



Chapter 1: Sexual Reproduction in Flowering Plants

QUICK REVISION: ONE-LINER QUESTIONS AND ANSWERS

1. What is the reproductive part of a flowering plant? **- The flower.**
2. What is the male part of a flower called? **- The Androecium.**
3. The androecium is made of what units? **- Stamens.**
4. A stamen has which two parts? **- The anther and the filament.**
5. What part of the anther makes pollen? **- The microsporangium (or pollen sac).**
6. What is the ploidy of a microspore mother cell? **- Diploid (2n).**
7. How do microspore mother cells form microspores? **- Through meiosis.**
8. What is the ploidy of a pollen grain? **- Haploid (n).**
9. What is the hard outer layer of pollen? **- The exine.**
10. What tough material makes the exine? **- Sporopollenin.**
11. What is the thin inner layer of pollen? **- The intine.**
12. Name the two cells in a mature pollen grain. **- The vegetative cell and generative cell.**
13. Which pollen cell is larger and forms the pollen tube? **- The vegetative cell.**
14. Which pollen cell forms the two male gametes? **- The generative cell.**
15. What is the female part of a flower called? **- The Gynoecium (or pistil).**
16. A pistil has which three parts? **- Stigma, style, and ovary.**
17. Which part of the pistil catches pollen? **- The stigma.**
18. What structure is found inside the ovary? **- The ovule.**
19. After fertilization, what does the ovule become? **- The seed.**
20. What sac inside the ovule holds the egg cell? **- The embryo sac.**
21. What is the ploidy of a megasporangium? **- Diploid (2n).**
22. Meiosis of a megasporangium produces how many megasporangia? **- Four.**
23. How many of the four megasporangia usually survive? **- Only one.**
24. A typical embryo sac has how many cells and nuclei? **- 7 cells, 8 nuclei.**
25. Name the three cells at the micropylar end. **- One egg cell and two synergids.**
26. What do we call the egg cell and its two synergids? **- The egg apparatus.**
27. Name the three cells at the opposite (chalazal) end. **- The antipodal cells.**
28. What is the large cell in the middle of the embryo sac? **- The central cell.**
29. What two nuclei are in the central cell? **- The two polar nuclei.**
30. What is the transfer of pollen to a stigma called? **- Pollination.**
31. Pollination within the same flower is called what? **- Autogamy.**
32. Pollination between flowers on the same plant is called what? **- Geitonogamy.**
33. Pollination between flowers on different plants is called what? **- Xenogamy.**
34. What is pollination by wind called? **- Anemophily.**
35. What is pollination by insects called? **- Entomophily.**
36. What is pollination by water called? **- Hydrophily.**
37. Can the male gametes in flowering plants swim? **- No, they are non-motile.**
38. What tube grows from the pollen grain to the ovule? **- The pollen tube.**
39. How many male gametes does the pollen tube deliver? **- Two.**
40. What is the fusion of a male gamete and the egg cell? **- Syngamy (fertilization).**
41. Syngamy results in what new cell? **- The zygote.**
42. What is a zygote's ploidy? **- Diploid (2n).**
43. What is the second fertilization event in angiosperms? **- Triple fusion.**
44. What three nuclei fuse during triple fusion? **- One male gamete and two polar nuclei.**
45. Triple fusion forms what special nucleus? **- The Primary Endosperm Nucleus (PEN).**
46. What is the endosperm's ploidy? **- Triploid (3n).**
47. What do we call syngamy and triple fusion happening together? **- Double fertilization.**
48. What is the main job of the endosperm? **- To feed the growing embryo.**
49. The zygote grows into what structure? **- The embryo.**
50. What part of the ovule becomes the seed coat? **- The integuments.**
51. After fertilization, what does the ovary become? **- The fruit.**
52. What do we call a fruit that forms without fertilization? **- A parthenocarpic fruit.**
53. The banana is a natural example of what? **- Parthenocarpy.**
54. A fruit that develops only from the ovary is a what? **- A true fruit.**
55. A fruit that develops from more than the ovary is a what? **- A false fruit.**
56. The apple is a common example of what kind of fruit? **- A false fruit.**
57. An embryo developing from an unfertilized egg is called what? **- Parthenogenesis.**
58. What is it called when seeds form without any fertilization? **- Apomixis.**
59. What do we call it when a single seed has multiple embryos? **- Polyembryony.**
60. Polyembryony is common in which type of fruit? **- Citrus fruits.**

IMPORTANT QUESTIONS AND ANSWERS

1. **Mention the adaptations of wind-pollinated flowers.**
Wind-pollinated flowers are typically small and inconspicuous, lacking nectar and fragrance. They produce enormous quantities of lightweight, non-sticky pollen to increase dispersal by wind. Their stigmas are often large and feathery to effectively trap this airborne pollen.
2. **Define a clone. Write about one advantage and one disadvantage of a clone.**
A clone is a group of genetically identical organisms produced from a single parent via asexual reproduction. An **advantage** is the rapid preservation of desirable parental traits. A major **disadvantage** is the lack of genetic variation, making the entire population susceptible to the same diseases or environmental stresses.
3. **What are the names of the component cells of the embryo sac?**
A mature angiosperm embryo sac contains an **egg apparatus** (one egg cell and two synergids) at the micropylar end, three **antipodal cells** at the chalazal end, and one large **central cell** in the middle containing two polar nuclei.
4. **What do you understand by emasculation? Why is it done?**
Emasculation is the removal of anthers from a bisexual flower before they mature to prevent self-pollination. This technique is a crucial step in artificial hybridization programs, as it ensures that the flower can be cross-pollinated with pollen from a specifically chosen male parent to create improved plant varieties.
5. **Tell about false fruit with an example.**
A false fruit (or pseudocarp) is a fruit where the main fleshy part develops from tissues other than the ovary, such as the thalamus. This is unlike a true fruit, which develops solely from the ovary. A classic example is the apple, where the edible portion is the swollen, fleshy thalamus.
6. **Give the definition of monocarpic fruits with an example.**
Monocarpic plants are those that flower, produce fruit, and set seed only once in their entire lifetime before dying. Their fruits are a result of this single reproductive event. Well-known examples of monocarpic plants include bamboo and agave.
7. **Explain false fruit with an example.**
A false fruit is one in which the fleshy part is derived from tissues adjacent to the ovary, such as the thalamus or receptacle. In a true fruit, the flesh develops only from the ovary wall. A common example is the strawberry, where the red fleshy part is the swollen receptacle.
8. **Write a short note on asexual reproduction in organisms.**
Asexual reproduction is a method of reproduction involving a single parent that produces offspring, called clones, which are genetically identical to it. This process does not involve the fusion of gametes and is a rapid form of multiplication. Common methods include fission in bacteria, budding in yeast, and vegetative propagation in plants.
9. **Explain asexual reproduction in an organism with the help of example.**
Asexual reproduction is a process where an organism creates genetically identical offspring from a single parent. For instance, the freshwater organism *Hydra* reproduces asexually through budding. A bud develops as an outgrowth on the parent's body, matures into a miniature hydra, and then detaches to live independently.
10. **Define the following: (i) Protozoan endoparasite (ii) Ovule**
(i) **Protozoan endoparasite:** A single-celled eukaryotic parasite that lives inside its host's body, like *Plasmodium* which causes malaria. (ii) **Ovule:** The structure within a plant's ovary containing the female gamete; after fertilization, it develops into a seed.
11. **Define and give one example of each of the following. (i) False fruit (ii) True fruit (iii) Parthenogenic fruits (iv) Polyembryony**
(i) **False Fruit:** Develops from parts other than the ovary; Example: Apple. (ii) **True Fruit:** Develops only from the ovary; Example: Mango. (iii) **Parthenocarpic Fruit:** Develops without fertilization and is seedless; Example: Banana. (iv) **Polyembryony:** Presence of more than one embryo in a seed; Example: Citrus.
12. **What is the importance of embryo sac in angiospermic plants?**
The embryo sac is vital for sexual reproduction in angiosperms. It contains the egg cell, which upon fertilization forms the zygote, and the polar nuclei, which form the endosperm. The endosperm then serves as the nutritive tissue for the developing embryo.
13. **Show the well labelled diagram of an angiospermic 8-nucleate embryo-sac.**
A diagram shows an oval structure with an **egg apparatus** (one egg, two synergids) at the micropylar end, three **antipodal cells** at the chalazal end, and a large **central cell** with two **polar nuclei**.
14. **Define cross-pollination with the help of suitable example.**
Cross-pollination is the transfer of pollen from the anther of a flower on one plant to the stigma of a flower on a different plant of the same species. This process is essential for genetic variation. For example, papaya plants, being dioecious, depend entirely on cross-pollination by agents like wind or insects.
15. **What do you understand by parthenogenesis ? Explain with example.**
Parthenogenesis is a form of asexual reproduction where an embryo develops from an unfertilized egg. For example, in honeybees, the male drones are produced from the queen's unfertilized haploid eggs, while female workers and queens develop from fertilized diploid eggs.
16. **Describe the structure of microsporangium.**
A microsporangium (pollen sac) is typically surrounded by four wall layers: the epidermis, endothecium, middle layers, and the innermost nutritive tapetum. At its center lies the sporogenous tissue, which contains microspore mother cells that produce pollen grains.
17. **Explain double fertilization.**
Double fertilization, unique to angiosperms, involves two fusions. One male gamete fuses with the egg to form the diploid (\$2n\$) zygote. The second male gamete fuses with the two polar nuclei in the central cell to form the triploid (\$3n\$) primary endosperm nucleus, which nourishes the embryo.
18. **What is double fertilisation? in which plant group does it occur?**
Double fertilization is a complex reproductive process involving two fusions: one male gamete with the egg to form the zygote (\$2n\$), and the second with the two polar nuclei to form the endosperm (\$3n\$). This unique event occurs exclusively in **angiosperms** (flowering plants).
19. **What is polyembryony? Give example.**
Polyembryony is the condition of having more than one embryo in a single seed. It can occur when cells of the nucellus or integuments develop into additional embryos alongside the normal one. A common example is found in **citrus** fruits like oranges and lemons.



Chapter 2: Human Reproduction

QUICK REVISION: ONE-LINER QUESTIONS AND ANSWERS

1. What is the process of forming gametes called? - **Gametogenesis.**
2. What are the primary male reproductive organs? - **The testes.**
3. Where are the testes located outside the abdominal cavity? - **In the scrotum.**
4. Why is the scrotum located outside the body? - **To maintain a lower temperature for sperm production.**
5. What are the functional units of the testes where sperm are produced? - **The seminiferous tubules.**
6. What are the two main types of cells in the seminiferous tubules? - **Male germ cells (spermatogonia) and Sertoli cells.**
7. What is the function of Sertoli cells? - **To provide nutrition to the developing sperm.**
8. What cells outside the tubules secrete androgens like testosterone? - **Interstitial cells (or Leydig cells).**
9. What hormone directly controls spermatogenesis? - **Androgens (like testosterone).**
10. What is the correct sequence of cells during spermatogenesis? - **Spermatogonia → primary spermatocytes → secondary spermatocytes → spermatids → spermatozoa.**
11. What is the process of sperm formation called? - **Spermatogenesis.**
12. What is the ploidy of spermatogonia and primary spermatocytes? - **Diploid (2n).**
13. What is the ploidy of secondary spermatocytes and spermatids? - **Haploid (n).**
14. What are the three distinct regions of a mature sperm? - **Head, middle piece, and tail.**
15. What cap-like structure covers the anterior part of the sperm head? - **The acrosome.**
16. What is the function of the acrosome? - **It contains enzymes to help fertilize the ovum.**
17. What provides energy for sperm movement and is found in the middle piece? - **Mitochondria.**
18. What are the primary female reproductive organs? - **The ovaries.**
19. What are the two main functions of the ovaries? - **Producing the female gamete (ovum) and secreting female hormones.**
20. What is the process of ovum formation called? - **Oogenesis.**
21. Which female reproductive cell is haploid? - **The secondary oocyte.**
22. What is the ploidy of a human gamete (sperm or ovum)? - **Haploid, containing 23 chromosomes.**
23. What is the ploidy of a human zygote? - **Diploid, containing 46 chromosomes.**
24. Which organelle, essential for cell division, is absent from the ovum's cytoplasm? - **The centrosome.**
25. The female reproductive cycle in primates (humans, monkeys) is called what? - **The menstrual cycle.**
26. What is the term for the first occurrence of menstruation? - **Menarche.**
27. In which uterine layer do the major cyclic changes occur? - **The endometrium.**
28. Which three hormones are the primary regulators of the menstrual cycle? - **LH, FSH, and Estrogen.**
29. What is the release of an ovum from the ovary called? - **Ovulation.**
30. Which hormone surge is the main trigger for ovulation? - **Luteinizing Hormone (LH).**
31. On approximately which day of the menstrual cycle does ovulation occur? - **The 14th day.**
32. After ovulation, the ovum is surrounded by a layer of cells called what? - **The corona radiata.**
33. After ovulation, what does the ruptured Graafian follicle develop into? - **The corpus luteum.**
34. What is the primary hormone secreted by the corpus luteum? - **Progesterone.**
35. What is the main function of progesterone? - **To maintain the endometrium for pregnancy.**
36. What hormone is secreted by the corpus luteum and placenta to relax pelvic ligaments? - **Relaxin.**
37. In which part of the fallopian tube does fertilization typically occur? - **The ampillary region.**
38. What do we call fertilization that occurs inside the female's body? - **Internal fertilization.**
39. What is fertilization that occurs outside the body, as in jellyfish? - **External fertilization.**
40. The attachment of the blastocyst to the uterine wall is called what? - **Implantation.**
41. What organ connects the developing fetus to the uterine wall? - **The placenta.**
42. What structure forms a pore known as the blastopore during embryonic development? - **The gastrula.**
43. From which primary germ layer does the human heart develop? - **The mesoderm.**
44. After how long is the embryo's heart formed? - **After one month of pregnancy.**
45. When do the limbs and digits of the embryo develop? - **By the end of the second month.**
46. Approximately how many eggs does a healthy human female ovulate in her lifetime? - **About 400.**
47. Which animal is a hermaphrodite (has both male and female organs)? - **The earthworm.**
48. Which common insect is not a hermaphrodite? - **The housefly.**
49. What term describes animals that lay eggs, like hens and crocodiles? - **Oviparous.**

IMPORTANT QUESTIONS AND ANSWERS

1. Describe spermatogenesis in brief.

Spermatogenesis is the process of sperm production in the testes. It begins at puberty when diploid spermatogonia ($2n$) mature into primary spermatocytes ($2n$), which undergo meiosis I to form haploid secondary spermatocytes (n). These complete meiosis II to produce four haploid spermatids (n), which then mature into spermatozoa through **spermiogenesis**.

2. Differentiate between spermatogenesis and oogenesis.

Spermatogenesis, occurring in males from puberty, is a continuous process that produces four motile sperm from a single precursor cell. In contrast, oogenesis begins in the female fetus, is a discontinuous process, and results in the formation of only one large, non-motile ovum and smaller polar bodies due to unequal cytoplasmic division.

3. What is the function of Corpus Luteum?

The corpus luteum forms from the ruptured ovarian follicle after ovulation. Its primary function is to secrete large amounts of the hormone **progesterone**, which is essential for maintaining the uterine lining (endometrium) to support a potential pregnancy.

4. What are the roles of the placenta?

The placenta serves as the vital link between the mother and fetus. It facilitates the transport of **oxygen and nutrients** to the fetus, removes **waste products**, and acts as an endocrine gland, secreting hormones like **hCG and progesterone** to maintain pregnancy.

5. What are Sertoli cells? Write down their roles.

Sertoli cells are supportive cells within the seminiferous tubules of the testes. Their primary role is to **provide nourishment** and structural support to developing sperm cells during spermatogenesis. They also regulate the process and form the blood-testis barrier.

6. Give two main functions each of testis and ovary.

The **Testis** produces male gametes (sperm) and secretes the male hormone, **testosterone**. The **Ovary** produces the female gamete (ovum) and secretes the female hormones, **estrogen and progesterone**.

7. Describe the structure of a human sperm.

A human sperm consists of a **head, neck, middle piece, and tail**. The head contains the haploid nucleus and is capped by the **acrosome**, which has enzymes for fertilization. The middle piece is filled with **mitochondria** to provide energy for the tail's motility.

8. What are spermatogonia, primary spermatocytes and secondary spermatocytes?

These are successive stages in spermatogenesis. **Spermatogonia** are diploid ($2n$) germ cells that develop into **primary spermatocytes** ($2n$). These undergo meiosis I to form two haploid (n) **secondary spermatocytes**.

9. Differentiate between oestrous cycle and menstrual cycle.

The menstrual cycle (in primates) involves the shedding of the uterine lining (menstruation) if fertilization fails. In the oestrous cycle (in non-primates), the uterine lining is reabsorbed, and females are sexually receptive only during a specific 'heat' period.

10. Differentiate between external and internal fertilization.

Internal fertilization is the fusion of gametes inside the female's body, as seen in humans and birds. **External fertilization** is the fusion of gametes outside the body, which typically occurs in an aquatic environment, as seen in fish and frogs.

11. What is the menstrual cycle? Name its phases.

The menstrual cycle is the reproductive cycle in female primates involving cyclic changes in the ovary and uterus. Its four main phases are the **Menstrual Phase, Follicular Phase, Ovulatory Phase**, and the **Luteal Phase**.

12. What is implantation and where does it occur?

Implantation is the attachment and embedding of the blastocyst stage of the embryo into the uterine wall. This process allows the embryo to receive nourishment and occurs in the **endometrium** of the uterus.

13. What is the acrosome? State its function.

The acrosome is a cap-like structure on the head of a sperm containing hydrolytic enzymes. Its function is to release these enzymes to digest the outer layers of the ovum, enabling the sperm to penetrate and fertilize the egg.

14. What are the three primary germ layers? Mention one organ derived from each.

The three primary germ layers are the **Ectoderm** (forms skin, nervous system), **Mesoderm** (forms muscle, heart, bones), and **Endoderm** (forms the lining of the digestive tract and lungs).

15. What is parturition? Which hormone induces it?

Parturition is the process of childbirth, involving strong uterine contractions to expel the fetus. It is induced by a complex neuroendocrine mechanism, with the hormone **oxytocin** playing a major role in stimulating these powerful contractions.

16. Describe the structure of a human ovum.

The human ovum is a spherical, non-motile cell. It is enclosed by a plasma membrane, a glycoprotein layer called the **zona pellucida**, and an outer layer of follicular cells called the **corona radiata**.

17. What is colostrum? Why is it important?

Colostrum is the initial milk produced after childbirth. It is highly important because it is rich in **antibodies** (especially IgA), which provide crucial **passive immunity** to the newborn against infections.

18. What is the function of Leydig cells?

Leydig cells, located in the testes, are responsible for producing and secreting **androgens**, primarily **testosterone**. This hormone is essential for spermatogenesis and the development of male secondary sexual characteristics.

19. Name the accessory glands of the male reproductive system and state their collective function.

The accessory glands are the **seminal vesicles, prostate gland, and bulbourethral glands**. Their collective secretions form the seminal plasma, which provides nourishment, lubrication, and a protective medium for the sperm.

20. Explain the roles of LH and FSH during the menstrual cycle.

FSH stimulates the growth of ovarian follicles and their secretion of estrogen. A surge in **LH** triggers ovulation around day 14 and subsequently promotes the development of the corpus luteum, which secretes progesterone.



Chapter 3: Reproductive Health

QUICK REVISION: ONE-LINER QUESTIONS AND ANSWERS

1. What is a state of total well-being in all aspects of reproduction called?
- **Reproductive health.**
2. What major problem arises from a rapid increase in population?
- **Overpopulation, leading to scarcity of resources.**
3. What day is celebrated as World Population Day?
- **July 11th.**
4. According to the 2001 census, what was India's population growth rate?
- **Approximately 2%.**
5. What is the legal minimum age for marriage for girls and boys in India?
- **18 years for girls and 21 years for boys.**
6. What are the methods used to prevent unwanted pregnancies called?
- **Contraception or birth control.**
7. How do oral contraceptive pills primarily prevent pregnancy?
- **By inhibiting ovulation and implantation.**
8. What is 'Saheli'?
- **A non-steroidal, 'once-a-week' oral contraceptive pill for females.**
9. What are devices inserted into the uterus to prevent pregnancy called?
- **Intra-Uterine Devices (IUDs).**
10. Which IUD releases hormones?
- **LNG-20 (Progestasert).**
11. How does a Copper-T IUD work?
- **It releases copper ions that suppress sperm motility and fertilizing capacity.**
12. By what primary mechanism does Copper-T prevent pregnancy?
- **It prevents fertilization.**
13. What is the surgical method of contraception in males called?
- **Vasectomy.**
14. What is surgically cut or tied during a vasectomy?
- **The vas deferens.**
15. What is the surgical method of contraception in females called?
- **Tubectomy.**
16. What is surgically cut or tied during a tubectomy?
- **The fallopian tubes.**
17. Are vasectomy and tubectomy temporary or permanent methods of contraception?
- **They are permanent (sterilization) methods.**
18. What does MTP stand for?
- **Medical Termination of Pregnancy.**
19. What is another term for a voluntary or induced abortion?
- **MTP.**
20. Up to how many weeks of pregnancy is MTP considered relatively safe?
- **Up to 12 weeks (the first trimester).**
21. What are diseases transmitted through sexual intercourse called?
- **Sexually Transmitted Diseases (STDs) or Venereal Diseases (VDs).**
22. Name two common bacterial STDs.
- **Syphilis and Gonorrhoea.**
23. What is the causative pathogen for Syphilis?
- **Treponema pallidum.**
24. What is the inability to conceive or produce children called?
- **Infertility.**
25. What do we call the technologies used to help infertile couples have children?
- **Assisted Reproductive Technologies (ART).**
26. What is fertilization that occurs outside the body in a lab setting called?
- **In vitro fertilization (IVF).**
27. A baby conceived through IVF is commonly known as what?
- **A test-tube baby.**
28. What technique involves transferring an embryo (zygote) into the fallopian tube?
- **ZIFT (Zygote Intra-Fallopian Transfer).**
29. At what temperature is semen cryopreserved for long-term storage?
- **In liquid nitrogen (-196°C).**
30. What is the prenatal diagnostic technique used to detect genetic disorders in a fetus?
- **Amniocentesis.**
31. What is analyzed during amniocentesis?
- **The amniotic fluid.**
32. Which condition cannot be detected by amniocentesis?
- **Jaundice.**
33. What is the full form of RCH programs initiated by the government?
- **Reproductive and Child Health Care.**
34. Besides preventing pregnancy, what is another key function of condoms?
- **Protection against Sexually Transmitted Diseases (STDs).**
35. The "rhythm method," based on avoiding intercourse during the fertile period, is what kind of contraception?
- **A natural method.**
36. What is the term for pills taken after unprotected sex to prevent pregnancy?
- **Emergency contraceptives.**
37. What is the full form of AIDS?
- **Acquired Immuno Deficiency Syndrome.**
38. What virus causes AIDS?
- **Human Immunodeficiency Virus (HIV).**
39. Are all STDs completely curable?
- **No, viral STDs like AIDS and Genital Herpes are not completely curable.**
40. What is the full form of GIFT in the context of ART?
- **Gamete Intra-Fallopian Transfer.**
41. What ART involves directly injecting a sperm into an ovum in the laboratory?
- **ICSI (Intracytoplasmic Sperm Injection).**
42. What does the ART technique IUI stand for?
- **Intra-Uterine Insemination.**
43. Why is there a statutory ban on using amniocentesis for sex determination?
- **To prevent female foeticide.**
44. What are the three main categories of contraceptive methods?
- **Natural, Barrier, and Hormonal/Chemical methods.**
45. What is the full form of WHO?
- **World Health Organization.**
46. What is the term for the natural end of the menstrual cycle in women?
- **Menopause.**
47. What is the name for creams, jellies, and foams that kill sperm?
- **Spermicides.**
48. What is the most widely used contraceptive method by males in India?
- **Condoms.**

IMPORTANT QUESTIONS AND ANSWERS

1. **What are contraceptive pills ? How do they function ?**
Contraceptive pills are hormonal preparations, usually containing progestogen alone or a combination of progestogen and estrogen, taken orally by females to prevent pregnancy. They primarily function by **inhibiting ovulation** (the release of an egg from the ovary). They also alter the cervical mucus to prevent sperm entry and make the uterine wall unsuitable for implantation.
2. **What is sterilization? Mention its methods.**
Sterilization is a permanent surgical method of contraception that blocks the transport of gametes, thus preventing fertilization. The two main methods are **vasectomy** in males, where the vas deferens is cut and tied, and **tubectomy** in females, where the fallopian tubes are cut and tied.
3. **What is M.T.P.? Mention its safe and fatal period (time).**
MTP stands for Medical Termination of Pregnancy, which is the intentional or voluntary termination of pregnancy before the fetus becomes viable. The safe period for MTP is considered to be during the **first trimester** (up to 12 weeks of pregnancy). Abortions performed in the **second trimester** are much riskier.
4. **What is a test-tube baby?**
A 'test-tube baby' is a non-scientific term for a child conceived through **In Vitro Fertilization (IVF)**. In this process, an ovum from the female and sperm from the male are collected and induced to fertilize outside the body, in a laboratory dish. The resulting embryo is then transferred into the mother's uterus to complete its development.
5. **What is Amniocentesis?**
Amniocentesis is a prenatal diagnostic procedure in which a small amount of **amniotic fluid**, containing fetal cells, is withdrawn from the uterus. This fluid is then analyzed to detect **chromosomal abnormalities** and certain genetic disorders in the developing fetus. However, its misuse for sex determination is legally banned.
6. **Explain about vasectomy.**
Vasectomy is the surgical sterilization procedure for males. It involves making a small incision in the scrotum and cutting or tying the **vas deferens**, the tubes that carry sperm from the testes. This procedure blocks the transport of sperm, so they are not present in the ejaculate, thus preventing fertilization. It is a highly effective and permanent form of birth control.
7. **Explain tubectomy.**
Tubectomy is the surgical sterilization procedure for females. In this method, a small part of both **fallopian tubes** is removed or tied up through an incision in the abdomen or through the vagina. This blocks the path of the ovum, preventing it from meeting the sperm, and thus fertilization cannot occur. It is a permanent contraceptive method.
8. **Write the names of any four sexually transmitted diseases along with their causative pathogens.**
Four common sexually transmitted diseases (STDs) are: 1. **Syphilis**, caused by the bacterium *Treponema pallidum*. 2. **Gonorrhoea**, caused by the bacterium *Neisseria gonorrhoeae*. 3. **Genital Herpes**, caused by the Herpes simplex virus. 4. **AIDS**, caused by the Human Immunodeficiency Virus (HIV).
9. **Give a brief description of infertility.**
Infertility is the inability of a couple to conceive or produce children despite regular, unprotected sexual intercourse for a year or more. The causes can be varied and may lie with the male partner, the female partner, or both. These issues can be physical, congenital, immunological, or psychological. Many cases can be treated with the help of **Assisted Reproductive Technologies (ART)**.
10. **What are Assisted Reproductive Technologies (ART)? Give two examples.**
Assisted Reproductive Technologies (ART) are special medical procedures used to help infertile couples achieve pregnancy. These techniques handle either the eggs or the sperm. Two common examples are **In Vitro Fertilization (IVF)**, where fertilization occurs outside the body, and **Intra-Uterine Insemination (IUI)**, where sperm is directly placed into the uterus.
11. **What are Intra-Uterine Devices (IUDs)? Give one example.**
Intra-Uterine Devices (IUDs) are contraceptive devices inserted by medical professionals into the uterus. They prevent pregnancy either by increasing phagocytosis of sperm, suppressing sperm motility, or by making the uterus unsuitable for implantation. An example of a copper-releasing IUD is the **Copper-T**.
12. **What is the principle of barrier methods of contraception? Give an example.**
Barrier methods of contraception work on the principle of physically preventing the sperm from meeting the ovum. These methods create a barrier in the female reproductive tract. The most common example is the **condom**, which also provides the added benefit of protecting against sexually transmitted diseases (STDs).
13. **What is ZIFT? How is it different from GIFT?**
ZIFT stands for Zygote Intra-Fallopian Transfer. It is an ART where fertilization is done *in vitro*, and the resulting **zygote** or early embryo (up to 8 blastomeres) is transferred into the fallopian tube. It differs from GIFT (Gamete Intra-Fallopian Transfer), where the collected **gametes** (unfertilized eggs and sperm) are transferred directly into the fallopian tube to allow fertilization to occur inside the body.
14. **Explain the role of 'Saheli' as a contraceptive.**
'Saheli' is an oral contraceptive pill for females developed in India. It is a **non-steroidal** preparation that is taken 'once-a-week'. It works by inhibiting implantation of the embryo in the uterus. Due to its non-steroidal nature, it has very few side effects and high contraceptive value.
15. **What is biopiracy?**
Biopiracy refers to the use of bio-resources by multinational companies and other organizations without proper authorization from the countries and people concerned and without compensatory payment. It often involves patenting and commercializing traditional knowledge or genetic resources of a community or country without permission.



Chapter 4: Principles of Inheritance and Variation

QUICK REVISION: ONE-LINER QUESTIONS AND ANSWERS

1. Who is known as the Father of Genetics? - **Gregor Mendel.**
2. What plant did Mendel choose for his experiments? - **The garden pea (*Pisum sativum*).**
3. How many pairs of contrasting traits did Mendel study in pea plants? - **Seven.**
4. The basic units of heredity, which Mendel called 'factors', are now known as what? - **Genes.**
5. What are the alternative forms of a gene called? - **Alleles.**
6. Who first proposed the 'Genotype-Phenotype' concept? - **Wilhelm Johannsen.**
7. Which of Mendel's laws states that in a heterozygous pair, one allele expresses itself over the other? - **The Law of Dominance.**
8. Which of Mendel's laws states that alleles for a trait separate during gamete formation? - **The Law of Segregation.**
9. The Law of Segregation is also known as what? - **The Law of Purity of Gametes.**
10. Which two laws of inheritance were derived from the monohybrid cross? - **The Law of Dominance and the Law of Segregation.**
11. What is the phenotypic ratio of a typical monohybrid cross in the F₂ generation? - **3:1.**
12. What is the genotypic ratio of a typical monohybrid cross in the F₂ generation? - **1:2:1.**
13. Which of Mendel's laws is based on the dihybrid cross? - **The Law of Independent Assortment.**
14. What is the phenotypic ratio of a typical dihybrid cross in the F₂ generation? - **9:3:3:1.**
15. What phenomenon occurs when the F₁ generation has a phenotype intermediate between the two parents? - **Incomplete Dominance.**
16. The pink flowers from a cross between red and white-flowered Antirrhinum plants is an example of what? - **Incomplete Dominance.**
17. What is the phenotypic ratio in the F₂ generation for incomplete dominance? - **1:2:1.**
18. What phenomenon occurs when both alleles in a heterozygote express themselves fully? - **Codominance.**
19. Human ABO blood groups are a classic example of which two genetic principles? - **Codominance and Multiple Allelism.**
20. What is it called when a gene exists in more than two allelic forms? - **Multiple Allelism.**
21. Which blood group is the universal donor? - **Blood group O.**
22. Which blood group has no antigens on its red blood cells? - **Blood group O.**
23. Which blood group has no antibodies in its plasma? - **Blood group AB.**
24. If a child has blood group 'O' and the father has 'B', what must the father's genotype be? - **I^Bi (heterozygous).**
25. What is it called when a single gene influences multiple phenotypic traits? - **Pleiotropy.**
26. Sickle-cell anemia is a classic example of which genetic phenomenon? - **Pleiotropy.**
27. Who proposed the Chromosomal Theory of Inheritance? - **Sutton and Boveri.**
28. The physical exchange of genetic material between homologous chromosomes is called what? - **Crossing over.**
29. In which stage of meiosis does crossing over occur? - **Pachytene.**
30. The tendency of genes on the same chromosome to be inherited together is called what? - **Linkage.**
31. Linkage is considered an exception to which of Mendel's laws? - **The Law of Independent Assortment.**
32. The number of linkage groups in an organism is equal to what? - **Its haploid number of chromosomes (n).**
33. If an organism has 2n=14 chromosomes, how many linkage groups does it have? - **Seven.**
34. Who created the first recombination maps of chromosomes? - **Alfred Sturtevant.**
35. What is the phenomenon where one gene pair masks the effect of a non-allelic gene pair? - **Epistasis.**
36. What are the sex chromosomes in a human male? - **XY.**
37. What are the sex chromosomes in a human female? - **XX.**
38. Which chromosome determines maleness in humans? - **The Y-chromosome.**
39. In birds, which sex is heterogametic (produces two different types of gametes)? - **The female (ZW).**
40. The gene for hypertrichosis (hair on ears) is located on which chromosome? - **The Y-chromosome.**
41. What is a sudden, heritable change in the genetic material called? - **A mutation.**
42. What is a disease present from birth called? - **A congenital disease.**
43. Haemophilia is what type of genetic disorder? - **An X-linked recessive disorder.**
44. Why is Haemophilia also called "Bleeder's disease"? - **Because it impairs the body's ability to form blood clots.**
45. A person with color blindness cannot distinguish between which two colors? - **Red and green.**
46. Sickle-cell anemia is what type of genetic disorder? - **An autosomal recessive disorder.**
47. Which disease is caused by a defect in hemoglobin? - **Sickle-cell anemia.**
48. What is any change in the number or structure of chromosomes called? - **A chromosomal aberration.**
49. What is the condition of having an abnormal number of chromosomes (e.g., 2n±1, 2n±2) called? - **Aneuploidy.**
50. What is the trisomy of the 21st chromosome known as? - **Down's syndrome.**

IMPORTANT QUESTIONS AND ANSWERS

1. Write the laws proposed by Mendel on the basis of monohybrid cross.
Based on his monohybrid cross experiments, Mendel proposed two fundamental laws of inheritance. The first is the **Law of Dominance**, which states that in a heterozygous pair, one allele (the dominant) masks the expression of the other (the recessive). The second is the **Law of Segregation**, which states that the two alleles for a character separate or segregate from each other during gamete formation, so that each gamete receives only one allele.
2. What do you mean by Incomplete dominance? Explain with suitable example.
Incomplete dominance is a pattern of inheritance where the phenotype of the heterozygous offspring is an intermediate blend of the two homozygous parental phenotypes. Neither allele is completely dominant over the other. A classic example is the flower color in snapdragon plants (*Antirrhinum*). A cross between a red-flowered plant (RR) and a white-flowered plant (rr) results in all pink-flowered offspring (Rr).
3. Describe the law of segregation with any one example.
The Law of Segregation states that during gamete formation, the two alleles for a heritable character separate from each other, so that each gamete ends up with only one allele. For example, if a tall pea plant has the genotype Tt, its gametes will not be Tt. Instead, 50% of its gametes will carry the 'T' allele and 50% will carry the 't' allele, ensuring the purity of each gamete.
4. Define linkage.
Linkage is the tendency of genes that are located physically close to each other on the same chromosome to be inherited together during meiosis. These genes do not assort independently and are known as linked genes. The strength of linkage is inversely proportional to the distance between the genes; the closer the genes are, the higher the frequency of their joint inheritance.
5. Write about multiple allelism with an example.
Multiple allelism is a condition where a single gene exists in a population in more than two allelic forms. Although an individual can only have two alleles for a gene, many different alleles can exist within the gene pool of the population. The classic example in humans is the **ABO blood group system**, which is controlled by three alleles: I^A , I^B , and i .
6. Why did Mendel select pea plants for his experiments?
Mendel selected the garden pea plant (*Pisum sativum*) for several key reasons. It has a short life cycle and produces many offspring, allowing for the study of multiple generations quickly. It has several easily distinguishable contrasting traits (like height and seed color). Furthermore, its flowers are bisexual and naturally self-pollinating, but can be easily cross-pollinated, giving Mendel control over the breeding experiments.
7. Explain haemophilia.
Haemophilia is an **X-linked recessive** genetic disorder that impairs the body's ability to make blood clots, a process needed to stop bleeding. It is caused by a defect in one of the clotting factor genes located on the X chromosome. Because it is a recessive trait, it affects males more frequently than females, as males (XY) have only one X chromosome and will express the trait if they inherit the defective allele.
8. Write a brief note on Down's syndrome.
Down's syndrome is a chromosomal disorder caused by the presence of an extra copy of chromosome 21, a condition known as **Trisomy 21**. Individuals with this syndrome have 47 chromosomes instead of the usual 46. Common characteristics include short stature, a small round head, a flattened facial profile, and congenital heart defects, along with varying degrees of cognitive delay.
9. Comment upon Klinefelter syndrome.
Klinefelter syndrome is a chromosomal disorder affecting males, caused by the presence of an extra X chromosome, resulting in the karyotype **47, XXY**. Individuals with this syndrome are male but have underdeveloped testes, reduced testosterone production, and are typically sterile. They may also exhibit some feminine characteristics, such as the development of breast tissue (gynecomastia).
10. What do you mean by Mendelian disorder? Explain in brief with the help of suitable example.
A Mendelian disorder is a genetic disease caused by an alteration or mutation in a single gene. These disorders follow the patterns of inheritance established by Gregor Mendel. They can be dominant or recessive and may be autosomal (linked to non-sex chromosomes) or sex-linked. A suitable example is **Sickle-cell anemia**, which is an autosomal recessive disorder caused by a mutation in the gene for hemoglobin.
11. What is inbreeding?
Inbreeding is the mating of more closely related individuals within the same breed for 4-6 generations. It is a strategy used in animal breeding to increase **homozygosity**, which helps in accumulating superior genes and eliminating undesirable ones. However, continuous inbreeding can often lead to reduced fertility and productivity, a phenomenon known as inbreeding depression.
12. Define chromosomal aberration.
A chromosomal aberration is any change in the normal structure or number of chromosomes in a cell. These changes can arise due to errors during cell division. They include numerical abnormalities like **aneuploidy** (gain or loss of one or more chromosomes, e.g., Down's syndrome) and structural abnormalities like deletion, duplication, inversion, or translocation of a part of a chromosome.
13. What do you understand by Pedigree analysis ? How is it useful?
Pedigree analysis is the study of the inheritance of a particular genetic trait over several generations in a family, represented in the form of a family tree or chart. It is extremely useful for genetic counseling as it helps in determining the mode of inheritance (dominant, recessive, etc.) of a trait or disorder and in predicting the probability of its appearance in future offspring.
14. What happens in haemophilia?
In haemophilia, a person's blood lacks sufficient blood-clotting proteins, known as clotting factors. A minor cut or injury can lead to prolonged bleeding because the normal cascade of reactions that forms a blood clot is disrupted. This is due to a mutation in a gene on the X chromosome responsible for producing these factors.
15. What would be the blood group of offspring, if the blood group of mother is AB and blood group of father is O?
If the mother has blood group AB (genotype $I^A I^B$) and the father has blood group O (genotype ii), their offspring can only have blood group **A** (genotype $I^A i$) or blood group **B** (genotype $I^B i$). There is a 50% probability for each of these blood groups. The offspring cannot have blood group AB or O.



Chapter 5: Molecular Basis of Inheritance

QUICK REVISION: ONE-LINER QUESTIONS AND ANSWERS

1. Polymers of nucleotides are called?
- **Nucleic acids (DNA and RNA).**
2. The three components of a nucleotide?
- **A pentose sugar, a nitrogenous base, and a phosphate group.**
3. The two components of a nucleoside?
- **A pentose sugar and a nitrogenous base.**
4. Pentose sugar found in DNA?
- **Deoxyribose.**
5. Pentose sugar found in RNA?
- **Ribose.**
6. The two types of nitrogenous bases? - **Purines and Pyrimidines.**
7. Which nitrogenous bases are purines?
- **Adenine (A) and Guanine (G).**
8. Pyrimidine bases in DNA?
- **Thymine (T) and Cytosine (C).**
9. Pyrimidine bases in RNA?
- **Uracil (U) and Cytosine (C).**
10. Base present in RNA but not DNA?
- **Uracil (U).**
11. Base present in DNA but not RNA?
- **Thymine (T).**
12. Who provided DNA's X-ray diffraction data?
- **Maurice Wilkins and Rosalind Franklin.**
13. Who proposed the double helix model of DNA?
- **Watson and Crick.**
14. How are the two DNA strands oriented?
- **Antiparallel and complementary.**
15. What bond holds the two DNA strands together?
- **Hydrogen bonds.**
16. In DNA, Adenine (A) always pairs with what?
- **Thymine (T).**
17. Guanine (G) always pairs with what?
- **Cytosine (C).**
18. What is Chargaff's rule?
- **The amount of A equals T, and the amount of G equals C.**
19. If DNA has 18% Cytosine, what is Adenine's percentage?
- **32%.**
20. Why is the distance between DNA strands uniform?
- **Because a purine always pairs with a pyrimidine.**
21. How many base pairs are in one turn of the B-DNA helix?
- **Ten.**
22. Whose experiment demonstrated transformation?
- **Frederick Griffith.**
23. Whose experiment proved DNA is the genetic material?
- **Hershey and Chase.**
24. In the Hershey-Chase experiment, what was the bacteriophage's genetic material?
- **DNA.**
25. The process of making an identical copy of DNA is called?
- **Replication.**
26. In which direction does DNA replication always occur?
- **The 5' to 3' direction.**
27. Why is DNA replication called semi-conservative?
- **Because each new molecule has one old strand and one new strand.**
28. Short DNA fragments on the lagging strand are called?
- **Okazaki fragments.**
29. What is the main enzyme for DNA replication?
- **DNA polymerase.**
30. What is the central dogma of molecular biology?
- **DNA → RNA → Protein.**
31. Synthesizing RNA from a DNA template is called?
- **Transcription.**
32. What is the primary enzyme required for transcription?
- **RNA polymerase.**
33. Where does transcription occur in eukaryotes?
- **In the nucleus.**
34. In eukaryotes, which enzyme transcribes tRNA and 5S rRNA?
- **RNA polymerase III.**
35. The transcriptionally active region of a chromosome is called?
- **Euchromatin.**
36. Non-coding sequences within a eukaryotic gene are called?
- **Introns (or Junk DNA).**
37. The expressed, coding sequences are called?
- **Exons.**
38. The flow of information from RNA back to DNA is called?
- **Reverse transcription.**
39. A three-base mRNA sequence for an amino acid is a?
- **Codon.**
40. How many codons are in the genetic code?
- **64.**
41. What property means one amino acid can have multiple codons?
- **Degeneracy.**
42. What is the universal start codon?
- **AUG.**
43. Name one of the three termination (stop) codons.
- **UAA (or UAG, UGA).**
44. What property means the genetic code is read without punctuation?
- **It is commaless.**
45. Who proposed the 'One gene, one enzyme' hypothesis?
- **Beadle and Tatum.**
46. Synthesizing a protein from an mRNA template is called?
- **Translation.**
47. Which RNA carries an amino acid to the ribosome?
- **Transfer RNA (tRNA).**
48. What is the three-base sequence on tRNA called?
- **An anticodon.**
49. What does the "charging" of tRNA refer to?
- **The linking of an amino acid to its corresponding tRNA.**
50. A unit of gene regulation in prokaryotes is called?
- **An operon.**
51. Who proposed the lac operon model?
- **Jacob and Monod.**
52. The operon model represents what process?
- **Gene regulation.**
53. In the lac operon, what does the 'y' gene code for?
- **Permease.**
54. Where does the repressor protein bind in the lac operon?
- **To the operator region.**
55. Mobile genetic elements are called?
- **Transposons.**
56. The human chromosome with the most genes? The fewest?
- **Chromosome 1 (most) and Chromosome Y (fewest).**
57. Who initially developed DNA fingerprinting?
- **Alec Jeffreys.**
58. What is the technical basis of DNA fingerprinting?
- **Polymorphism in DNA sequences.**

IMPORTANT QUESTIONS AND ANSWERS

1. Differentiate between Transcription and Translation.

Transcription is the process of synthesizing an RNA molecule from a DNA template, occurring inside the nucleus in eukaryotes. It is the first step of gene expression. In contrast, **Translation** is the process of synthesizing a protein (a polypeptide chain) from the information encoded in an mRNA molecule. This process occurs on ribosomes in the cytoplasm.

2. Differentiate between DNA and RNA.

DNA and RNA are both nucleic acids but differ in key ways. **DNA** contains deoxyribose sugar, has thymine (T) as a pyrimidine base, and is typically a double-stranded helix. It functions as the primary genetic material. **RNA** contains ribose sugar, has uracil (U) instead of thymine, and is usually single-stranded. It has diverse roles, including acting as a messenger (mRNA) and in protein synthesis (tRNA, rRNA).

3. What is DNA fingerprinting? Explain it.

DNA fingerprinting is a technique used to identify and compare individuals based on their unique DNA profiles. It focuses on specific regions of DNA called Variable Number of Tandem Repeats (VNTRs), which are highly variable between people. The process involves isolating DNA, cutting it with restriction enzymes, separating the fragments by gel electrophoresis, and creating a unique pattern or 'fingerprint' for analysis in forensics or paternity testing.

4. Describe transcription in brief.

Transcription is the process of creating a complementary RNA copy of a sequence of DNA. It is the first step in gene expression and is catalyzed by the enzyme **RNA polymerase**. The process involves three stages: initiation, where the polymerase binds to a promoter; elongation, where the RNA strand is synthesized; and termination, where the synthesis ends and the new RNA molecule is released.

5. What is the difference between a nucleoside and a nucleotide?

The primary difference lies in their composition. A **nucleoside** is a compound formed by the combination of a pentose sugar (ribose or deoxyribose) and a nitrogenous base. A **nucleotide** is more complex; it consists of a nucleoside (sugar + base) that is also linked to one or more **phosphate groups**. Nucleotides are the monomers that build the nucleic acid polymers, DNA and RNA.

6. Name any two enzymes of DNA replication and mention one specific function of each.

Two essential enzymes in DNA replication are: 1. **DNA Helicase**, which functions to unwind and separate the two strands of the DNA double helix at the replication fork. 2. **DNA Polymerase**, which is responsible for synthesizing the new DNA strands by adding nucleotides complementary to the template strand in the 5' to 3' direction.

7. Describe the two salient features of double Helix structure of DNA.

Two salient features of the DNA double helix are: 1. **Antiparallel Strands**: The two polynucleotide chains run in opposite directions, meaning the 5' end of one strand is parallel to the 3' end of the other. 2. **Complementary Base Pairing**: The nitrogenous bases on the two strands are paired specifically through hydrogen bonds; Adenine (A) always pairs with Thymine (T) with two bonds, and Guanine (G) always pairs with Cytosine (C) with three bonds.

8. Write two uses of DNA fingerprinting.

Two major uses of DNA fingerprinting are: 1. **Forensic Science**: It is used to identify criminals by comparing the DNA profile from a crime scene (e.g., blood, hair) with that of a suspect. 2. **Paternity and Maternity Testing**: It can definitively establish the biological relationship between a child and their potential parents by comparing their DNA patterns.

9. What are start codons? Write them.

A start codon, also known as an initiator codon, is the specific mRNA triplet that signals the beginning of protein synthesis (translation) by the ribosome. The most common start codon in both prokaryotes and eukaryotes is **AUG**, which codes for the amino acid methionine.

10. Differentiate between Euchromatin and Heterochromatin.

Euchromatin is a loosely packed form of chromatin that is rich in gene concentration and is transcriptionally active, meaning genes within it are expressed. In contrast, **Heterochromatin** is a tightly packed, condensed form of chromatin that is transcriptionally inactive, and its genes are generally not expressed.

11. What are the goals of the Human Genome Project (HGP)?

The primary goals of the Human Genome Project were to identify all the approximately 20,000-25,000 genes in human DNA, determine the sequences of the 3 billion chemical base pairs that make up human DNA, store this information in databases, and address the ethical, legal, and social issues (ELSI) that might arise from the project.

12. Write a note on RNA polymerase enzyme.

RNA polymerase is the primary enzyme responsible for the process of **transcription**, where it synthesizes an RNA strand from a DNA template. It binds to the promoter region of a gene, unwinds the DNA, and adds complementary RNA nucleotides in the 5' to 3' direction. Unlike DNA polymerase, it does not require a primer to initiate synthesis.

13. What are 'Expressed Sequence Tags' (ESTs)?

Expressed Sequence Tags (ESTs) are short subsequences of a cDNA (complementary DNA) sequence. Since cDNA is derived from mRNA, ESTs represent parts of genes that are actively being expressed as proteins. They were widely used in the Human Genome Project as a method to identify gene transcripts and were instrumental in gene discovery.

14. Distinguish between continuous and discontinuous replication.

During DNA replication, the **leading strand** is synthesized continuously in the 5' to 3' direction as a single fragment. In contrast, the **lagging strand** is synthesized discontinuously. Because it runs in the opposite direction, it must be synthesized in small segments called **Okazaki fragments**, which are later joined together by the enzyme DNA ligase.

15. What is the Central Dogma of molecular biology?

The Central Dogma, proposed by Francis Crick, describes the directional flow of genetic information within a biological system. It states that information flows from **DNA** to **RNA** (through transcription) and then from **RNA** to **protein** (through translation). This framework explains how the genetic code in DNA is ultimately used to produce functional proteins.



Chapter 6: Evolution

QUICK REVISION: ONE-LINER QUESTIONS AND ANSWERS

1. Who proposed that life originated from pre-existing non-living organic molecules?
- **Oparin and Haldane.**
2. Whose experiment simulated early Earth conditions to test the theory of chemical evolution?
- **S.L. Miller.**
3. What critical gas was absent from the atmosphere in Miller's experiment?
- **Oxygen (O₂).**
4. The gradual change in life forms over millions of years is called?
- **Evolution (or organic evolution).**
5. Evidence for evolution based on the study of fossils is called?
- **Paleontological evidence.**
6. In which type of rock are fossils generally found?
- **Sedimentary rocks.**
7. Organs with the same basic structure but different functions are called?
- **Homologous organs.**
8. The forelimbs of humans and the wings of birds are examples of what?
- **Homologous organs.**
9. Homologous structures suggest what type of evolution?
- **Divergent evolution.**
10. Organs with different structures but similar functions are called?
- **Analogous organs.**
11. The wings of insects and the wings of birds are examples of what?
- **Analogous organs.**
12. Analogous structures suggest what type of evolution?
- **Convergent evolution.**
13. Who proposed the Law of Embryonic Development (Ontogeny recapitulates phylogeny)?
- **Ernst Haeckel (popularized), but based on Von Baer's laws.**
14. The reappearance of an ancestral trait in an organism is called?
- **Atavism.**
15. A living organism that shows characteristics of two different groups is called a?
- **Connecting link.**
16. Echidna is a connecting link between which two groups?
- **Reptiles and Mammals.**
17. Peripatus is a connecting link between which two phyla?
- **Annelida and Arthropoda.**
18. Archaeopteryx is a fossil connecting link between which two groups?
- **Reptiles and Birds.**
19. Archaeopteryx fossils are from which geological period?
- **The Jurassic period.**
20. Who proposed the theory of "Inheritance of Acquired Characters"?
- **Jean-Baptiste Lamarck.**
21. Who proposed the theory of "Natural Selection"?
- **Charles Darwin.**
22. The appearance of antibiotic-resistant bacteria is an example of evolution by?
- **Natural selection acting on pre-existing variation.**
23. The process where different species evolve from a common ancestor in a specific area is called?
- **Adaptive radiation.**
24. The evolution of Australian marsupials is a prime example of what?
- **Adaptive radiation.**
25. Who proposed the "Theory of Mutation"?
- **Hugo de Vries.**
26. Sudden, large-scale mutations leading to speciation were termed what by de Vries?
- **Salutation.**
27. What is the main source of variation for evolution?
- **Mutation.**
28. Random changes in allele frequencies in a small population are known as what?
- **Genetic drift.**
29. A change in allele frequency when a few individuals establish a new population is called?
- **The Founder Effect.**
30. What is a key factor in the formation of new species by preventing gene flow?
- **Isolation (Reproductive isolation).**
31. The Devonian period is known as the "Age of ___"?
- **Fishes.**
32. Which early hominid was considered more similar to an ape?
- **Dryopithecus.**
33. Prehistoric cave art is estimated to have first appeared around when?
- **18,000 years ago.**
34. Which plant group is known as the "amphibians of the plant kingdom"?
- **Bryophytes.**
35. Who is a famous paleontologist from India?
- **Birbal Sahni.**
36. Euglena is considered a connecting link between which two kingdoms?
- **Plants and Animals.**
37. What are the two key concepts of Darwin's theory of evolution?
- **Branching Descent and Natural Selection.**
38. What phrase describes the reproductive success of an organism in Darwinian terms?
- **Survival of the Fittest.**
39. What principle describes the condition of a non-evolving population's gene pool?
- **The Hardy-Weinberg principle.**
40. What is the transfer of genetic material from one population to another called?
- **Gene flow or gene migration.**
41. Organs that are reduced and non-functional but were functional in ancestors are called?
- **Vestigial organs.**
42. Give a common example of a vestigial organ in humans.
- **The appendix or wisdom teeth.**
43. Which fossil man was the first to make and use stone tools, earning the name 'Handy Man'?
- **Homo habilis.**
44. Which human ancestor first controlled fire?
- **Homo erectus.**
45. The hominid species that lived in caves and were the first to bury their dead was?
- **Neanderthal Man (Homo neanderthalensis).**
46. What is the scientific name for modern man?
- **Homo sapiens.**
47. The different beaks of finches on the Galapagos Islands are a classic example of what?
- **Adaptive radiation.**
48. The evolutionary process by which new biological species arise is called?
- **Speciation.**
49. What type of selection favors the average phenotype and selects against extremes?
- **Stabilizing selection.**
50. The evolution of industrial melanism in peppered moths is a classic example of what?
- **Directional selection.**

IMPORTANT QUESTIONS AND ANSWERS

1. What are homologous organs? Give examples.

Homologous organs are structures that have a common fundamental anatomical plan and embryonic origin but have evolved to perform different functions in different species. They provide strong evidence for **divergent evolution**. Examples include the forelimbs of humans (for grasping), whales (flippers for swimming), bats (wings for flying), and cheetahs (for running), all of which share the same basic bone structure.

2. What are analogous organs? Give any two examples.

Analogous organs are structures that have different anatomical origins but have evolved to perform a similar function. They are a result of **convergent evolution**, where different species adapt to similar ecological niches. Two examples are the wings of a butterfly and the wings of a bird, and the eyes of an octopus and the eyes of a mammal.

3. Write in brief on natural selection.

Natural selection is the key mechanism of evolution proposed by Charles Darwin. It is the process by which organisms with heritable traits that are better suited to their environment tend to survive and reproduce more successfully than others. This differential survival and reproduction lead to a gradual increase in the frequency of those advantageous traits in a population over generations.

4. What is organic evolution? Write.

Organic evolution is the process of gradual and continuous change in the heritable characteristics of biological populations over successive generations. It is the theory that all forms of life on Earth have descended from a common ancestor. This process, driven by mechanisms like natural selection, mutation, and genetic drift, has led to the immense biodiversity we see today.

5. What is genetic drift?

Genetic drift refers to the random fluctuations in the frequency of alleles within a population, purely by chance. Its effects are most pronounced in **small populations**. Unlike natural selection, the changes caused by genetic drift are not necessarily adaptive. It can lead to the loss of some alleles and the fixation of others, thereby reducing the genetic variation of a population.

6. What is founder effect?

The founder effect is a specific case of genetic drift that occurs when a new population is established by a small number of individuals (the 'founders') from a larger parent population. This new population may have, by chance, allele frequencies that are very different from the original population, leading to a loss of genetic variation and a distinct genetic makeup.

7. Write in brief about chemical evolution.

The theory of chemical evolution, proposed by **Oparin and Haldane**, suggests that the first life forms originated from pre-existing non-living organic molecules (like RNA, proteins) on early Earth. This process is thought to have occurred in the primitive atmosphere, which lacked free oxygen and was rich in methane, ammonia, and water vapor, with energy provided by lightning and UV radiation.

8. What is gene mutation? What is its role in organic evolution?

A gene mutation is a sudden, permanent alteration in the DNA sequence of a gene. Its role in organic evolution is fundamental, as it is the **ultimate source of all new genetic variation**. While most mutations are neutral or harmful, occasionally a mutation can produce an advantageous new trait that is then acted upon by natural selection, leading to adaptation and evolutionary change.

9. Explain about connecting link and missing link.

A **connecting link** is a living species that possesses characteristics of two different taxonomic groups, providing evidence of an evolutionary path between them (e.g., *Peripatus*, linking Annelida and Arthropoda). A **missing link** is a fossil species that shows characteristics of two different groups, representing an intermediate evolutionary stage that has since become extinct (e.g., *Archaeopteryx*, linking reptiles and birds).

10. What is the relationship between thorns of Bougainvillea and tendrils of Cucurbita?

The thorns of *Bougainvillea* and the tendrils of *Cucurbita* are **homologous organs**. Both are modifications of the axillary bud, meaning they share a common anatomical origin. However, they have been modified to perform different functions: thorns provide protection, while tendrils provide support for climbing. This is a classic example of divergent evolution.

11. What is adaptive radiation? Give an example.

Adaptive radiation is an evolutionary process where a single ancestral species diversifies rapidly into multiple new species, each adapted to a different ecological niche. This often occurs when an organism enters a new environment with various unoccupied niches. A classic example is the evolution of **Darwin's finches** on the Galápagos Islands, where an ancestral finch species evolved into many different species with specialized beaks for different food sources.

12. What do you understand by atavism? State its benefits.

Atavism is the reappearance of an ancestral characteristic in an organism after several generations of absence. These traits were present in distant ancestors but were lost in the intermediate ones. Examples include the appearance of a tail in a human baby. The primary benefit of studying atavism is that it provides strong **evidence for evolution** by showing the genetic connection to ancestral forms.

13. Differentiate between Ramapithecus and Dryopithecus.

Dryopithecus and *Ramapithecus* are fossil apes that are considered ancestors in the line of human evolution. *Dryopithecus* is considered to be more **ape-like**, with features like a U-shaped jaw and larger canines. In contrast, *Ramapithecus* is considered more **man-like**, with features such as a more rounded dental arch, smaller canines, and thicker tooth enamel, suggesting a diet that included tough, coarse food.

14. What is the theory of recapitulation?

The theory of recapitulation, often summarized by the phrase '**Ontogeny recapitulates phylogeny**', was proposed by Ernst Haeckel. It suggests that the development of an organism's embryo (ontogeny) goes through successive stages that resemble the adult forms of its evolutionary ancestors (phylogeny). Although now considered an oversimplification, it highlights the evidence for evolution found in embryology.

15. What do you understand by Palaeontology? Give the name of various eras.

Palaeontology is the scientific study of ancient life, primarily through the examination of fossils. It provides direct evidence for evolution by showing the forms of life that existed in the past. The major geological eras, from oldest to most recent, are the **Precambrian, Paleozoic, Mesozoic, and Cenozoic** eras.



Chapter 7: Human Health and Disease

QUICK REVISION: ONE-LINER QUESTIONS AND ANSWERS

1. What is a disease-causing organism called? **- A pathogen.**
2. Which diagnostic test is used to confirm Typhoid? **- The Widal test.**
3. What is the pathogen that causes Typhoid fever? **- The bacterium *Salmonella typhi*.**
4. What virus causes the common cold? **- Rhinovirus.**
5. Diphtheria is caused by a pathogen from which group? **- Bacteria.**
6. The BCG vaccine is administered to prevent which disease? **- Tuberculosis (TB).**
7. Tuberculosis is primarily transmitted through what medium? **- The air.**
8. Which mosquito is the vector for malaria? **- The female *Anopheles mosquito*.**
9. What is the infective stage of the malarial parasite (Plasmodium) for humans? **- The sporozoite.**
10. Amoebiasis (amoebic dysentery) is caused by which pathogen? **- The protozoan *Entamoeba histolytica*.**
11. The disease Filariasis (Elephantiasis) is caused by what? **- The helminth worm *Wuchereria bancrofti*.**
12. Rabies is caused by which type of pathogen? **- A virus.**
13. Chickenpox is caused by which virus? **- The Varicella-zoster virus.**
14. Which of these is a viral disease: Tetanus, Rabies, or Kala-azar? **- Rabies.**
15. Which of these is a bacterial disease: Mumps, Diphtheria, or Measles? **- Diphtheria.**
16. The body's ability to fight disease-causing organisms is called? **- Immunity.**
17. A foreign substance that elicits an immune response is called an? **- Antigen.**
18. Y-shaped proteins produced in response to antigens are called? **- Antibodies.**
19. Human antibodies are made of what type of molecule? **- Glycoproteins.**
20. The immunity present from birth is called? **- Innate immunity.**
21. Immunity acquired after birth is called? **- Acquired immunity.**
22. Who discovered the principle of passive immunity? **- Emil von Behring.**
23. The first milk produced by a mother, rich in antibodies, is called? **- Colostrum.**
24. Which antibody is abundantly found in colostrum? **- IgA.**
25. What are the two types of lymphocytes? **- B-lymphocytes and T-lymphocytes.**
26. Where are B-lymphocytes and T-lymphocytes produced? **- In the bone marrow.**
27. Where do T-lymphocytes mature? **- In the thymus.**
28. Which cells differentiate into plasma cells to produce antibodies? **- B-lymphocytes.**
29. Rejection of a transplanted organ is primarily due to which cells? **- Cytotoxic T-cells.**
30. The process of introducing a weakened pathogen to stimulate immunity is called? **- Vaccination.**
31. The DPT vaccine ("Triple antigen") protects against Diphtheria, Pertussis, and what else? **- Tetanus.**
32. The DPT vaccine is NOT used for which disease: Diphtheria, Typhoid, or Tetanus? **- Typhoid.**
33. An exaggerated immune response to certain environmental antigens is called an? **- Allergy.**
34. Which antibody type is associated with allergic reactions? **- IgE.**
35. Which chemicals are released from mast cells during an allergic reaction? **- Histamine and Serotonin.**
36. Hay fever is a common disease caused by what? **- Allergens.**
37. A disease where the body's immune system attacks its own cells is called an? **- Autoimmune disease.**
38. Rheumatoid arthritis is an example of what type of disease? **- An autoimmune disease.**
39. What does the acronym AIDS stand for? **- Acquired Immuno Deficiency Syndrome.**
40. What is the causative agent of AIDS? **- Human Immunodeficiency Virus (HIV).**
41. What type of virus is HIV? **- A retrovirus.**
42. Which specific cells does HIV primarily attack and destroy? **- Helper T-cells.**
43. Which screening test is widely used for detecting AIDS? **- ELISA (Enzyme-Linked Immunosorbent Assay).**
44. The study of cancer is called? **- Oncology.**
45. Genes that can cause cancer are called? **- Oncogenes.**
46. The spread of malignant tumor cells to distant sites is called? **- Metastasis.**
47. Which of the following is a non-infectious disease: AIDS, Malaria, or Cancer? **- Cancer.**
48. From which plant is opium obtained? **- Papaver somniferum (the poppy plant).**
49. Diacetylmorphine is commonly known as what? **- Heroin.**
50. Morphine is classified as what type of drug? **- An opiate narcotic.**
51. What are the main physiological effects of tobacco use due to nicotine? **- Increased heart rate and blood pressure.**
52. Which organ is most affected by excessive alcohol consumption? **- The liver.**
53. What is the study of viruses called? **- Virology.**
54. A virus is fundamentally composed of what two things? **- Protein and nucleic acid.**

IMPORTANT QUESTIONS AND ANSWERS

1. **Mention two symptoms of AIDS.**
AIDS (Acquired Immuno Deficiency Syndrome) weakens the immune system, making the body vulnerable to infections. Two common symptoms are **prolonged fever and chronic diarrhea**, often accompanied by significant weight loss. Patients also frequently suffer from opportunistic infections like pneumonia or tuberculosis.
2. **What do you understand by the term 'pathogen'?**
A pathogen is any disease-causing microorganism, such as a bacterium, virus, fungus, or protozoan. These organisms are capable of invading a host and causing an infection or disease by disrupting normal physiological processes. Examples include *Salmonella typhi* which causes typhoid and *Plasmodium* which causes malaria.
3. **Comment upon Innate immunity.**
Innate immunity is the non-specific, inborn defense mechanism of the body. It is the first line of defense against invading pathogens and is present from birth. It consists of four types of barriers: **physical barriers** (like skin), **physiological barriers** (like stomach acid), **cellular barriers** (like phagocytes), and **cytokine barriers** (like interferons).
4. **Write about the role of lymphocytes in immunity.**
Lymphocytes are crucial for acquired immunity. There are two main types: **B-lymphocytes** and **T-lymphocytes**. B-lymphocytes produce **antibodies** to fight pathogens (humoral immunity). T-lymphocytes are responsible for **cell-mediated immunity**; helper T-cells activate other immune cells, while cytotoxic T-cells directly kill infected cells.
5. **Define antigens and antibody.**
An **antigen** is any foreign substance, such as a part of a virus or bacterium, that enters the body and triggers an immune response. An **antibody** is a Y-shaped protein produced by B-lymphocytes in response to a specific antigen. Antibodies bind to antigens and help neutralize or eliminate them from the body.
6. **What is vaccination?**
Vaccination is the process of administering a preparation of weakened or inactivated pathogens, or their antigens (a vaccine), into the body. This stimulates the immune system to produce memory B and T-cells without causing the actual disease, thereby providing **active acquired immunity** against future infections by that specific pathogen.
7. **How are malaria and pneumonia transmitted?**
Malaria is a vector-borne disease transmitted through the bite of an infected female *Anopheles* mosquito, which injects the *Plasmodium* parasite into the human bloodstream. **Pneumonia** is primarily transmitted through inhaling respiratory droplets or aerosols released by an infected person when they cough or sneeze.
8. **Describe the causative organism, mode of transmission, symptoms and therapy of malaria disease.**
Malaria is caused by a protozoan parasite of the genus *Plasmodium*. It is transmitted to humans through the bite of an infected female *Anopheles* mosquito. Symptoms include recurring cycles of high fever, chills, and sweating. Therapy primarily involves the use of **antimalarial drugs** like quinine and chloroquine to kill the parasite in the bloodstream.
9. **Write the cause, causative organism and symptoms of typhoid fever.**
Typhoid fever is a bacterial infection caused by *Salmonella typhi*. The cause of infection is the ingestion of contaminated food and water. Its primary symptoms include sustained high fever, weakness, stomach pain, headache, and loss of appetite. In severe cases, intestinal perforation may occur. The disease is confirmed by the **Widal test**.
10. **What are allergies? Describe its symptoms in brief.**
An allergy is an exaggerated or hypersensitive response of the immune system to certain environmental substances called allergens, such as pollen or dust. This response is mediated by **IgE antibodies** and involves the release of chemicals like histamine. Symptoms can range from sneezing, watery eyes, and a runny nose to skin rashes and difficulty breathing.
11. **Mention two symptoms of cancer.**
Cancer is characterized by uncontrolled cell growth, and its symptoms can be varied. Two common warning signs are the presence of a persistent **lump or thickening** in any part of the body, such as the breast, and a **change in bowel or bladder habits** that is unexplained and persistent.
12. **Describe the ill-effects of alcohol.**
Chronic and excessive alcohol consumption has severe ill-effects on the body. It can cause significant damage to the **liver**, leading to conditions like fatty liver, alcoholic hepatitis, and cirrhosis. It also adversely affects the central nervous system, impairing judgment and coordination, and can lead to dependence, social problems, and damage to the heart and stomach.
13. **What are cannabinoids?**
Cannabinoids are a group of chemical compounds that interact with cannabinoid receptors in the brain. They are naturally obtained from the inflorescences of the plant *Cannabis sativa*. Products like marijuana, hashish, and charas are derived from this plant and are known to affect the cardiovascular system and produce hallucinogenic effects.
14. **What is cocaine? From which plant it is obtained?**
Cocaine is a powerful central nervous system stimulant that interferes with the transport of the neurotransmitter dopamine, producing a sense of euphoria. It is obtained from the leaves of the **coca plant** (*Erythroxylum coca*), which is native to South America. It is a potent and addictive drug.
15. **What is cell mediated immunity?**
Cell-mediated immunity (CMI) is an immune response that does not involve antibodies. It is primarily mediated by **T-lymphocytes**. This arm of the immune system is crucial for defending against intracellular pathogens like viruses and bacteria, and is also responsible for killing cancerous cells and for the rejection of transplanted organs.
16. **Define active immunity.**
Active immunity is the immunity that develops in an individual when their own immune system produces antibodies in response to an infection or vaccination. This type of immunity is long-lasting and creates an immunological memory. For example, recovering from chickenpox provides long-term active immunity against the disease.
17. **Name the primary and secondary lymphoid organs.**
Lymphoid organs are where lymphocytes originate, mature, and proliferate. The **primary lymphoid organs** are the **bone marrow** and the **thymus**, where immature lymphocytes differentiate into antigen-sensitive lymphocytes. The **secondary lymphoid organs** include the **spleen, lymph nodes, tonsils**, and Peyer's patches, where lymphocytes interact with antigens.
18. **What is oncogenesis?**
Oncogenesis is the process by which normal cells are transformed into cancerous cells. It is a multi-step process involving genetic and epigenetic changes that disrupt the normal regulation of the cell cycle, leading to uncontrolled cell division and proliferation. This transformation is often triggered by carcinogens or mutations in key regulatory genes like **oncogenes**.
19. **What is metastasis?**
Metastasis is the most feared property of malignant tumors. It is the process by which cancer cells break away from the primary tumor, travel through the blood or lymph system, and form new, secondary tumors in other parts of the body. This spread of cancer makes it much more difficult to treat.



Chapter 8: Microbes in Human Welfare

QUICK REVISION: ONE-LINER QUESTIONS AND ANSWERS

1. Which bacteria are used to convert milk into curd?
- **Lactic Acid Bacteria (LAB), such as Lactobacillus.**
2. Converting milk to curd increases the content of which vitamin?
- **Vitamin B12.**
3. Which microbe is used to make dough for idli, dosa, and bread?
- **Yeast (specifically Saccharomyces cerevisiae).**
4. The yeast Saccharomyces cerevisiae is commonly known as what?
- **Brewer's yeast.**
5. Yeast is primarily used in the industrial production of what?
- **Ethyl alcohol (ethanol).**
6. How does yeast typically reproduce?
- **Through budding.**
7. Chemicals produced by microbes that can kill or retard the growth of other microbes are called?
- **Antibiotics.**
8. Who discovered the first antibiotic, penicillin?
- **Alexander Fleming.**
9. Fleming discovered penicillin while working on which bacterium?
- **Staphylococcus.**
10. Penicillin is produced by which fungus?
- **The fungus Penicillium notatum.**
11. Who confirmed penicillin's effectiveness as an antibiotic?
- **Ernest Chain and Howard Florey.**
12. The antibiotic cephalosporin is obtained from what type of organism?
- **A fungus.**
13. Which fungus produces citric acid?
- **Aspergillus niger.**
14. Which microbe is used to produce statins?
- **The yeast Monascus purpureus.**
15. What is the primary function of statins?
- **They inhibit cholesterol synthesis.**
16. The enzyme streptokinase is used for what purpose?
- **As a 'clot-buster' for removing clots from blood vessels.**
17. Cyclosporin A is used for what medical purpose?
- **As an immunosuppressant agent in organ transplants.**
18. Municipal wastewater is also known as what?
- **Sewage.**
19. What does BOD stand for?
- **Biochemical Oxygen Demand.**
20. A higher BOD indicates what about a water body?
- **Higher pollution levels.**
21. In sewage treatment, the mesh-like structures of bacteria and fungi are called?
- **Flocs.**
22. The production of biogas involves which group of bacteria?
- **Methanogens.**
23. What is the main component of biogas?
- **Methane (CH₄).**
24. Methanogens produce methane but do NOT produce what gas?
- **Oxygen (O₂).**
25. Microbes used to kill insects and pests are called?
- **Biocontrol agents.**
26. Which bacterium is widely used as a biocontrol agent for insect pests?
- **Bacillus thuringiensis (Bt).**
27. Which free-living fungus is an effective biocontrol agent for plant pathogens?
- **Trichoderma.**
28. Organisms used to enrich the nutrient quality of the soil are called?
- **Biofertilizers.**
29. What is a key characteristic of blue-green algae (cyanobacteria)?
- **Nitrogen fixation.**
30. Rhizobium is a famous bacterium that performs what function?
- **Symbiotic nitrogen fixation.**
31. In which plants are Rhizobium bacteria found?
- **In the root nodules of leguminous plants.**
32. Which cyanobacteria are well-known nitrogen fixers?
- **Anabaena and Nostoc.**
33. Which fungus forms a symbiotic association with plant roots, known as mycorrhiza?
- **Glomus.**
34. The process of preserving liquids by heating and then rapidly cooling is called?
- **Pasteurization.**
35. The practice of farming that avoids the use of chemical fertilizers is called?
- **Organic farming.**
36. Which of these is NOT a biofertilizer: Azotobacter or Bacillus thuringiensis?
- **Bacillus thuringiensis (it is a biocontrol agent).**
37. What are live microbial food supplements called?
- **Probiotics.**
38. Microbes grown for protein-rich food are called?
- **Single Cell Protein (SCP).**
39. Spirulina and Chlorella are examples of what?
- **Single Cell Protein (SCP).**
40. The rearing of honeybees for honey is called?
- **Apiculture or beekeeping.**
41. In a beehive, which bees produce the honey?
- **The worker honeybees.**
42. The rearing of silkworms for silk production is called?
- **Sericulture.**
43. The farming of fish is called?
- **Pisciculture.**
44. The raising of birds like chicken and ducks is called?
- **Poultry farming.**
45. Which of these is NOT considered part of animal husbandry: pisciculture or organic farming?
- **Organic farming.**
46. The cultivation of flowering plants is called?
- **Floriculture.**
47. 'Kalyan Sona' is an improved variety of what crop?
- **Wheat.**
48. A common viral disease in chickens is?
- **Ranikhet disease.**
49. 'Lohi' is a well-known breed of what animal?
- **Sheep.**
50. Which scientist is NOT primarily associated with microbiology: Louis Pasteur or Stephen Hales?
- **Stephen Hales.**
51. What is the scientific term for the rearing of forest trees?
- **Silviculture.**

IMPORTANT QUESTIONS AND ANSWERS

1. **What do you mean by sewage? Describe the role of microbes in sewage treatment.**
Sewage is municipal wastewater containing large amounts of human excreta and organic matter. Microbes play a crucial role in its treatment. During **secondary treatment**, aerobic microbes consume the organic matter, forming masses called **flocs** and significantly reducing the BOD. Later, anaerobic microbes in sludge digesters break down the remaining organic matter, producing biogas.
2. **What is biofertilizer and what are its sources?**
A biofertilizer is a preparation containing living microorganisms which, when applied to seed, plant surfaces, or soil, colonize the rhizosphere and promote growth by increasing the supply of primary nutrients to the host plant. The main sources are **bacteria** (like \textit{Rhizobium}, \textit{Azotobacter}), **cyanobacteria** (like \textit{Anabaena}, \textit{Nostoc}), and **fungi** (like \textit{Glomus}, which forms mycorrhiza).
3. **Write in brief about nitrogen fixation from the atmosphere.**
Nitrogen fixation is the biological process by which atmospheric nitrogen (N_2) is converted into ammonia (NH_3) or other nitrogenous compounds. This is carried out by specialized microorganisms. Some are free-living, like \textit{Azotobacter}, while others, like \textit{Rhizobium}, form a symbiotic relationship with the root nodules of leguminous plants, providing the plant with usable nitrogen.
4. **What is cyclosporin-A and what is its use?**
Cyclosporin A is a bioactive molecule produced by the fungus \textit{Trichoderma polysporum}. It is used medically as an **immunosuppressive agent**. Its primary use is in organ transplant patients to prevent the immune system from rejecting the newly transplanted organ.
5. **What do you understand by organic farming?**
Organic farming is a holistic agricultural system that avoids the use of synthetic fertilizers, pesticides, and genetically modified organisms. It relies on techniques like crop rotation, green manure, compost, and biological pest control. This approach aims to maintain soil fertility and ecological balance, producing healthy food while minimizing environmental pollution.
6. **What are flocs?**
Flocs are mesh-like structures formed during the secondary treatment of sewage. They consist of masses of **aerobic bacteria** that are held together by fungal filaments. These microbes consume the organic matter present in the sewage, thereby significantly reducing the Biochemical Oxygen Demand (BOD) of the effluent.
7. **Define antibiotics and give an example.**
Antibiotics are chemical substances produced by certain microbes that can kill or inhibit the growth of other disease-causing microbes. They are powerful drugs used to treat bacterial infections. The first discovered antibiotic was **penicillin**, which is produced by the fungus \textit{Penicillium notatum}.
8. **What are statins and what is their function?**
Statins are bioactive molecules produced by the yeast \textit{Monascus purpureus}. They are used medically as blood-cholesterol-lowering agents. Statins function by competitively inhibiting the enzyme responsible for the synthesis of cholesterol in the liver, thus helping to prevent cardiovascular diseases.
9. **What are methanogens? Give an example.**
Methanogens are a group of anaerobic archaea that produce **methane (CH_4)** as a metabolic byproduct. They are found in anaerobic sludge during sewage treatment, the rumen of cattle, and marshy areas. An example is \textit{Methanobacterium}. They are essential for the production of biogas.
10. **What are Single Cell Proteins (SCP)? Give an example.**
Single Cell Protein (SCP) refers to the dried cells of microorganisms, such as bacteria, yeast, or algae, which are grown in large-scale cultures and used as a protein-rich supplement for human food or animal feed. A common example is \textit{Spirulina}, a type of cyanobacteria that is rich in protein, vitamins, and minerals.
11. **Write two benefits of using organic manure.**
Using organic manure offers several benefits. Firstly, it improves the **soil structure** and water-holding capacity, reducing soil erosion. Secondly, it enriches the soil with essential nutrients in a slow-release manner, which promotes healthy plant growth without causing the environmental pollution associated with chemical fertilizers.
12. **Give a brief account of poultry farm management.**
Effective poultry farm management involves several key practices for raising domesticated fowl like chickens and ducks. This includes the selection of disease-free and suitable breeds, maintaining proper farm conditions with adequate space and ventilation, ensuring the supply of clean water and hygienic feed, and implementing strict healthcare measures, including regular vaccination and cleaning, to prevent diseases.
13. **What is a biocontrol agent? Give an example.**
A biocontrol agent is a living organism, such as a predator, parasitoid, or pathogen, that is used to control the population of another organism considered to be a pest. This method reduces the reliance on chemical pesticides. For example, the bacterium \textit{Bacillus thuringiensis (Bt)} is used to control butterfly caterpillars.
14. **What do you mean by Green-farming?**
Green farming, also known as organic or sustainable farming, is an agricultural practice that focuses on producing crops in an environmentally friendly way. It avoids the use of synthetic pesticides and fertilizers, instead relying on natural methods like using **biofertilizers** to enrich the soil and **biocontrol agents** to manage pests, thus promoting ecological balance.
15. **Write the names of some antibiotics that are obtained from bacteria.**
While many antibiotics are derived from fungi, several important ones are also obtained from bacteria. Examples include **Streptomycin**, which is produced by the bacterium \textit{Streptomyces griseus}, and **Tetracycline**, which is also derived from species of \textit{Streptomyces}.



Chapter 9: Biotechnology: Principles and Processes

QUICK REVISION: ONE-LINER QUESTIONS AND ANSWERS

1. Techniques that use live organisms to produce useful products are called?
- **Biotechnology.**
2. The manipulation of an organism's genes is called?
- **Genetic engineering.**
3. The creation of DNA by combining sequences that wouldn't normally occur together is known as?
- **Recombinant DNA technology.**
4. Enzymes that cut DNA at specific sites are called?
- **Restriction enzymes (endonucleases).**
5. Restriction enzymes are also famously known as what?
- **'Molecular scissors'.**
6. The first restriction endonuclease to be isolated was?
- **Hind II.**
7. Restriction enzymes recognize and cut what specific type of DNA sequence?
- **A palindromic nucleotide sequence.**
8. The restriction enzyme EcoRI is isolated from which bacterium?
- **Escherichia coli (E. coli).**
9. The recognition site for the restriction enzyme EcoRI is?
- **GAATTCT.**
10. Which enzyme is used to join or paste DNA fragments together?
- **DNA ligase.**
11. A DNA molecule used to carry foreign genetic material into another cell is a?
- **Vector.**
12. Small, circular, extrachromosomal DNA molecules found in bacteria are called?
- **Plasmids.**
13. Which feature is NOT part of the pBR322 plasmid: ori, T-DNA, or antibiotic resistance genes?
- **T-DNA.**
14. Which bacterium is known as a "natural genetic engineer" for plants?
- **Agrobacterium tumefaciens.**
15. The tumor-inducing plasmid found in Agrobacterium tumefaciens is called?
- **The Ti-plasmid.**
16. Which of these is NOT a cloning vector for bacteria: Plasmid, Bacteriophage, or T-DNA?
- **T-DNA (used for plants).**
17. To isolate DNA from a bacterial cell, which enzyme is used?
- **Lysozyme.**
18. To isolate DNA from a fungal cell, which enzyme is used?
- **Chitinase.**
19. A technique to separate DNA fragments based on size is called?
- **Gel electrophoresis.**
20. From what is the agarose gel for electrophoresis extracted?
- **Seaweed.**
21. Why do DNA fragments move towards the anode in gel electrophoresis?
- **Because DNA is negatively charged.**
22. What does PCR stand for?
- **Polymerase Chain Reaction.**
23. What is the primary purpose of the PCR technique?
- **DNA amplification (making multiple copies of a gene).**
24. Which heat-stable DNA polymerase is used in PCR?
- **Taq polymerase.**
25. From which bacterium is Taq polymerase isolated?
- **Thermus aquaticus.**
26. Which of these is used to introduce DNA into a host cell: a gene gun or a micropipette?
- **Both can be used.**
27. The method of directly injecting recombinant DNA into an animal cell's nucleus is called?
- **Microinjection.**
28. The biolistic or gene gun method is most suitable for transforming which type of cells?
- **Plant cells.**
29. A gene used to help identify transformed cells is called a?
- **Selectable marker.**
30. In plasmids like pBR322, what is the role of the ampr gene?
- **It provides resistance to the antibiotic ampicillin.**
31. If a foreign gene is inserted into the tetracycline resistance gene, what happens to the recombinant plasmid?
- **It will lose its resistance to tetracycline.**
32. Large vessels used for growing microbes to produce products on a large scale are called?
- **Bioreactors.**
33. The process of growing cells or tissues in a sterile, nutrient-rich medium is called?
- **Tissue culture.**
34. The entire series of processes after the biosynthetic stage to obtain a finished product is called?
- **Downstream processing.**
35. The plasmid from which bacterium was used to construct the first recombinant DNA?
- **Salmonella typhimurium.**
36. Which chemicals are known to induce protoplast fusion?
- **Polyethylene glycol (PEG) and sodium nitrate.**
37. What is the term for enzymes that cut DNA from the ends?
- **Exonucleases.**
38. What is the function of the 'ori' site in a plasmid vector?
- **It is the Origin of Replication, where DNA copying begins.**
39. What are the three main steps of a single PCR cycle?
- **Denaturation, Annealing, and Extension.**
40. What happens during the 'denaturation' step of PCR?
- **The two strands of the DNA helix are separated by heating.**
41. What staining agent is used to visualize DNA in gel electrophoresis?
- **Ethidium bromide.**
42. The process of making a host cell competent to take up foreign DNA is called?
- **Transformation.**
43. What is a DNA probe?
- **A single-stranded DNA or RNA fragment used to detect a specific complementary sequence.**
44. The blotting technique used for transferring DNA from a gel to a membrane is called?
- **Southern Blotting.**
45. To isolate DNA from a plant cell, which enzyme is primarily used?
- **Cellulase.**
46. What type of bioreactor is most commonly used?
- **Stirring-type bioreactor.**

IMPORTANT QUESTIONS AND ANSWERS

1. What are restriction endonucleases?

Restriction endonucleases are enzymes, often called '**molecular scissors**', that recognize and cut DNA molecules at specific, short nucleotide sequences known as restriction sites. Their ability to make precise cuts is fundamental to genetic engineering, allowing for the isolation of specific genes and the creation of recombinant DNA.

2. What is Gel electrophoresis? Mention any two applications of it.

Gel electrophoresis is a laboratory technique used to separate macromolecules like DNA, RNA, and proteins based on their size and charge. An electric field is applied to a gel matrix, causing the negatively charged DNA fragments to move towards the positive electrode, with smaller fragments moving faster and farther. Two key applications are in **DNA fingerprinting** and the **isolation of a desired DNA fragment** for recombinant DNA technology.

3. Describe the steps involved in the process of Recombinant DNA technology.

The process of recombinant DNA technology involves several key steps: 1) **Isolation** of the desired gene and a suitable vector (like a plasmid). 2) **Cutting** both the gene and the vector with the same restriction enzyme. 3) **Ligation** of the gene into the vector using DNA ligase to form recombinant DNA. 4) **Transformation** of this recombinant DNA into a host organism. 5) **Selection** and multiplication of the transformed host cells to produce the desired product.

4. What is a plasmid? Briefly write about the structure and utility of a plasmid.

A plasmid is a small, circular, extrachromosomal DNA molecule found naturally in bacteria. Structurally, it contains an origin of replication (ori), one or more restriction sites, and selectable marker genes (like antibiotic resistance genes). Its key utility in biotechnology is as a **cloning vector**, where it is used to carry a foreign gene of interest into a host bacterium for cloning or expression.

5. Define gene engineering.

Gene engineering, also known as genetic engineering or recombinant DNA technology, is the direct manipulation of an organism's genes using biotechnology. It involves altering the genetic makeup of an organism by introducing, deleting, or modifying specific genes to produce desired characteristics, such as producing a therapeutic protein or creating a pest-resistant crop.

6. What do you mean by selectable marker?

A selectable marker is a gene introduced into a cell, usually on a plasmid, that confers a trait suitable for artificial selection. Its purpose is to help identify and select host cells that have successfully taken up the foreign DNA (transformed cells) from those that have not. Common selectable markers are genes that provide **resistance to antibiotics** like ampicillin or tetracycline.

7. How are DNA fragments separated and isolated?

DNA fragments are separated and isolated primarily using **gel electrophoresis**. In this technique, the DNA fragments are forced to move through an agarose gel matrix by an electric field. Since DNA is negatively charged, it moves towards the positive electrode. The fragments separate according to size, with smaller fragments moving farther than larger ones. The separated bands can then be visualized and cut out from the gel, a process called **elution**.

8. What is PCR? What is its main purpose?

PCR stands for **Polymerase Chain Reaction**. It is a revolutionary **in vitro** technique used to amplify a specific segment of DNA, creating millions to billions of copies from a very small starting amount. Its main purpose is the rapid **amplification of DNA** for use in various applications, including molecular diagnosis of diseases, DNA fingerprinting, and genetic research.

9. How is the nomenclature of restriction endonucleases done?

The naming of restriction endonucleases follows a specific convention. The first letter comes from the **genus** and the next two letters from the **species** of the prokaryotic cell from which they were isolated. For example, in `EcoRI`, the 'E' comes from `Escherichia`, 'co' from `coli`, 'R' denotes the particular strain (RY13), and the Roman numeral 'I' indicates it was the first enzyme isolated from that strain.

10. What is microinjection? How is it helpful in recombinant DNA technology?

Microinjection is a method used to directly introduce foreign DNA into a host cell. It involves using a very fine micropipette to physically inject the recombinant DNA solution directly into the nucleus of a target cell, typically an animal cell or ovum. It is helpful as a direct method of transformation, ensuring the delivery of the gene of interest for creating **transgenic animals**.

11. Define tissue culture.

Tissue culture is the **in vitro** technique of growing plant cells, tissues, or organs in a sterile, artificial nutrient medium under controlled laboratory conditions. Based on the principle of totipotency, this method allows for the regeneration of a whole plant from a small piece of plant tissue, called an explant. It is widely used for micropropagation and producing disease-free plants.

12. What is downstream processing?

Downstream processing refers to all the stages involved after the biosynthetic or fermentation stage in biotechnology. This includes the **separation, purification, and preservation** of the product (like a protein or antibiotic) obtained from bioreactors. It is a critical step to ensure the final product is pure, effective, and ready for marketing.

13. What do you understand by the Southern Blotting technique?

Southern blotting is a molecular biology technique used to detect a specific DNA sequence in a DNA sample. The method involves separating DNA fragments by gel electrophoresis, transferring them from the gel to a membrane, and then using a labeled **DNA probe** that is complementary to the target sequence to identify its location on the membrane.

14. What is a \$DNA\$ probe? State its uses in biotechnology.

A DNA probe is a short, single-stranded segment of DNA (or RNA) that is tagged with a radioactive or fluorescent marker. Its sequence is complementary to a target DNA sequence of interest. In biotechnology, probes are used to **detect and identify specific genes** or DNA sequences in a sample, which is crucial for diagnosing genetic disorders and identifying pathogens.

15. Show the structure of plasmid \$pBR322\$.

A diagram of the plasmid pBR322 would show a circular DNA molecule with key features labeled. These include the **origin of replication (ori)**, two **selectable marker genes** (ampicillin resistance gene, `amp^R`, and tetracycline resistance gene, `tet^R`), and several unique **restriction sites** (like BamHI, Sall, EcoRI) which are used for inserting foreign DNA.



Chapter 10: Biotechnology and its Applications

QUICK REVISION: ONE-LINER QUESTIONS AND ANSWERS

1. Plants, bacteria, or animals whose genes have been altered are called?
- **Genetically Modified Organisms (GMOs).**
2. Which bacterium produces a protein that is toxic to certain insects?
- **Bacillus thuringiensis.**
3. The toxic insecticidal protein produced by Bacillus thuringiensis is called?
- **Bt toxin (or Cry protein).**
4. The Bt toxin exists as an inactive protoxin but becomes active at what pH?
- **An alkaline pH (found in the insect's gut).**
5. Which crop is famously protected from bollworms by the Cry gene?
- **Cotton (creating Bt cotton).**
6. The genes crylAc and crylAb control which pest?
- **Cotton bollworms.**
7. The gene crylAb controls which specific pest?
- **The corn borer.**
8. The process of silencing a specific gene using double-stranded RNA is called?
- **RNA interference (RNAi).**
9. RNAi is used to protect which plant from the nematode Meloidogyne incognita?
- **Tobacco.**
10. The nematode Meloidogyne incognita infects which part of the tobacco plant?
- **The roots.**
11. 'Golden Rice' is a transgenic crop developed to be rich in what?
- **Vitamin A (due to B-carotene).**
12. The transgenic tomato variety with a longer shelf life is named what?
- **Flavr Savr.**
13. Human insulin produced using biotechnology is often called?
- **Humulin.**
14. Who first determined the molecular structure of insulin?
- **Frederick Sanger.**
15. Which polypeptide chain is removed from proinsulin to form mature, functional insulin?
- **The C-peptide.**
16. The first clinical gene therapy was performed to treat what deficiency?
- **Adenosine Deaminase (ADA) deficiency, which causes SCID.**
17. The use of molecular biology for medical diagnosis is called?
- **Molecular diagnostics.**
18. Which technique is used for early detection of HIV infection?
- **PCR (Polymerase Chain Reaction).**
19. Which diagnostic test is based on the principle of antigen-antibody interaction?
- **ELISA (Enzyme-Linked Immunosorbent Assay).**
20. Animals that have had their DNA manipulated to express a foreign gene are called?
- **Transgenic animals.**
21. The first transgenic cow, capable of producing human protein-enriched milk, was named?
- **Rosie.**
22. Transgenic mice are often used for what primary purpose?
- **To test the safety of vaccines.**
23. What is the protein alpha-1-antitrypsin used to treat?
- **Emphysema.**
24. The unauthorized use of bio-resources by organizations without proper authorization is called?
- **Biopiracy.**
25. Which Indian organization makes decisions regarding the validity of GM research?
- **GEAC (Genetic Engineering Approval Committee).**
26. The ability of a single plant cell to regenerate into a whole plant is called?
- **Totipotency.**
27. The production of a large number of plants in a short time through tissue culture is called?
- **Micropropagation.**
28. Micropropagation involves what type of reproduction?
- **Asexual reproduction.**
29. Artificial seeds are produced from what?
- **Somatic embryos.**
30. The chemical used to induce the fusion of protoplasts in culture is?
- **PEG (Polyethylene glycol).**
31. The large-scale culturing of fish and other aquatic animals is called?
- **Pisciculture.**
32. What food source is particularly rich in protein: fish flour or wheat?
- **Fish flour.**
33. A dramatic increase in food production, especially wheat and rice, is known as the?
- **Green Revolution.**
34. 'Sonalika' and 'Kalyan Sona' are high-yielding varieties of what crop?
- **Wheat.**
35. 'Taichung Native-1' is a variety of what crop?
- **Rice.**
36. Developing yellow mosaic virus-resistant mung beans was achieved through what technique?
- **Mutation breeding.**
37. 'Hisardale' is a new breed of sheep developed through what breeding technique?
- **Cross-breeding.**
38. 'Jaffrabandi', 'Murrah', and 'Mehsana' are all breeds of what animal?
- **Buffalo.**
39. The first animal to be successfully cloned was?
- **A sheep named Dolly.**
40. How many varieties of Basmati rice are grown in India?
- **27.**
41. What are plants called that are genetically identical to the original plant from which they were grown?
- **Somoclones.**
42. What is the main purpose of gene therapy?
- **To correct a defective gene in a person's cells.**
43. What is the full form of MOET in animal breeding?
- **Multiple Ovulation Embryo Transfer technology.**
44. The transgenic protein 'hirudin' (an anticoagulant) was produced in the seeds of which plant?
- **Brassica napus.**
45. What does GMO stand for?
- **Genetically Modified Organism.**
46. What is a "transgene"?
- **A gene that has been transferred from one organism to another.**
47. What is a man-made allopolyploid cereal crop created by crossing wheat and rye?
- **Triticale.**
48. A plant containing a gene that provides resistance to herbicides is called what?
- **A herbicide-resistant plant.**
49. The hormone insulin is naturally produced by which organ?
- **The pancreas.**

IMPORTANT QUESTIONS AND ANSWERS

1. **What do you mean by genetically modified organism? Describe two benefits of these crops.**

A Genetically Modified Organism (GMO) is a plant, animal, or microbe whose genetic material has been altered using genetic engineering techniques. Two major benefits of GM crops are: 1) **Increased Pest Resistance**, as seen in Bt cotton, which reduces the need for chemical pesticides. 2) **Enhanced Nutritional Value**, such as in Golden Rice, which is enriched with Vitamin A to combat deficiency.
2. **What do you understand by Bt cotton?**

Bt cotton is a genetically modified pest-resistant cotton variety. It has been engineered to contain a gene from the bacterium *Bacillus thuringiensis* (Bt). This gene codes for the **Cry protein**, an insecticidal toxin. When pests like bollworms ingest the plant tissue, the toxin becomes active in their alkaline gut, leading to their death and thus protecting the cotton crop.
3. **Describe the benefits of transgenic animals.**

Transgenic animals, whose DNA has been manipulated to express a foreign gene, offer several benefits. They are used to study normal physiology and disease development, produce useful **biological products** (like human proteins in milk), and test the safety of **vaccines and chemical toxins**. For example, the transgenic cow 'Rosie' produced human protein-enriched milk.
4. **Mention two uses of biotechnology in the field of medicine.**

Biotechnology has revolutionized medicine in many ways. Two significant uses are: 1) The mass production of therapeutic drugs, such as genetically engineered **human insulin (Humulin)** for treating diabetes. 2) The development of techniques for disease treatment and diagnosis, such as **gene therapy** to correct genetic defects and **ELISA** for detecting diseases like AIDS.
5. **What is micropagation? What are the advantages of producing plants through this technique?**

Micropropagation is a method of plant tissue culture used to produce a large number of plants from a small piece of parent tissue (explant) in a short amount of time. The key advantages are the rapid production of a vast number of **genetically identical plants (somaclones)** and the ability to generate **disease-free plants** from infected parent stock by using meristem culture.
6. **What is gene therapy? Give an example.**

Gene therapy is a technique that involves replacing a defective gene with a normal, healthy gene to treat or cure a genetic disorder. It is a collection of methods that allows for the correction of a gene defect. The first clinical gene therapy was given in 1990 to a four-year-old girl with **adenosine deaminase (ADA) deficiency**, a severe immunodeficiency disorder.
7. **What is RNA interference (RNAi)?**

RNA interference (RNAi) is a natural cellular defense mechanism in all eukaryotic organisms that involves the silencing of a specific gene. In biotechnology, this process is used to prevent the expression of a target gene by introducing double-stranded RNA, which triggers the degradation of the corresponding mRNA. It is famously used to protect tobacco plants from the nematode *Meloidogyne incognita*.
8. **Explain Bio-piracy in brief.**

Bio piracy is the term for the unauthorized use and commercialization of biological resources and traditional knowledge from a country or community without proper authorization or fair compensation. It often involves multinational companies patenting genetic resources or traditional knowledge (e.g., of medicinal plants) that have been used by indigenous people for centuries.
9. **What do you understand by Green Revolution?**

The Green Revolution refers to the period of dramatic increase in agricultural production, particularly in the production of wheat and rice, during the mid-20th century. This was achieved through the development of **high-yielding and disease-resistant crop varieties**, combined with the use of modern agricultural techniques like better irrigation, fertilizers, and pesticides.
10. **What is ELISA?**

ELISA stands for Enzyme-Linked Immunosorbent Assay. It is a widely used diagnostic technique based on the principle of **antigen-antibody interaction**. The presence of an antigen (like a pathogen) or an antibody in a sample is detected by using an enzyme-linked antibody, which produces a color change, indicating a positive result. It is commonly used for the diagnosis of AIDS.
11. **What is MOET?**

MOET stands for **Multiple Ovulation Embryo Transfer** technology. It is a program for herd improvement in cattle. In this procedure, a cow is administered hormones to induce superovulation (producing multiple eggs). The cow is then artificially inseminated, and the resulting embryos are recovered and transferred to surrogate mothers to increase the herd size in a short time.
12. **What are somaclones?**

Somaclones are plants that are produced through micropropagation or plant tissue culture from somatic (body) cells. Since they are derived from a single parent through asexual means, they are **genetically identical** to each other and to the parent plant. This technique is used to produce a large number of uniform plants.
13. **Comment upon Ethical Issues in context of modern biological advancement.**

Modern biological advancements, particularly genetic engineering, raise significant ethical issues. These include concerns about the **unpredictable long-term effects** of GMOs on ecosystems, the morality of manipulating animal genes for human benefit, which may cause animal suffering, and the potential for biopiracy. Organizations like GEAC are established to monitor the validity and safety of such research.
14. **What are cannabinoids?**

Cannabinoids are a group of chemical compounds that interact with cannabinoid receptors in the brain and are primarily obtained from the plant *Cannabis sativa*. These chemicals, found in products like marijuana and hashish, are known for their psychoactive effects and impact on the cardiovascular system.
15. **What is a 'bioreactor' and what is its function?**

A bioreactor is a large vessel used in biotechnology to carry out biological reactions on a large scale. Its function is to provide the **optimal environmental conditions** (temperature, pH, oxygen, etc.) for microorganisms or cells to grow and produce a desired biological product, such as an enzyme, antibiotic, or therapeutic protein, in large quantities.



Chapter 11: Organisms and Populations

QUICK REVISION: ONE-LINER QUESTIONS AND ANSWERS

1. The study of interactions among organisms and their environment is called?
- **Ecology.**
2. Who is known as the Father of Ecology in India?
- **Ramdeo Misra.**
3. As one moves from the equator towards the poles, what happens to the temperature?
- **It decreases.**
4. As one moves up in altitude, what happens to the temperature?
- **It decreases.**
5. What is the ability of an organism to adjust to its environment called?
- **Adaptation.**
6. Plants that are adapted to live in dry, desert conditions are called?
- **Xerophytes.**
7. Opuntia (prickly pear cactus) and Acacia are examples of what type of plant?
- **Xerophytes.**
8. A key adaptation of xerophytes to reduce water loss is?
- **Sunken stomata and thick cuticles.**
9. Plants that are adapted to live in water are called?
- **Hydrophytes.**
10. Trapa (water chestnut) and Hydrilla are examples of what type of plant?
- **Hydrophytes.**
11. A key characteristic of hydrophytes is the reduction of what tissues?
- **Vascular and mechanical tissues.**
12. Plants that grow on rocks are called?
- **Lithophytes.**
13. Plants that grow in mangrove areas are called?
- **Halophytes (e.g., Rhizophora).**
14. A group of individuals of the same species living in a given area is a?
- **Population.**
15. The number of births in a population during a given period is called?
- **Natality.**
16. The number of deaths in a population during a given period is called?
- **Mortality.**
17. The ratio of the birth rate to the death rate in a population is called the?
- **Vital Index.**
18. An age pyramid with a broad base, showing a high number of pre-reproductive individuals, indicates what?
- **An expanding population.**
19. At which level does natural selection operate to evolve desired traits?
- **The population level.**
20. An interaction between two species where both are benefited is called?
- **Mutualism.**
21. The relationship between fungi and algae in a lichen is an example of what?
- **Mutualism.**
22. An interaction where one species benefits and the other is unaffected is called?
- **Commensalism.**
23. The interaction between a clownfish and a sea anemone is an example of what?
- **Commensalism.**
24. An interaction where one species harms another to obtain nutrients is called?
- **Parasitism.**
25. An obligate root parasite that produces the world's largest flower is?
- **Rafflesia.**
26. An interaction where one species kills and eats another is called?
- **Predation.**
27. An interaction where both competing species are harmed is called?
- **Competition.**
28. What principle states that two closely related species competing for the same resources cannot coexist indefinitely?
- **Gause's Competitive Exclusion Principle.**
29. The process by which species avoid competition by choosing different resources is called?
- **Resource partitioning.**
30. Which organism is a well-known indicator of SO₂ (sulfur dioxide) pollution?
- **Lichens.**
31. Which of these plants are insectivorous: Drosera, Nepenthes, or Hydrilla?
- **Drosera and Nepenthes.**
32. What is the ability of soil to hold water called?
- **Water holding capacity.**
33. Which plant produces poisonous cardiac glycosides as a defense mechanism?
- **Calotropis.**
34. The internal buds produced by sponges for asexual reproduction are called?
- **Gemmules.**
35. Pacific salmon fish and bamboo are known for what reproductive strategy?
- **They reproduce only once in their lifetime.**
36. In which plant groups is water necessary for fertilization?
- **Algae, Bryophytes, and Pteridophytes.**
37. The plant tissue responsible for water transport is called?
- **Xylem.**
38. Mycorrhiza is a symbiotic association between fungi and plant roots; what is an example of an endomycorrhizal fungus?
- **Glomus.**
39. What is the movement of individuals into a population called?
- **Immigration.**
40. What is the movement of individuals out of a population called?
- **Emigration.**
41. What shape describes the population growth curve when resources are unlimited?
- **J-shaped (Exponential growth).**
42. What shape describes the population growth curve when resources are limited?
- **S-shaped (Sigmoid or Logistic growth).**
43. What does the term 'K' represent in the logistic growth model?
- **Carrying capacity.**
44. Organisms that can tolerate a wide range of temperatures are called?
- **Eurythermal.**
45. Organisms that can tolerate a narrow range of temperatures are called?
- **Stenothermal.**
46. What is an ectoparasite?
- **A parasite that lives on the outer surface of its host (e.g., lice).**
47. What is an endoparasite?
- **A parasite that lives inside the body of its host (e.g., tapeworm).**
48. The interaction where one species is harmed and the other is unaffected is called?
- **Amensalism.**

IMPORTANT QUESTIONS AND ANSWERS

1. What are adaptations? Explain with examples.

Adaptation is any attribute of an organism—morphological, physiological, or behavioral—that enables it to survive and reproduce in its specific habitat. For example, desert plants like cacti (**xerophytes**) have adapted by modifying their leaves into spines to reduce water loss. Similarly, seals living in polar regions have a thick layer of fat called blubber for insulation against the cold.

2. What is the mutualism? Explain with examples.

Mutualism is a type of population interaction where both interacting species benefit from the relationship. Neither species is harmed, and the association is mutually advantageous. A classic example is the relationship between fungi and algae in **lichens**, where the fungus provides shelter and absorbs nutrients, while the alga performs photosynthesis to provide food for both.

3. Explain commensalism with an example.

Commensalism is a type of interspecific interaction in which one species benefits, while the other is neither harmed nor benefited. A common example is an orchid growing as an epiphyte on a mango tree. The **orchid benefits** by getting a place to grow and better access to sunlight, but the **mango tree is unaffected** by its presence.

4. Describe the ecological adaptation of xerophytic plants.

Xerophytic plants, which live in arid conditions, have several adaptations to conserve water. These include a thick, waxy **cuticle** on their leaf surfaces, **sunken stomata** (stomata arranged in deep pits), and a specialized photosynthetic pathway called CAM that allows stomata to remain closed during the day. Many xerophytes, like *Opuntia*, also have their leaves modified into **spines** to reduce water loss through transpiration.

5. What are the factors which affect population growth?

Population growth is primarily affected by four basic processes. Two factors that increase population density are **Natality** (birth rate) and **Immigration** (the influx of individuals from other populations). Two factors that decrease population density are **Mortality** (death rate) and **Emigration** (the movement of individuals out of the population).

6. What is the competitive exclusion principle?

The competitive exclusion principle, proposed by Gause, states that two closely related species competing for the same limited resources cannot coexist indefinitely. The competitively inferior species will eventually be eliminated by the competitively superior one. This principle highlights that complete competitors cannot coexist in the same niche.

7. Write about hydrophytes, xerophytes, and mesophytes with examples.

Hydrophytes are plants adapted to live in aquatic environments, like *Hydrilla*. **Xerophytes** are plants adapted to dry, arid conditions, like cactus (*Opuntia*). **Mesophytes** are terrestrial plants that are adapted to moderate conditions, neither particularly dry nor wet, like a mango tree.

8. Differentiate between commensalism and Amensalism.

In **commensalism**, one species benefits while the other remains unaffected (a '+, 0' interaction), for example, an orchid on a tree. In **amensalism**, one species is harmed while the other is unaffected (a '-, 0' interaction). An example is the mold *Penicillium* secreting penicillin, which kills bacteria without the mold itself being affected.

9. What is Vital Index? Write the formula to find it.

The Vital Index is a measure used in population studies to indicate the growth trend of a population. It is the ratio of the number of births (natality) to the number of deaths (mortality) within a population over a specific period. The formula to calculate it is: **Vital Index = (Natality / Mortality) x 100**.

10. Explain parasitic adaptations.

Parasites have evolved several special adaptations to thrive on or within their hosts. These often include the **loss of unnecessary sense organs**, the presence of **adhesive organs or suckers** for clinging to the host, the loss of a digestive system (in endoparasites), and a very **high reproductive capacity** to ensure the transmission of their offspring to new hosts.

11. What is a population?

In ecology, a population is defined as a group of individuals of the **same species** that live in a particular geographical area at a specific time. The members of a population share or compete for similar resources and can potentially interbreed.

12. What is carrying capacity?

Carrying capacity, denoted as 'K', is the maximum population size of a biological species that can be sustained indefinitely by a given environment, considering the available resources like food, water, and space. When a population reaches its carrying capacity, its growth rate slows down and becomes zero, leading to a logistic or S-shaped growth curve.

13. What is resource partitioning? Give an example.

Resource partitioning is an evolutionary mechanism that allows two or more competing species to coexist by dividing a limited resource. The species do this by using the resource in different ways, at different times, or in different places. For example, MacArthur's study on warblers showed that five closely related species could coexist on the same tree by foraging for insects in different parts of the tree.

14. What is camouflage? How is it an adaptation?

Camouflage is a type of cryptic coloration or patterning that allows an organism to blend in with its surroundings. It is a crucial adaptation for both predators and prey. For prey, it helps them avoid detection by predators (e.g., a stick insect). For predators, it helps them remain unseen by their prey, increasing their chances of a successful hunt (e.g., a snow leopard).

15. Distinguish between Homothallic and Heterothallic conditions with the help of examples.

These terms describe the reproductive strategies in fungi. A **homothallic** species is one in which a single individual is self-fertile and can perform sexual reproduction on its own. A **heterothallic** species requires two different, compatible mating types to come together for sexual reproduction. It is analogous to dioecious and monoecious conditions in plants.



Chapter 12: Ecosystem

QUICK REVISION: ONE-LINER QUESTIONS AND ANSWERS

1. Who first used the term 'Ecosystem'? **- A.G. Tansley.**
2. What are the two main components of an ecosystem? **- Biotic (living) and Abiotic (non-living).**
3. Organisms that produce their own food are called? **- Producers (or autotrophs).**
4. Green plants convert what form of energy into chemical energy? **- Light energy.**
5. Organisms that feed on other organisms are called? **- Consumers (or heterotrophs).**
6. Bacteria and fungi that feed on dead organic matter are called? **- Decomposers (or saprotrophs).**
7. A sequence of organisms eating one another is a? **- Food chain.**
8. Which is a correct food chain: "Goat, Cow, Grass" or "Grass, Goat, Lion"? **- Grass, Goat, and Lion.**
9. A network of interconnected food chains is a? **- Food web.**
10. Each step or level in a food chain is a? **- Trophic level.**
11. Green plants belong to which trophic level? **- The first trophic level (T1).**
12. The rate of biomass production by producers is? **- Primary productivity.**
13. The total rate of photosynthesis is called? **- Gross Primary Productivity (GPP).**
14. The rate of biomass formation by consumers is? **- Secondary productivity.**
15. How does energy flow through an ecosystem? **- It is unidirectional.**
16. What percentage of energy is transferred between trophic levels? **- 10 percent.**
17. A graphical representation of trophic structure is an? **- Ecological pyramid.**
18. Which ecological pyramid is always upright? **- The pyramid of energy.**
19. The gradual change in species composition of an area is? **- Ecological succession.**
20. The first species to colonize a bare area are? **- Pioneer species.**
21. In a dry succession (xerosere), what are the pioneer species? **- Lichens.**
22. In a wet succession (hydrosere), what are the pioneer species? **- Phytoplankton.**
23. The final, stable community in succession is the? **- Climax community.**
24. The nature of a climax community is determined by what? **- The climate.**
25. The process of breaking down dead organic matter is called? **- Decomposition.**
26. Which is NOT a process of decomposition: Leaching or Anabolism? **- Anabolism.**
27. A food chain starting with dead organic matter is a? **- Detritus food chain.**
28. The process of nutrients washing down into the soil is? **- Leaching.**
29. The cycling of nutrients like carbon and phosphorus is called? **- Nutrient cycling.**
30. The natural aging of a lake due to nutrient enrichment is? **- Eutrophication.**
31. The main cause of acid rain? **- Air pollution from NO₂ and SO₂.**
32. Which organism is an indicator of SO₂ pollution? **- Lichens.**
33. A generally safe sound intensity level for humans is? **- 20-30 decibels.**
34. According to WHO, what is a safe noise pollution standard? **- Around 20-30 decibels.**
35. Where do phytoplankton grow most abundantly in a lake? **- In the limnetic zone.**
36. What is the term for the total living matter at a trophic level? **- Standing crop.**
37. What are animals that eat only plants called? **- Herbivores.**
38. What are animals that eat other animals called? **- Carnivores.**
39. What is PAR? **- Photosynthetically Active Radiation.**
40. How much PAR do plants capture for photosynthesis? **- About 2-10%.**
41. The breakdown of detritus into smaller particles is called? **- Fragmentation.**
42. The process of forming a dark, amorphous substance from detritus is? **- Humification.**
43. The process where microbes degrade humus to release inorganic nutrients is? **- Mineralization.**
44. Which major nutrient cycle is considered a gaseous cycle? **- The carbon cycle.**
45. Which major nutrient cycle is considered a sedimentary cycle? **- The phosphorus cycle.**
46. Which zone in a lake is the shallow, well-lit water close to the shore? **- The littoral zone.**
47. What are the primary consumers in most aquatic ecosystems? **- Zooplankton.**
48. A parasitic plant that feeds on other plants is considered what type of consumer? **- A primary consumer.**
49. What is a Rhizocarpon an example of? **- A crustose lichen.**
50. What is a major source of atmospheric carbon dioxide? **- Combustion of fossil fuels.**

IMPORTANT QUESTIONS AND ANSWERS

1. What do you understand by an ecosystem?

An ecosystem is a functional unit of nature where living organisms (biotic components) interact among themselves and also with their surrounding physical environment (abiotic components). It comprises both **biotic factors** like producers, consumers, and decomposers, and **abiotic factors** like temperature, water, and sunlight, linked together by energy flow and nutrient cycling.

2. Differentiate between Food chain and Food-web.

A **food chain** represents a single, linear pathway of energy transfer in an ecosystem, showing who eats whom (e.g., Grass -> Deer -> Tiger). In contrast, a **food web** is a more realistic representation, consisting of a complex network of many interconnected food chains. It shows that most organisms have multiple food sources and are eaten by multiple predators.

3. What are the primary and secondary productivities ?

Primary productivity is the rate at which biomass or organic matter is produced by producers (plants) through photosynthesis per unit area over a time period. **Secondary productivity** is the rate of formation of new organic matter by consumers (herbivores and carnivores). It represents the rate at which consumers convert the chemical energy of their food into their own biomass.

4. Explain the pyramid of energy.

The pyramid of energy is a graphical representation that illustrates the flow of energy from one trophic level to the next in an ecosystem. It is always **upright** because energy transfer is inefficient. According to the **10 percent law**, only about 10% of the energy from one trophic level is incorporated into the biomass of the next level, with the rest being lost as heat during metabolic processes.

5. What is a food web? Name the organisms of two food chains of a grassland ecosystem.

A food web is a natural interconnection of multiple food chains, forming a complex web-like pattern that shows all the possible feeding relationships in an ecosystem. In a grassland ecosystem, two possible food chains are: 1) **Grass -> Grasshopper -> Frog -> Snake**. 2) **Grass -> Rabbit -> Fox**.

6. Define Trophic level and Ecological Pyramid.

A **Trophic Level** refers to the specific position an organism occupies in a food chain. Organisms are grouped into levels based on their source of food, such as producers (T1), primary consumers (T2), etc. An **Ecological Pyramid** is a graphical representation designed to show the biomass, number, or energy content at each trophic level in an ecosystem.

7. What is decomposition? Name its key steps.

Decomposition is the natural process by which decomposers, like bacteria and fungi, break down complex organic matter from dead plants and animals into simpler inorganic substances like CO_2 , water, and nutrients. The key steps involved in this process are **fragmentation**, **leaching**, **catabolism**, **humification**, and **mineralization**.

8. What is global warming? Describe its effects and measures for its control.

Global warming is the long-term heating of Earth's climate system observed since the pre-industrial period due to human activities, primarily fossil fuel burning, which increases heat-trapping greenhouse gas levels in the atmosphere. Its effects include rising sea levels, more frequent extreme weather events, and disruption of ecosystems. Control measures involve reducing greenhouse gas emissions by shifting to renewable energy, promoting reforestation, and improving energy efficiency.

9. What is ecological succession?

Ecological succession is the gradual and fairly predictable change in the species composition of a given area over time. It is a process where a community of organisms changes, leading eventually to a stable, self-perpetuating climax community. There are two types: primary succession, which occurs on barren land, and secondary succession, which occurs in an area that has been disturbed.

10. Show pond ecosystem with the help of a diagram.

A diagram of a pond ecosystem would illustrate its key components. The **abiotic components** include water, sunlight, soil, and dissolved nutrients. The **biotic components** would include **producers** like phytoplankton and aquatic plants; **primary consumers** like zooplankton and small insects; **secondary consumers** like small fish; **tertiary consumers** like large fish or birds; and **decomposers** like bacteria and fungi at the bottom.



Chapter 13: Biodiversity and Conservation

QUICK REVISION: ONE-LINER QUESTIONS AND ANSWERS

1. The variety of life on Earth at all levels is called? **- Biodiversity.**
2. According to Robert May's estimate, what is the global species diversity? **- About 7 million.**
3. India's share of the world's species diversity is approximately what percentage? **- 8.1%.**
4. Which group of organisms has the highest number of species in nature? **- Insects.**
5. What is a region with very high levels of species richness and endemism called? **- A biodiversity hotspot.**
6. How many biodiversity hotspots have been identified in the world? **- 34.**
7. The complete disappearance of a species from Earth is called? **- Extinction.**
8. The Dodo is an example of what kind of species? **- An extinct species.**
9. Which species became extinct due to over-exploitation by humans? **- Steller's sea cow.**
10. The extinction of cichlid fish in Lake Victoria was caused by what? **- Alien species invasion (introduction of the Nile Perch).**
11. A species facing a very high risk of extinction in the wild is called? **- An endangered species.**
12. Nepenthes (pitcher plant) is an example of what kind of plant species? **- An endangered plant species.**
13. What is the book that maintains a record of rare and endangered species? **- The Red Data Book.**
14. The protection and preservation of wildlife and natural resources is called? **- Conservation.**
15. Conservation of species within their natural habitats is called? **- In-situ conservation.**
16. National Parks, Sanctuaries, and Biosphere Reserves are examples of what type of conservation? **- In-situ conservation.**
17. What is protected in a National Park? **- Both flora (plants) and fauna (animals) of the entire ecosystem.**
18. Conservation of species outside their natural habitats is called? **- Ex-situ conservation.**
19. Zoological parks and botanical gardens are examples of what type of conservation? **- Ex-situ conservation.**
20. The technique of preserving genetic material at very low temperatures is called? **- Cryopreservation.**
21. What are tracts of forest set aside and protected in the name of God or deities called? **- Sacred groves.**
22. The Gir National Park is famous for which animal? **- The Asiatic lion.**
23. The Kanha National Park is famous for which animal? **- The tiger.**
24. The Rhino Sanctuary in Kaziranga National Park is located in which state? **- Assam.**
25. Periyar Sanctuary in Kerala provides protection to which animal? **- The elephant.**
26. Ranthambore National Park is located in which state? **- Rajasthan.**
27. The increase in the average temperature of the Earth is known as? **- Global warming.**
28. What is the primary cause of global warming? **- The greenhouse effect.**
29. Which of these is NOT a greenhouse gas: Methane, Nitrogen, or CO₂? **- Nitrogen.**
30. Greenhouse gases are effective at absorbing what type of radiation? **- Infrared radiation.**
31. The thinning of the protective ozone layer in the stratosphere is known as? **- Ozone depletion.**
32. What is the main cause of ozone depletion? **- Chlorofluorocarbons (CFCs).**
33. The depletion of the ozone layer leads to an increase in what type of radiation on Earth? **- UV-B radiation.**
34. Absorption of UV-B radiation is a major cause of what condition in humans? **- Snow blindness and skin cancer.**
35. The thickness of the ozone layer is measured in which units? **- Dobson Units (DU).**
36. What is the primary cause of acid rain? **- Emissions of sulfur dioxide (SO₂) and nitrogen oxides.**
37. A mixture of smoke and fog is called? **- Smog.**
38. Photochemical smog is formed from ozone, PAN, and what other pollutant? **- Nitrogen dioxide (NO₂).**
39. At what noise level is sound generally considered to be pollution? **- Above 80-99 decibels (dB).**
40. Why is Carbon Monoxide (CO) more toxic than Carbon Dioxide (CO₂)? **- It reduces the oxygen-carrying capacity of hemoglobin.**
41. What is a common example of a non-biodegradable pollutant? **- DDT or plastics.**
42. Which invasive aquatic plant is known as the 'Terror of Bengal'? **- Water hyacinth (Eichhornia crassipes).**
43. What date is celebrated as World Environment Day? **- June 5th.**
44. What date is celebrated as International Day for Biological Diversity? **- May 22nd.**
45. The World Summit on Sustainable Development in 2002 was held in which city? **- Johannesburg.**
46. What was the toxic gas responsible for the Bhopal gas tragedy? **- Methyl isocyanate (MIC).**
47. What is India's National Aquatic Animal? **- The River Dolphin.**
48. A pollutant that can cause mutations is called a? **- Mutagenic pollutant (e.g., chlorinated hydrocarbons).**
49. The famous 'Chipko Movement' was started for what purpose? **- To protect trees from being cut down.**

IMPORTANT QUESTIONS AND ANSWERS

1. What do you know about biodiversity?

Biodiversity, or biological diversity, refers to the variety and variability of life on Earth. It encompasses diversity at all levels of biological organization, including **genetic diversity** (diversity within a species), **species diversity** (variety of species in an area), and **ecological diversity** (variety of ecosystems).

2. What is a Biodiversity hotspot? Name two such hotspots found in India.

A biodiversity hotspot is a biogeographic region with a significant reservoir of biodiversity that is under threat from human activities. To qualify, a region must contain at least 1,500 species of vascular plants as endemics and have lost at least 70% of its primary native vegetation. Two major hotspots in India are the **Western Ghats** and the **Himalayas**.

3. Differentiate between in-situ and ex-situ conservation.

In-situ conservation is the protection of species within their natural habitats, such as in National Parks, Sanctuaries, and Biosphere Reserves. **Ex-situ conservation** involves the protection of threatened species outside their natural habitats, in settings like botanical gardens, zoological parks, and through techniques like cryopreservation in gene banks.

4. State two reasons for the extinction of some wild animals.

Two primary reasons for the extinction of wild animals are: 1) **Habitat Loss and Fragmentation**, where the natural homes of animals are destroyed or broken into small patches due to deforestation, urbanization, and agriculture. 2) **Over-exploitation**, which includes excessive hunting, poaching, and harvesting of species by humans at a rate faster than they can replenish their populations.

5. What is the greenhouse effect?

The greenhouse effect is a natural process that warms the Earth's surface. Greenhouse gases, such as carbon dioxide (CO_2) and methane (CH_4), trap heat from the sun in the atmosphere, preventing it from escaping into space. While this effect is necessary for life, an increase in these gases due to human activities is causing an enhanced greenhouse effect, leading to **global warming**.

6. What is global warming? Explain its effects.

Global warming is the long-term increase in the Earth's average surface temperature due to the enhanced greenhouse effect caused by human activities. Its major effects include the **melting of polar ice caps and glaciers**, leading to a **rise in sea levels**, and an increase in the frequency and intensity of extreme weather events like floods, droughts, and heatwaves.

7. What do you mean by ozone hole? What are the main reasons of ozone depletion?

An 'ozone hole' refers to the marked thinning or depletion of the ozone layer in the stratosphere, particularly over the Antarctic region. The main reason for ozone depletion is the release of man-made chemicals, especially **chlorofluorocarbons (CFCs)**. These chemicals release chlorine atoms in the stratosphere, which catalytically destroy ozone molecules, reducing the layer's ability to absorb harmful UV-B radiation.

8. What do you understand by biomagnification?

Biomagnification is the process by which the concentration of a toxic substance, such as DDT or mercury, increases in the tissues of organisms at successively higher levels in a food chain. Because these substances are not easily metabolized or excreted, they accumulate at each trophic level, reaching the highest concentrations in top predators.

9. Write a short note on the Red Data Book.

The Red Data Book is a public document created by the International Union for Conservation of Nature (IUCN) that compiles data on rare and endangered species of plants and animals. It provides information on their population status, threats, and conservation measures. Its primary purpose is to identify and protect those species that are at a high risk of extinction.

10. Define endangered species with examples.

An endangered species is a species that is facing a very high risk of extinction in the wild in the near future. Their population has declined to a critical level, and their survival is unlikely if the causal factors continue operating. Examples include the **Bengal Tiger** (an endangered animal) and the **Pitcher Plant**, *Nepenthes* (an endangered plant).

11. What are sacred groves and what is their significance?

Sacred groves are tracts of forest that have been set aside by local communities and are protected in the name of a deity or ancestral spirit. They are found in various parts of India, such as the Aravalli Hills of Rajasthan. Their significance lies in **biodiversity conservation**, as they act as refuges for many rare and threatened species and represent a traditional form of *in-situ* conservation.

12. What do you understand by noise pollution? Mention its harmful effects.

Noise pollution is the presence of unwanted or disturbing sound in the environment that has harmful effects on human health and wildlife. It is typically defined as sound exceeding 80 decibels (dB). Harmful effects on humans include **hearing loss, increased heart rate and blood pressure**, sleep disturbances, and psychological stress.

13. What is Dobson unit?

A Dobson Unit (DU) is the standard unit of measurement for the total amount of ozone in a column of air from the ground to the top of the atmosphere. One Dobson Unit refers to a layer of ozone that would be 0.01 mm thick at standard temperature and pressure. It is used to measure the thickness of the ozone layer.

14. How is smog formed?

Smog is a type of air pollution, a mixture of smoke and fog. **Photochemical smog** is formed when pollutants like nitrogen oxides and volatile organic compounds from vehicle emissions react with sunlight. This reaction produces secondary pollutants like ozone (O_3) and peroxyacetyl nitrate (PAN), which form a brownish haze over cities.

15. What do you know about the Bhopal gas tragedy?

The Bhopal gas tragedy was a catastrophic industrial accident that occurred on the night of December 2-3, 1984, at a Union Carbide pesticide plant in Bhopal, India. A highly toxic gas, **Methyl Isocyanate (MIC)**, was accidentally released, exposing over 500,000 people and resulting in thousands of immediate and long-term deaths and disabilities.