and the underlying causes.
  - This would help in initiating proper remedial steps or treatment.
- (v) Seeking professional and medical help - A lot of help is available in the form of highly qualified psychologists, psychiatrists, and de-addiction and rehabilitation programs to help individuals who have unfortunately got into the quagmire of drug/alcohol abuse. With such help, the affected individual with sufficient efforts and will power, can get rid of the problem completely and lead a perfectly normal and healthy life.

17.

- Certain bacteria which grow anaerobically on cellulosic material produce large amount of Methane along with CO_2 and H_2. These bacteria are collectively called methanogens, and one such common bacterium is *Methanobacterium.*
- These bacteria are commonly found in the anaerobic sludge during sewage treatment.
- These bacteria are also present in the rumen, a part of stomach of cattle. A lot of cellulosic material present in the food of cattle is also present in the rumen.
- In rumen, these bacteria help in the breakdown of cellulose and play an important role in the nutrition of cattle.

- The excreta(dung) of a cattle, commonly called gobar, is rich in these bacteria.
- Dung can be used for generation of biogas, commonly called gobar gas.

18.

- Several nematodes parasites a wide variety of plants and animals including human beings.
- A nematode *Meloidegyne incognitia* infects the roots of tobacco plants and causes a great reduction in yield.
- A novel strategy was adopted to prevent this infestation which was based on the process of RNA interference (RNAi).
- RNAi takes place in all eukaryotic organisms as a method of cellular defense.
- This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA (silencing).
- The source of this complementary RNA could be from an infection by viruses having RNA genomes or mobile genetic elements (transposons) that replicate via an RNA intermediate.
- Using *Agrobacterium* vectors, nematode-specific genes were introduced into the host plant.
- The introduction of DNA was such that it produced both sense and anti-sense RNA in the hostcells.
- These two RNA's being complementary to each other formed a double stranded (dsRNA) that initiated RNAi and thus, silenced the specific mRNA of then ematode.
- The consequence was that the parasite could not survive in a transgenic host expressing specific interfering RNA.
- The transgenic plant therefore got itself protected from the parasite.

19.

- In *Bacillus thuringiensis*, there is a bacterial gene which produce toxic crystal protein having insecticidal activity. This crystal protein is called Cry protein.
- Bt toxin is produced by a bacterium called *Bacillus thuringiensis*.
- Bt toxin gene has been cloned from the bacteria and been expressed in plants.
- So plants become resistance to insects without the need for insecticides. This is how a *biopesticide is* created.
- Some strains of *Bacillus thuringiensis* produce proteins that kill certain insects such as *lepidopterans* (tobacco budworm, armyworm), *coleopterans* (beetles) and *dipterans* (flies, mosquitoes).
- *B. thuringiensis* forms protein crystals during a particular phase of their growth.
- These crystals contain a toxic insecticidal protein.
- Actually, the Bt toxin protein exist as inactive protoxins.
- But once an insect ingest the inactive toxin, it is converted into an active form of toxin due to the alkaline pH of the gut which solubilise the crystals.
- The activated toxin binds to the surface of midgut epithelial cells and create pores.
- That cause cell swelling and lysis and eventually cause death of the insect.
- Specific Bt toxin genes were isolated from *Bacillus thuringiensis* and incorporated into the several crop plants such as cotton.
- The proteins encoded by the genes cryIAc and cryIIAb control the cotton bollworms.
- CryIAb controls corn borer.

20.

- The detritus food chain (DFC) begins with dead organic matter.
- It is made up of decomposers which are heterotrophic organisms, mainly fungi and bacteria.
- They meet their energy and nutrient requirements by degrading dead organic matter or detritus.
- These are also known as saprotrophs (sapro: to decompose).
- Decomposers secrete digestive enzymes that breakdown dead and waste materials into simple, inorganic materials, which are subsequently absorbed by them.
- In an aquatic ecosystem, GFC is the major conduit for energy flow.
- As against this, in a terrestrial ecosystem, a much larger fraction of energy flows through the detritus food chain than through the GFC.
- Detritus food chain may be connected with the grazing food chain at some levels: some of the organisms of DFC are prey to the GFC animals, and in a natural ecosystem, some animals like cockroaches, crows, etc., are omnivores.
- These natural interconnection of food chains make it a food web.

21.

- Stanford ecologist Paul Ehrlich used an analogy to give a proper perspective about biodiversity.
- In an airplane (ecosystem) all parts are joined together using thousands of rivets (species).
- If every passenger travelling in it starts popping a rivet to take home (causing a species to become extinct), it may not affect flight safety (proper functioning of the ecosystem) initially, but as more and more rivets are removed, 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 is obviously a more serious threat to flight safety than loss of a few rivets on the seats or windows inside the plane.
- The wings of airplane is compared with key species that drive major ecosystem functions.

Section C

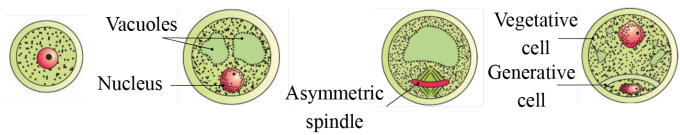
➢ **Write the answer of the following questions : (Each carries 4 Mark)**

22.

- The pollen grains represent the male gametophytes.
  - Pollen grains are generally spherical measuring about 25-50 micrometers in diameter.
  - It has a prominent two-layered wall. The hard outer layer called the exine and the inner wall of the pollen grain is called the intine.

    (i) Exine
- It is made up of sporopollenin which is one of the most resistant organic material known.
- It can withstand high temperatures and strong acids and alkali.
- No enzyme that degrades sporopollenin is known so far.
- Pollen grains are well-preserved as fossils because of the presence of sporopollenin.
- The exine exhibits a fascinating array of patterns and designs.
- The exine should be hard because it protects pollen grains.
- Germ pores
  - Pollen grain exine has prominent apertures called germ pores where sporopollenin is absent.
  - Function of germ pore : It is primarily responsible for the formation of pollen tubes.

    (ii) Intine
- The inner wall of the pollen grain is called the intine.
- It is a thin and continuous layer made up of cellulose and pectin.
- The cytoplasm of pollen grain is surrounded by a plasma membrane.
- When the pollen grain is mature it contains two cells, the vegetative cell and the generative cell.



  - (i) Vegetative cell

    It is bigger, has abundant food reserve and a large irregularly shaped nucleus.
  - (ii) Generative cell

    It is small and floats in the cytoplasm of the vegetative cell.

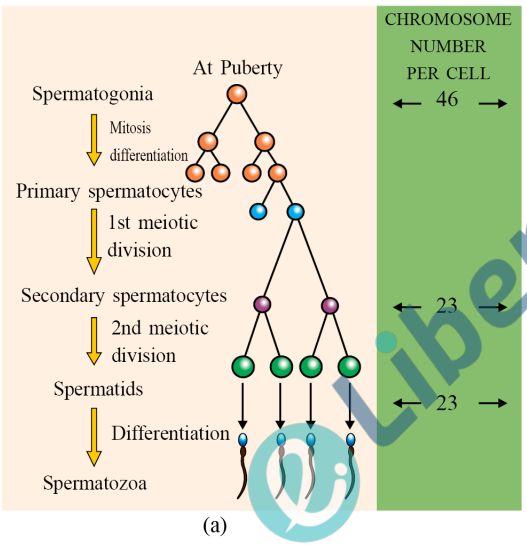
    It is spindle shaped with dense cytoplasm and a nucleus.

    In over 60 per cent of angiosperms, pollen grains are shed at this 2-celled stage.

    In the remaining species, the generative cell divides mitotically to give rise to the two male gametes before pollen grains are shed (3-celled stage).

23.

- Ans. Spermatogenesis is a process by which mature sperm cells are produced from immature male germ cells (spermatogonia) in testes. It begins at puberty.
- The spermatogonia (sing. spermatogonium) are present on the inside wall of seminiferous tubules.
- They multiply by mitotic division and increase in numbers.
- Each spermatogonium is diploid and contains 46 chromosomes.
- Some of the spermatogonia called primary spermatocytes, periodically undergo meiosis.
- A primary spermatocyte completes the first meiotic division (reduction division) leading to formation of two equal, haploid cells called secondary spermatocytes, which have only 23 chromosomes each.
- The secondary spermatocytes undergo the second meiotic division to produce four equal, haploid spermatids. The number of chromosome in each spermatid is 23.
- The spermatids are transformed into spermatozoa (sperms) by the process called spermiogenesis.
- After spermiogenesis, sperm heads become embedded in the sertoli cells, and are finally released from the seminiferous tubules by the process called spermiation.



(a)

24.

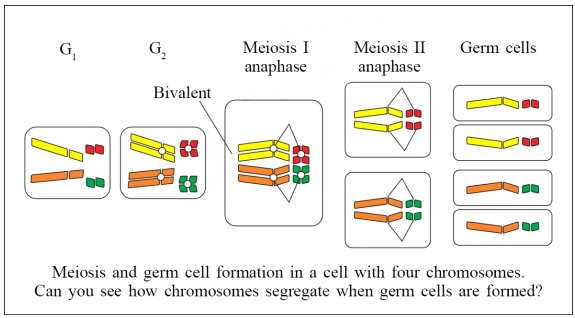
- Proposed by Walter Sutton & Theodore Boveri.
- They said that pairing & separation of a pair of chromosomes lead to segregation of a pair of factors they carried.
- Sutton united chromosomal segregation with Mendelian principles and called it the chromosomal theory of inheritance. It states that :

  (a) Chromosomes are vehicles of heredity.

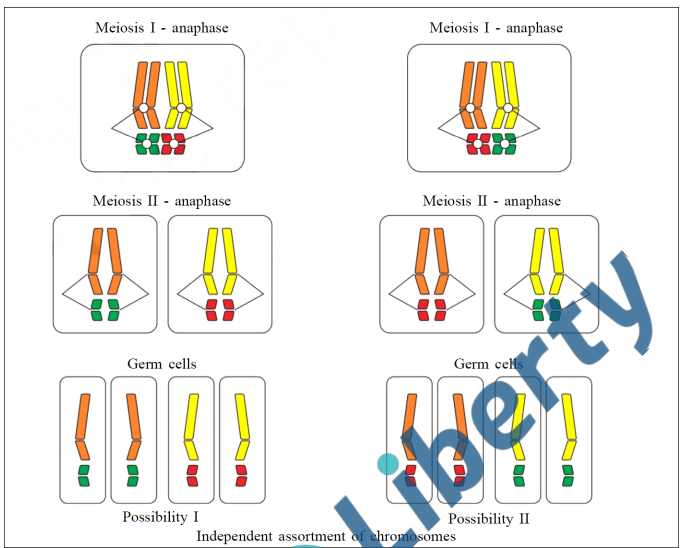
  (b) Two identical chromosomes form a homologous pair.

  (c) Homologous pair segregates during gamete formation.

  (d) Independent pairs segregate independently of each other. Genes (factors) are present on chromosomes. Hence genes and chromosomes show similar behaviours.



Meiosis and germ cell formation in a cell with four chromosomes.
Can you see how chromosomes segregate when germ cells are formed?



Thomas Hunt Morgan proved chromosomal theory of inheritance using fruit flies *(Drosophila melanogaster)*.

It is the suitable material for genetic study because :

- They can grow on simple synthetic medium.
- Short generation time (life cycle: 12-14 days).
- Breeding can be done throughout the year.
- Hundreds of progenies per mating.
- Male and female flies are easily distinguishable e.g. Male is smaller than female.
- It has many types of hereditary variations that can be seen with low power microscopes.

25.

- In eukaryotes, there are two additional complexities -

  (i) There are at least three RNA polymerases in the nucleus (in addition to the RNA polymerase found in the organelles). There is a clear cut division of labour. The RNA polymerase I transcribes rRNAs (28S, 18S, and 5.8S), whereas the RNA polymerase III is responsible for transcription of tRNA, 5srRNA, and snRNAs (small nuclear RNAs). The RNApolymerase II transcribes precursor of mRNA, the heterogeneous nuclear RNA (hnRNA).

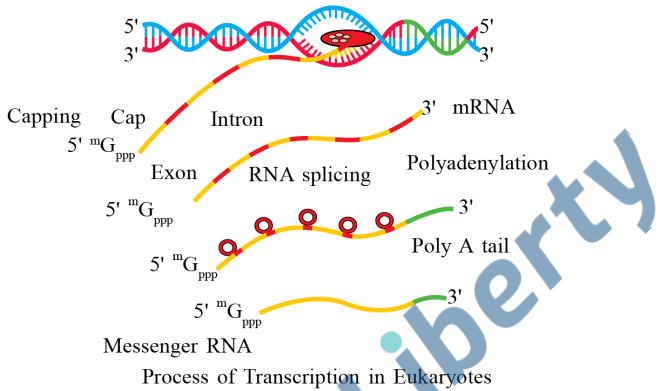
  (ii) The second complexity is that the primary transcripts contain both the exons and the introns and are non-functional.

- Post-Transcriptional changes
- Hence, it is subjected to a process called splicing where the introns are removed and exons are joined in a defined order.

  hnRNA undergoes additional processing called as capping and tailing

Capping	Tailing
In capping an unusual nucleotide (methyl guanosine triphoshate) is added to the 5'-end hnRNA.	In tailing, adenylate residues (200-300) are added at 3'-end in a template. independent manner.

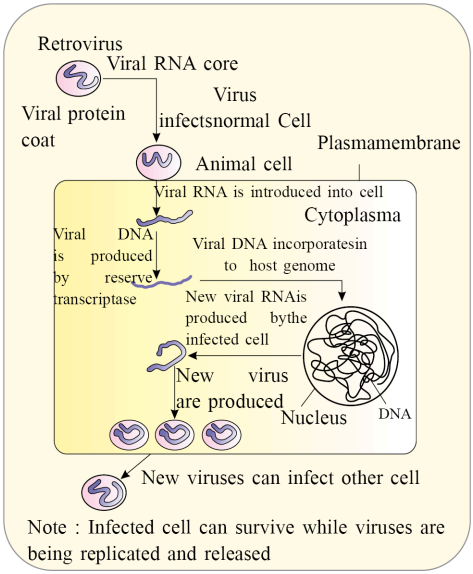
- It is the fully processed hnRNA, now called mRNA, that is transported out of the nucleus for translation.
- The significance of such complexities is now beginning to be understood. The split-gene arrangements represent probably an ancient feature of the genome.
- The presence of introns is reminiscent of antiquity, and the process of splicing represents the dominance of RNA-world.
- In recent times, the understanding of RNA and RNA-dependent processes in the living system have assumed more importance.



Process of Transcription in Eukaryotes

26.

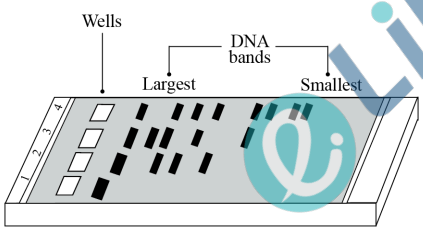
- Mechanism of action/replication of HIV :
- 1) HIV (Human Immunodeficiency virus) is an RNA virus
  - Its structure includes identical RNA strands, reverse transcriptase which are enclosed in protein coat.
  - Target cell of HIV- Macrophage & Helper T- lymphocyte (TH).
  - HIV first binds to the receptor on host macrophage where fusion of HIV takes place.
  - HIV RNA/ viral RNA- released in cytoplasm which undergoes reverse transcription with Reverse transcriptase enzyme- HIV DNA/ viral DNA.
  - Viral DNA enters host nucleus & integrates with host DNA transcription- new viral RNA forms viral genome & some translates in cytoplasm to new viral proteins.
  - Viral proteins & RNA- moves to surface of cell & buds off as new HIV.
  - They target helper T-lymphocyte- replicates & produce progeny virus- reduces helper T- lymphocytes.



Replication of retrovirus

27.

- The techniques used for separation and isolation of DNA fragments is known as gel electrophoresis.
- In this method Agarose gel is used as a medium.
- The cutting of DNA by restriction endonucleases results in the fragments of DNA.
- These fragments can be separated by a technique as shown in figure.



- Since, DNA fragments are negatively charged molecules they can be separated by forcing them to move towards the anode under an electric field througha medium/matrix.
- The DNA fragments separate (resolve) according to their size through sieving effect provided by the agarose gel.
- Hence, the smaller the fragment size, the farther it moves.
- The separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation.
- DNA appears as bright orange coloured bands of DNA in an ethidium bromide stained gel exposed to UV light.
- The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution.
- The DNA fragments purified in this way are used in constructing recombinant DNA by joining them with cloning vectors.