LIBERTY PAPER SET

STD. 12 : Biology

Full Solution

Time : 3 Hours **ASSIGNTMENT PAPER 14**

Part A

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

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Part B

Section A

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

1.

➥ Apomixis is the process of seed formation without the occurrence of fertilisation

➥ It plays a vital role in the production of hybrid seeds. Apomixis inhibits the loss of desired characters in a hybrid.

➥ Also the process of production of hybrid seeds through cultivation is expensive. Therefore, apomixis is used for the production of hybrid seeds.

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.

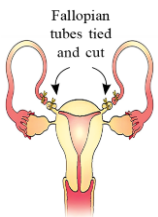
➥ It needs to be emphasised that the selection of a suitable contraceptive method and its use should always be undertaken in consultation with qualified medical professionals.

➥ 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.



Tubectomy

3.

➥ Inheritance : It is the process by which characters are passed on from parent to progeny. It is the basis of heredity.

➥ Variation : Variation is the degree by which progeny differs from their parents.

4.

➥ 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).

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- 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.

5.

- Ernst Haeckel gave the embryological basis of development.
- Based on his observation some traits are common in all lineages during the embryonic stage, but absent in the adult organism.
- For example, in the embryos of all vertebrates including humans, there is a row of vestigial folds behind the head, but it is only functional in fish, not in other adult vertebrates.
- However, the proposed embryological basis of this development was rejected in a careful study by Karl Ernst von Baer.
- He noted that embryos sometimes do not pass through the adult stages of other animals.

6.

- Amoebiasis (Amoebic dysentery) : Pathogen is Entamoeba histolytica.
  - Mode of transmission : Houseflies (mechanical carriers) transmit parasites from faeces to food & water.
  - Symptoms : constipation, abdominal pain and cramps, stools with excess mucus and blood clots.

7.

- Distillation: whisky, brandy and rum are produced by distillation of the fermented broth.
- Non distillate: Wine and beer are produced without distillation.

8.

- Population growth at given time (t + 1) :
- $Nt + 1 = Nt + [(B + I) – (D + E)]$,

  Where,

  $Nt + 1$ = population density at a given time

  Nt = initial population density

  B = Natality

  I = Number of immigrants

  D = Mortality

  E = Number of emigrants

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9.

- 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.

10.

- It is a once a week oral contraceptive pill
- It is developed by CDRI, Lucknow
- It is non-steroidal Preparation

11.

- Considering that the parasitic mode of life ensures free lodging and meals, it is not surprising that parasitism has evolved in so many taxonomic groups from plants to higher vertebrates.
- Many parasites have evolved to be host-specific (they can parasitise only a single species of host) in such a way that both host and the parasite tend to co-evolve; that is, if the host evolves special mechanisms for rejecting or resisting the parasite, the parasite has to evolve mechanisms to counteract and neutralise them, in order to be successful with the same host species.
- In accordance with their life styles, parasites evolved special adaptations such as the loss of unnecessary sense organs, presence of adhesive organs or suckers to cling on to the host, loss of digestive system and high reproductive capacity.
- The life cycles of parasites are often complex, involving one or two intermediate hosts or vectors to facilitate parasitisation of its primary host.
- The human liver fluke (a trematode parasite) depends on two intermediate hosts (a snail and a fish) to complete its life cycle. The malarial parasite needs a vector (mosquito) to spread to other hosts.
- Majority of the parasites harm the host; they may reduce the survival, growth and reproduction of the host and reduce its population density. They might render the host more vulnerable to predation by making it physically weak.

- **Ectoparasite :**
  - Parasites that feed on the external surface of the host organism are called ectoparasites.
  - The most familiar examples of this group are the lice on humans and ticks on dogs.
  - Many marine fish are infested with ectoparasitic copepods.
  - Cuscuta, a parasitic plant that is commonly found growing on hedge plants, has lost its chlorophyll and leaves in the course of evolution.
  - It derives its nutrition from the host plant which it parasitises. The female mosquito is not considered a parasite, although it needs our blood for reproduction.

- **Endoparasite :**
  - In contrast, endoparasites are those that live inside the host body at different sites (liver, kidney, lungs, red blood cells, etc.).
  - The life cycles of endoparasites are more complex because of their extreme specialisation.
  - Their morphological and anatomical features are greatly simplified while emphasising their reproductive potential.

- **Brood parasitism :**
  - Brood parasitism in birds is a fascinating example of parasitism in which the parasitic bird lays its eggs in the nest of its host and lets the host incubate them.
  - During the course of evolution, the eggs of the parasitic bird have evolved to resemble the host's egg in size and colour to reduce the chances of the host bird detecting the foreign eggs and ejecting them from the nest.

12.

- Standing crop of a trophic level represents the total mass of living material or energy content of all the organisms of a trophic level at a particular time and location.

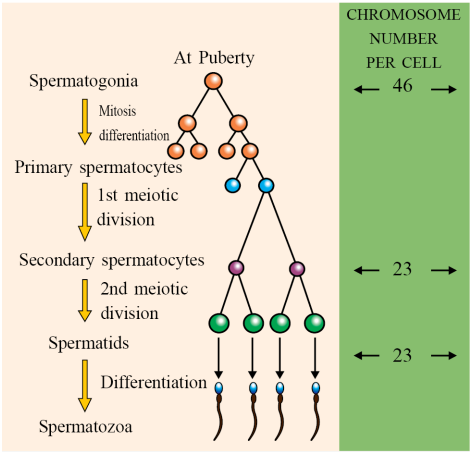
Section B

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

13.

- 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)

14.

- In living cells, such as E.coli, the process of replication requires a set of catalysts (enzymes).
- The main enzyme is referred to as DNA-dependent DNA polymerase, since it uses a DNA template to catalyse the polymerisation of deoxynucleotides.
- These enzymes are highly efficient as they have to catalyse polymerisation of a large number of nucleotides in a very short time.
- E.coli that has only 4.6×10^6 bp (compare it with human whose diploid content is 6.6×10^9 bp), completes the process of replication within 18 minutes; that means the average rate of polymerisation has to be approximately 2000 bp per second.
- Not only do these polymerases have to be fast, but they also have to catalyse the reaction with high degree of accuracy.
- Any mistake during replication would result into mutations. Furthermore, energetically replication is a very expensive process.
- Deoxyribonucleoside triphosphates serve dual purposes.
  - (i) act as a substrates.
  - (ii) provide energy for polymerisation reaction
  - (the two terminal phosphates in a deoxynucleoside triphosphates are high-energy phosphates, same as in case of ATP).
- DNA-dependent DNA polymerases :
- In addition to DNA-dependent DNA polymerases, many additional enzymes are required to complete the process of replication with high degree of accuracy.
- Replication fork :
- For long DNA molecules, since the two strands of DNA cannot be separated in its entire length (due to very high energy requirement), the replication occurs within a small opening of the DNA helix, referred to as replication fork.
- Continuous, discontinuous. Strands :
- The DNA-dependent DNA polymerases catalyse polymerisation only in one direction, that is5' → 3'.
- This creates some additional complications at the replicating fork.
- Consequently, on one strand (the template with polarity 3' → 5'), the replication is continuous, while on the other (the template with polarity5' → 3'), it is discontinuous.
- The discontinuously synthesised fragments are later joined by the enzyme DNA ligase.

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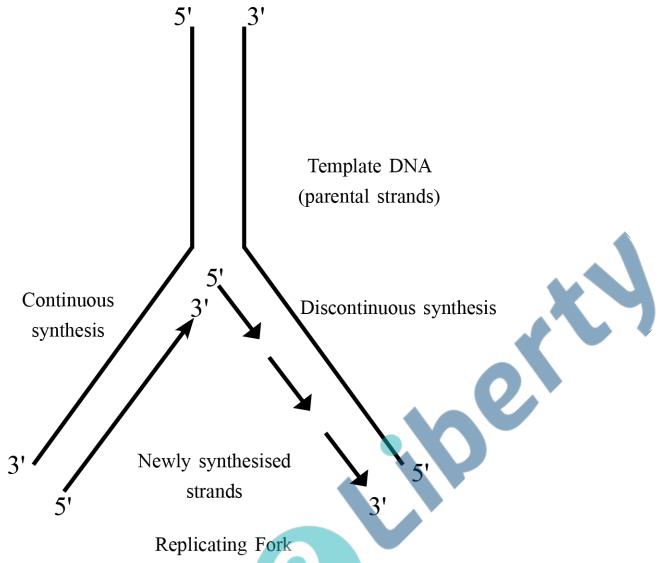
- Origin of replication :
- The DNA polymerases on their own cannot initiate the process of replication.
- Also the replication does not initiate randomly at any place in DNA.
- There is a definite region in E. coli DNA where the replication originates. Such regions are termed as origin of replication.
- It is because of the requirement of the origin of replication that a piece of DNA if needed to be propagated during recombinant DNA procedures, requires a vector.
- The vectors provide the origin of replication.
- Ccll division & DNA replication :
- In eukaryotes, the replication of DNA takes place at S-phase of the cell-cycle.
- The replication of DNA and cell division cycle should be highly coordinated.
- A failure in cell division after DNA replication results into polyploidy (a chromosomal anomaly).



15.

- Evidence of the emergence and development of life on earth is obtained from many directions.
- Fossils are the hard parts of life forms in rocks.
- Rocks, sediments and layers of the Earth's layers indicate the layering of organic elements over Earth's long history.
- Sedimentary rocks of different ages contain fossils of different life forms that must have died out during the formation of these particular rocks.
- Some of them show similarities with modern organisms. They represent extinct organisms.
- This study shows that life-forms change with time. And some life-forms do not change for certain planetary periods.
- Therefore, new life-forms have come into existence at different times in the history of the earth.
- All this is called fossil evidence.
- The age of fossils can be known by the method of radioactivity-dating.

16.

- Worm like *roundworm* and *wuchereria* like filariasis worm (elephantiasis worm) are pathogenic in humans.
- 1) Ascariasis :
  - Intestinal parasitic worms (*Ascaris lumbricoid*) are responsible for this disease.
- Spread through :
  - The eggs of this parasite come out with the faeces of the infected person. It contaminates the soil, water and plants. Its spread in a healthy person is by consuming such contaminated water, vegetables, fruits etc.

- Symptoms :
  - Internal bleeding, muscle pain, fever, anemia and intestinal obstruction.
- 2) Elephantasis -Filariasis :
- Pathogens : *wuchereria (w.bancrofti & w.malayi)*
- Spread through :
  - The pathogen are transmitted to a healthy person through the bite by female mosquito vector (*Culex fatigen*).
- Symptoms :
  - These worms slowly cause chronic inflammation in the lymphatic vessels of animals and remain in the host for years, hence the disease is called elephantiasis.
  - Often the genitals are also affected by this disease, causing many deformities.

17.

- Due to our present day life styles, environmental pollution is a major cause of concern.
  - The use of chemical fertilizers to meet the *ever-increasing demand* of agricultural produce *has contributed* significantly to this pollution.
  - There are *problems associated* with the overuse of chemical fertilizers and there is a large pressure to switch to organic farming – the use of biofertilizers.
  - Biofertilizers are organisms that enrich the nutrient quality of the soil.
  - The main sources of biofertilizers are bacteria, fungi and cyanobacteria.
  - The nodules on the roots of leguminous *plants are formed* by the symbiotic association of *Rhizobium.*
  - *These bacteria fix atmospheric* nitrogen into organic forms, which is used by the plant *as nutrient.*
  - Other bacteria can fix atmospheric nitrogen while free-living in the soil *Azospirillum* and *Azotobacter,* enriching *the nitrogen* content of the soil.
  - Fungi are also known to form symbiotic associations with plants(mycorrhiza).
  - Many members of the genus Glomus form mycorrhiza.
  - The fungal symbiont in these associations absorbs phosphorus from soil and passes it to the plant.
  - In paddy fields, *cyanobacteria serve* as an important biofertilizer.
  - Currently, in our country, a number of biofertilizers are available commercially in the market and farmers use these regularly in their fields to replenish soil nutrients and to reduce dependence on chemical fertilizers.
  - In agriculture, there is a method of controlling pests that relies on natural predation rather than introduced chemicals.
  - The use of biocontrol measures will greatly reduce our dependence on toxic chemicals and pesticides.
  - A biological control being developed for use in the treatment of *plant disease* is the fungus *Trichoderma. Trichoderma* species are free-living fungi.
  - *Trichoderma* is a biocontrol agent of several plant pathogens.

18.

- Advantages of GM crops :
  - (i) made crops more tolerant to abiotic stresses such as cold, drought, salt, heat.
  - (ii) reduced reliance on chemical pesticides (pest-resistant crops).
  - (iii) helped to reduce post harvest losses.
  - (iv) this prevents early exhaustion of fertility of soil.
  - (v) enhanced nutritional value of food.
- Disadvantages of GM crops :
  - (i) Toxic and allergic metabolites can be produced.
  - (ii) By cultivating GM crop, it affects on the natural biodiversity of that ecosystem.
  - (iii) GM plants can be having harmful effects on human health and can add antibiotic resistance chemicals in the body.
  - (iv) Due to presence of Bt toxin in plants, leads to decrease in the pollination by insects.

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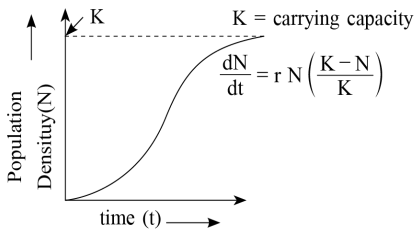
19.

- No population of any species in nature has at its disposal unlimited resources to permit exponential growth.
- This leads to competition between individuals for limited resources.
- Eventually, the 'fittest' individual will survive and reproduce.
- The governments of many countries have also realised this fact and introduced various restraints with a view to limit human population growth.
- In nature, a given habitat has enough resources to support a maximum possible number, beyond which no further growth is possible.
- This limit is nature's carrying capacity (K) for that species in that habitat.
- A population growing in a habitat with limited resources show initially a lag phase, followed by phases of acceleration and deceleration and finally an asymptote, when the population density reaches the carrying capacity.
- A plot of N in relation to time (t) results in a sigmoid curve. This type of population growth is called Verhulst-Pearl Logistic Growth.



- The Verhulst-Pearl Logistic Growth equation :
- dN / dt = rN (K-N/K)

  Where N = Population density at time t

  r = Intrinsic rate of natural increase

  K = Carrying capacity
- Since resources for growth for most animal populations are finite and become limiting sooner or later, the logistic growth model is considered a more realistic one.
- Gather from Government Census data the population figures for India for the last 100 years, plot them and check which growth pattern is evident.

20.

- As traditional breeding techniques failed to keep pace with demand and to provide sufficiently fast and efficient systems for crop improvement, another technology called tissue culture got developed.
- It was learnt by scientists, during 1950s, that whole plants could be regenerated from explants, i.e., any part of a plant taken out and grown in a test tube, under sterile conditions in special nutrient media.
- This capacity to generate a whole plant from any cell/explant is called totipotency.
- It is important to stress here that the nutrient medium must provide a carbon source such as sucrose and also inorganic salts, vitamins, amino acids and growth regulators like auxins, cytokinins etc.
- By application of these methods it is possible to achieve propagation of a large number of plants in very short durations.
- This called micro-propagation.
- Each of these plants will be genetically identical to the original plant from which they were grown, i.e., they are somaclones.
- Many important food plants like tomato, banana, apple, etc., have been produced on commercial scale using this method. Try to visit a tissue culture laboratory with your teacher to better understand and appreciate the process.
- Another important application of the method is the recovery of healthy pltnts from diseased plants.
- Even if the plant is infected with a virus, the meristem (apical and axillary) is free of virus.

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- Hence, one can remove the meristem and grow it in vitro to obtain virus-free plants. Scientists have succeeded in culturing meristems of banana. Sugarcane, potato. etc.
- Somatic hybridisation
- Scientists have even isolated single cells from plants and after digesting their cell walls have been able to isolate naked protoplasts (surrounded by plasm membranes).
- Isolated protoplasts from two different varieties of plants - each having a desirable character - can be fused to get hybrid protoplasts, which can be further grown to form a new plant. These hybrides are called somatic hybrids while the process is called somatic hybridisation.
- When a protoplast of tomato is fused with that potato, and then they are grown - to form new hybrid plants combining tomato and potato characteristics.
- Well this has been achieved - resulting in formation of pomato; unfortunately this plant did not have all the desired combination of characteristics for its commercial utilisation.

21.

- The most important of them are :
- (i) Genetic diversity :
  - A single species might show high diversity at the genetic level over its distributional range.
  - 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 :
  - The diversity at the species level, for example, the Western Ghats have a 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 a greater ecosystem diversity than a Scandinavian country like Norway.

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Section C

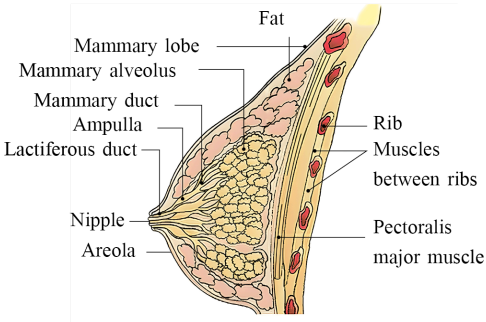
➢ **Write the answer of the following questions : (Each carries 4 Mark)**

22.

- Triple fusion occurs when a male gamete fuses with two polar nuclei within the embryo sac of flowering plants.
- The following events take place in triple fusion:
  - The pollen grains get dusted on stigma and germinate giving rise to a pollen tube that enters the ovule.
  - The pollen tube passes into one of the synergids and release two male gametes.
  - One out of the two gametes fuses with the egg nucleus and forms a zygote.
  - The other gamete fuses with the two polar nuclei located in the central cell and forms a triploid endosperm nucleus.
  - The nuclei involved in triple fusion are:
    - A male gamete nucleus (n)
    - Two polar nuclei (n + n)

23.

- A functional mammary gland is a characteristic of all female mammals.
- The mammary glands are paired structures (breasts) that contain glandular tissue and variable amount of fat.



- The glandular tissue of each breast is divided into 15-20 mammary lobes containing clusters of cells called alveoli.
- The cells of alveoli secrete milk, which is stored in the cavities (lumens) of alveoli.
- The alveoli open into mammary tubules.
- The tubules of each lobe join to form a mammary duct.
- Several mammary ducts join to form a wider mammary ampulla which is connected to lactiferous duct through which milk is sucked out.

24.

- (i) colourblindness, (ii) Haemophilia.
- **(i) Colour Blindness :**
  - It is a sex-linked recessive disorder due to defect in either red or green cone of eye resulting in failure do discriminate between red and green colour.
  - This defect is due to mutation in certain genes present in the X-chromosomes.
  - It occurs in about 8 per cent of males and only about 0.4 per cent of females.
  - This is because the genes that lead to red-green colour blindness are on the X-chromosomes.
  - Males have only one X-chromosomes and females have two.
  - The son of a woman who carries the gene has a 50 per cent chance of being colour blind.
  - The mother is not herself colour blind because the gene is recessive. That means that its effect is suppressed by her matching dominant normal gene.
  - A daughter will not normally be colour blind, unless her mother is a carrier and her father is colour blind.
- (ii) Haemophilia :
  - This sex linked recessive disease, which shows its transmission from unaffected carrier female to some of the male progeny has been widely studied.
  - In this disease, a single protein that is a part of the cascade of proteins involved in the clotting of blood is affected.
  - Due to this, in an affected individual a simple cut will result in non-stop bleeding.
  - The heterozygous female (carrier) haemophilia may transmit the disease to sons.
  - The possibility of a female becoming a haemophilic is extremely rare because mother of such a female has to be at least a carrier and the father should be haemophilic (unviable in the later stage of life.)
  - The family pedigree of Queen Victoria shows a number of haemophilic descendents as she was a carrier of the disease.

25.

- Transforming Principle
- In 1928, Frederick Griffith, in a series of experiments with Streptococcus pneumoniae (bacterium responsible for pneumonia), witnessed a miraculous transformation in the bacteria.
- During the course of his experiment, a living organism (bacteria) had changed in physical form.
- When Streptococcus pneumoniae (pneumococcus) bacteria are grown on a culture plate,

  (I) Some produce smooth shiny colonies (S) while others produce rough colonies (R).

  (II) This is because the S strain bacteria have a mucous (polysaccharide) coat, while R strain does not.

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- Mice infected with the S strain (virulent) die from pneumonia infection but mice infected with the R strain do not develop pneumonia.

S strain	⟶	Inject into mice	⟶ Mice die
R strain	⟶	Inject into mice	⟶ Mice live

- Griffith was able to kill bacteria by heating them.
- He observed that heat-killed S strain bacteria injected into mice did not kill them.

S strain ⟶ Inject into mice ⟶ Mice live
(heat-killed)

S strain
(heat-killed) ⟶ Inject into mice ⟶ Mice die
+
R strain
(live)

- When he injected a mixture of heat-killed S and live R bacteria, the mice died. Moreover, he recovered living S bacteria from the dead mice.
- He concluded that the R strain bacteria had somehow been transformed by the heat-killed S strain bacteria.
- Some 'transforming principle', transferred from the heat-killed S strain, had enabled the R strain to synthesise a smooth polysaccharide coat and become virulent.
- This must be due to the transfer of the genetic material. However, the biochemical nature of genetic material was not defined from his experiments.

26.

- (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.

27.

- Small volume cultures cannot yield appreciable quantities of products.
- To produce in large quantities, the development of bioreactors, where large volumes (100-1000 litres) of culture can be processed.
- Thus, bioreactors can be thought of as vessels in which raw materials are biologically converted into specific products, individual enzymes, etc.,using microbial plant, animal or human cells.
- A bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions temperature, pH, substrate, salts, vitamins, oxygen etc.

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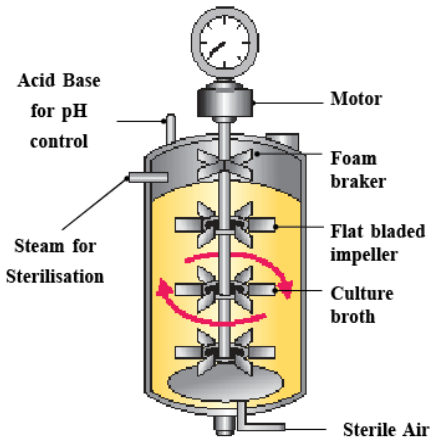
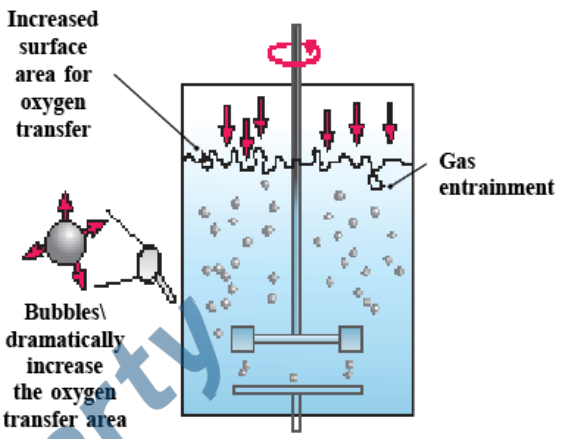
- The most commonly used bioreactors are of stirring type.
- A stirred-tank reactor is usually cylindrical or with a curved base to facilitate the mixing of the reactor contents.
- The stirrer facilitates even mixing and oxygen availability throughout the bioreactor.
- Alternatively air can be bubbled through the reactor.
- The bioreactor has an agitator system, an oxygen delivery system and a foam control system, a temperature control system, pH control system and sampling ports so that small volumes of the culture can be withdrawn periodically.
- The cells can also be multiplied in a continuous culture system wherein the used medium is drained out from one side while fresh medium is added from the other to maintain the cells in their physiologically most active log/exponential phase.
- This type of culturing method produces a larger biomass leading to higher yields of desired protein.





Liberty