Chapter 9: Heredity & Evolution

B09

1. **How is diversity achieved in asexual reproduction?**

   In asexual reproduction, the individuals generated would be very similar and only have minor differences between them due to small inaccuracies in DNA copying.

2. **Do all variations in a species have equal chance of surviving in the environment in which they live?**

   No, depending on the nature of variation, different individuals would have different kinds of advantages.

3. **What is the basis for evolutionary processes?**

   Selection of variants by environmental factors forms the basis for evolutionary processes.

4. **If a trait A exists in 10% of a population of an asexually reproducing species and a trait B exists in 60% of the same population, which trait is likely to have arisen earlier?**

   Trait 'B'. Percentage of any gene in a population increases from generation to generation.

5. **How does the creation of variations in a species promote survival?**

   During reproduction (also inaccuracies in DNA replications), many variations occur in the offspring. Some individuals have more favourable variations than the other. Such individuals survive and pass these variations to the next generation.

6. **How do asexually reproducing organisms produce variation among their progeny? Explain with an example.**

   In asexually reproducing organisms variation occurs due to inaccuracies in DNA copying at the time of nuclear division.

   For example: One bacteria divides, it will give rise to two bacteria. These daughter bacteria would be similar in body design but will have slight differences. The resultant bacteria divide again, and each bacterium will give rise to two bacteria in the next generation. The four individuals will be different from each other.

7. **Do all variations in a species have equal chances of surviving in the environment in which they find themselves?**

   No, Depending on the nature of variations, different individuals would have different kinds of advantages.

8. **Define heredity.**

   The process by which traits and characteristics are passed from the parents to the offsprings is called heredity.

9. **Define genetics.**

   The branch of biology which deals with heredity and variations is known as genetics.

10. **Write the expanded form of DNA.**

    Deoxyribonucleic acid (DNA)

11. **What is gene?**

    Gene is a functional segment of DNA on a chromosome occupying specific position which carries out a specific biological function.

12. Name the plant on which Mendel performed his experiments.

Garden pea (Pisum sativum)

13. What are traits?

Trait is a distinguishing quality or characteristic belonging to a person.

14. What are inherited traits?

The traits which are obtained by the off-springs from parents are called inherited traits.

15. For each trait there will be two versions in each child. Which trait is seen in the child?

Only one of the parental traits is seen in the child, not a mixture of the two.

16. Activity (9.1) - To study the earlobes of students in the class.

Observation: It is observed that the lowest part of the ear, called the earlobe, is closely attached to the side of the head in some of the students, and not in others. Hence, free and attached earlobes are two variants found in human populations.

17. Write the contrasting characteristics that were used by Mendel in his pea plant experiment.

The visible contrasting characteristics of pea plants were:

a) Tall & short plants. b) White & violet flowers c) Round & wrinkled seeds.

18. What do you mean by F1 generation?

F1 generation is the first generation of offspring produced by a set of parents.

19. What do you mean by F2 generation?

F2 or second filial generation is the generation produced as a result of interbreeding between individuals of F1 generation.

20. What conclusion was drawn by Mendel after obtaining F2 progeny in monohybrid cross?

Mendeleian experiments showed when pea plants one tall and one dwarf are self-pollinated then all the offsprings were tall. In the F2 generation when two tall pea plants were allowed to reproduce then all plants were not tall. One quarter of them are short. This indicates that both the tallness and shortness traits were inherited in the F1 plants but only the tallness trait was expressed.

21. How do traits gets expressed?

A trait in an organism results from the action of protein or proteins which is manufactured by a gene. Each protein is made from gene/s for that protein. In pea plant, there are two genes for plant height – 'T' and 't'. 'T' is dominant over 't'. In heterozygous plant (Tt), only the gene' T' will be able to make proteins as it is dominant over 't' gene. This protein would be the growth hormone which will result in the plant being tall.

22. What do you mean by dominant and recessive traits?

A dominant trait is an inherited characteristic that appears in an offspring if it is contributed from a parent.

Recessive traits is an inherited characteristic that is carried in a person's genes without appearing in that person.

23. How do Mendel's experiments show that traits may be dominant or recessive?

Mendel took pea plants of two different characters (tall plants and short plants). The first generation of F1 progeny formed were all tall. This shows that traits may be either dominant or recessive; there is no way in between traits obtained.

24. (Activity 9.2) What experiment would we do to confirm that the F2 generation did in fact have a 1:2:1 ratio of TT, Tt and tt trait combinations?

F3 generation may be raised by allowing self-pollination of F2 generation plants respectively.

Tall plants which produced only tall plants (TT). Tall plants which produced both tall and dwarf pea plants which are hybrid (Tt).

Dwarf plants produced only dwarf plants (tt). The ratio 1:2:1 of TT, Tt and tt trait combination in F2 generation is seen.

25. What happens when pea plants showing two different characteristics, rather than just one, are bred with each other?

When pea plants with round and green seeds are crossed with wrinkled and yellow seed, F1 generation plants have round and yellow seed. When F1 plants allowed to self-pollinate, we get a ratio of 9:3:3:1. It means, F2 generation shows four types of individuals–9/16 with both dominant trait, 3/16 with one dominant and second recessive, 3/16 second dominant and first recessive, 1/16 with both recessive traits.

26. What do the progeny of a tall plant with round seeds and a short plant with wrinkled-seeds look like?

All plants are tall and have round seeds as tallness and round seeds are dominant traits.

27. What happens when the F1 progeny are used to generate F2 progeny by self-pollination?

Mendel's experiment shows that some F2 progeny are tall plants with round seeds, and some were short plants with wrinkled seeds. There would also be some F2 progeny that showed new mixtures. Some of them would be tall, but have wrinkled seeds, while others would be short, but have round seeds.

28. How does the mechanism of heredity work?

The mechanism of heredity work in the following ways

Organisms transfer characters from parent to offsprings in the form DNA.

DNA is the basic unit of inheritance, during reproduction this DNA copies itself in the offspring. It is similar to the main DNA, similar because there may be some errors too.

In sexual reproduction the DNA of both parents work inheriting the characters of both parents.

It also helps in providing such offsprings which are similar to the parents. One of most important benefit is that it helps the offsprings in the current surroundings

29. How do proteins control the characteristics inherited?

Let us take the example of tallness as a characteristic. We know that plants have hormones that can trigger growth. Plant height can thus depend on the amount of a particular plant hormone. The amount of the plant hormone made will depend on the efficiency of the process for making it. Consider now an enzyme that is important for this process. If this enzyme works efficiently, a lot of hormone will be made, and the plant will be tall. If the gene for that enzyme has an alteration that makes the enzyme less efficient, the amount of hormone will be less, and the plant will be short. Thus, genes control characteristics, or traits.

30. How do germ-cells make a single set of genes from the normal two copies that all other cells in the body have?

Each cell will have two copies of each chromosome, one each from the male and female parents. Every germ-cell will take one chromosome from each pair and these may be of either maternal or paternal origin. When two germ cells combine, they will restore the normal number of chromosomes in the progeny, ensuring the stability of the DNA of the species

31. How many pairs of chromosomes are present in human beings? Out of these how many are sex chromosomes? How many types of sex chromosomes are found in human beings?

There are 23 pairs of chromosomes present in human beings. Out of these 23 pairs, one pair is of sex chromosomes. There are two types of sex chromosomes found in human beings X and Y. A female has 2 X chromosomes and a male one X and one Y chromosome.

32. How is the sex of a new-born individual determined?
OR "The sex of a new-born individual in some species is largely determined genetically while in others it is other ways". Give examples to justify this statement.

a) In some animals the temperature at which fertilised eggs are kept determines whether the animals developing in the eggs will be male or female.

b) In snails, individuals can change sex, indicating that sex is not genetically determined.

c) A child who inherits an X chromosome from her father will be a girl, and one who inherits a Y chromosome from him will be a boy.

33. How is the sex of the child determined in human beings?

In human beings, the females have two X chromosomes and the males have one X and one Y chromosome. Therefore, the females are XX and the males are XY.

The gametes receive half of the chromosomes. The male gametes have 22 autosomes and either X or Y sex chromosome.

Type of male gametes: 22+X OR 22+ Y.

Since the females have XX sex chromosomes, their gametes can only have X sex chromosome.

Type of female gamete: 22+X

Thus, the mother provides only X chromosomes. The sex of the baby is determined by the type of male gamete (X or Y) that fuses with the X chromosome of the female.

34. "It is a matter of chance whether a couple will give birth to a boy or a girl". Justify the statement and support your answer with a neat illustration.

OR

"The sex of the children is determined by what they inherit from their father and not their mother". Justify

OR

Explain with the help of a figure that father is responsible for the sex of the child.

OR

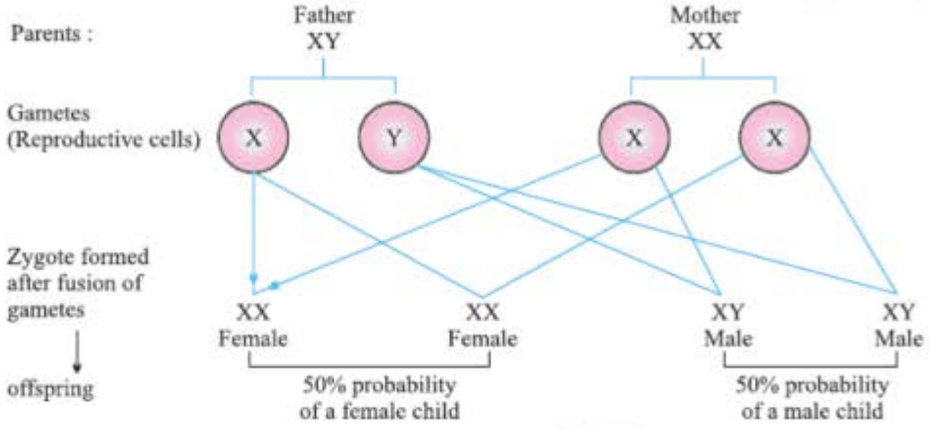
"Sex of a child is determined at the time of conception in human beings". Explain the statement.

Male gametes (sperms) possess XY combination of sex chromosomes while female gametes (eggs) have one pair of X chromosome (XX) as sex chromosomes.

When a sperm carrying X-chromosome fertilises an egg, the zygote (XX) will develop into a girl.

When a sperm carrying Y-chromosome fertilises an egg, the zygote (XY) will develop into a boy.

Thus it is only the father or male who is responsible for the sex of a new born child.



35. How do Mendel's experiments show that traits may be dominant or recessive?

Mendel selected true breeding tall (TT) and dwarf (tt) pea plants. Then, he crossed these two plants. The seeds formed after fertilization were grown and these plants that were formed represent the first filial or F1 generation. All the F1 plants obtained were tall. Then, Mendel self-pollinated the F1 plants and observed that all plants obtained in the F2 generation were not tall. Instead, one-fourth of the F2 plants were short. From this experiment, Mendel concluded that the F1 tall plants were not true breeding. They were carrying traits of both short height and tall height. They appeared tall only because the tall trait is dominant over the dwarf trait.

36. How do Mendel's experiments show that traits are inherited independently?

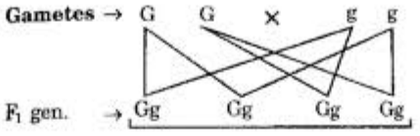
Mendel crossed pea plants having round green seeds (RRyy) with pea plants having wrinkled yellow seeds (rrYY). Since the F1 plants are formed after crossing pea plants having green round seeds and pea plants having yellow wrinkled seeds, F1 generation will have both these characters in them. However, as we know that yellow seed colour and round seeds are dominant characters, therefore, the F1 plants will have yellow round seeds.

Then this F1 progeny was self-pollinated and the F2 progeny was found to have yellow round seeds, green round seeds, yellow wrinkled seeds, and green wrinkled seeds in the ratio of 9:3:3:1.

37. A man with blood group A marries a woman with blood group O and their daughter has blood group O. Is this information enough to tell you which of the traits – blood group A or O – is dominant? Why or why not?

No. This information is not sufficient to determine which of the traits – blood group A or O – is dominant. This is because we do not know about the blood group of all the progeny. Blood group A can be AA or AO. Hence, the information is incomplete to draw any such conclusion.

38. If green stemmed tomato plants is denoted by GG and that of purple stemmed tomato plants as gg. Sketch the outline of the cross and answer the following:



a) What colour of stem would you expect in F1 generation?

Green

b) Give the percentage of purple stemmed plants if F1 plants are self-pollinated?

25%

c) In what ratio would you find the GG and Gg in the F2 generation?

GG: Gg = 1 : 2

39. A round green seeded plant (RRyy) is crossed with a wrinkled yellow (rrYY) seeded plant. Find out the type of plants in F1 and F2 generations with the help of a cross.

When a pea plant with round green seeds was crossed with a pea plant with wrinkled yellow seeds, the F1 progeny were all plants with round yellow seeds. It means that round and yellow seeds are dominant trait while wrinkled and green seeds are recessive traits. When the F1 plants were self-pollinated, there were four types of plants obtained in the F2 generation – Round yellow seeds, Round green seeds, Wrinkled yellow seeds and wrinkled yellow seeds.

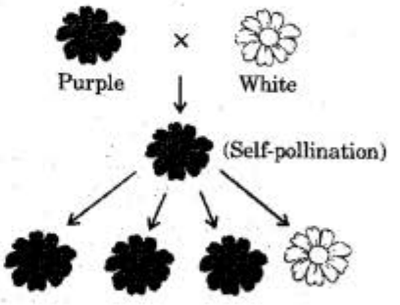
40. In Mendel's experiment on pea plants, which trait gets expressed in the first generation?

Only dominant trait gets expressed in the first generation.

41. In what ratio, traits with one contrasting character get expressed in the second generation?

3:1 (Three dominant and one recessive)

42. From the figure a) identify the flower having dominant and recessive trait.

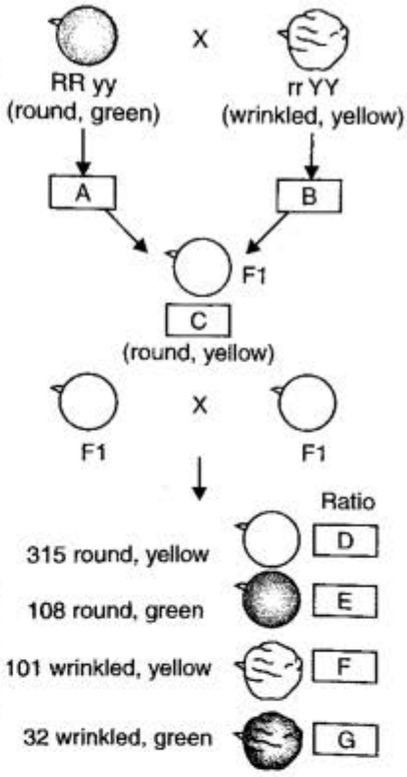


Purple colour is the dominant trait and white colour is the recessive trait.

43. When pesticide is sprayed on a population of insects, all insects do not get killed but a few of them survive. Give reason.

The insects, who survive have developed the resistance against the pesticide, by generating variation in their DNA in comparison to the other insects. The insects which did not have the variation in their DNA could not develop resistance against the pesticide so they got killed.

44. Given below is the experiment carried out by Mendel to study inheritance of two traits in garden pea.



a) What do A, B, C, D, E, F and G represent in these boxes?

A= gamete of round green (RY) plant.

B= gamete of wrinkled (ry)

C= F1 generation (all round yellow)

D= 9

E= 3

F= 3

G= 1

b) State the objective for which Mendel performed this experiment.

To show independent inheritance of traits

Or

To prove law of independent assortment.

45. In a population of red beetles, living on green bushes, is being eaten by crows, during sexual reproduction, a green beetle is found in progeny. a) What is the future of the new trait? B) Will it survive in the new habitat?

a) The new trait (green beetle) will have a better chance of survival and will increase in number.

b) Yes, it will because it has an advantage of survival due to its green colour the same as of leaves of plant which will protect it from being eaten by the crows.

46. What are acquired traits?

The characteristics which are developed during the lifetime of an individual is called acquired traits. Ex: larger muscle size, skills like painting, singing, swimming, dancing etc.

47. Explain whether the traits like eye colour or height is genetically inherited or not. Do power to lift weight and reading a language also belong to the same category? Justify your answer.

Eye colour or height traits cannot be changed or acquired in the life time because they are controlled by the genes which an individual inherits from his/her parents. So such traits are genetically inherited and are transmitted one generation to the next generation. Power to lift weights and reading a language, painting, singing, etc. can be acquired during life time by practice. Such acquired characters do not change DNA. These changes are in non-reproductive tissues and cannot be passed to next generation. They are not genetically inherited.

48. Distinguish between acquired traits and inherited traits.

Acquired traits	Inherited traits
Characteristics which are developed during the lifetime of an individual	Characteristics which are transmitted from parent to the offspring.
The characteristics do not get inherited to another generation.	The characteristics get

49. If the tails of the mice are removed by surgery in each generation, do these tailless mice have tailless progeny?

No, because removal of the tail cannot change the genes of the germ cells of the mice.

50. What are the different ways in which individuals with a particular trait may increase in a population?

Individuals with a particular trait may increase in a population as a result of the following:

(i) Natural selection: When that trait offers some survival advantage.

(ii) Genetic drift: When some genes governing that trait become common in a population.

(iii) When that trait gets acquired during the individual's lifetime.

51. Why are traits acquired during the life-time of an individual not inherited?

This happens because an acquired trait involves change in non-reproductive tissues (somatic cells) which cannot be passed on to germ cells or the progeny. Therefore, these traits cannot be inherited.

52. Why are the small numbers of surviving tigers a cause of worry from the point of view of genetics?

Small numbers of tigers means that fewer variations in terms of genes are available. This means that when these tigers reproduce, there are less chances of producing progeny with some useful variations. Hence, it is a cause of worry from the point of view of genetics.

53. What is speciation?

The process of origin of a new species is called speciation.

54. Define specie.

A species is a group of organisms in which most of the characters are similar and members of a species are able to breed among themselves.

55. List four factors responsible for speciation & Explain

a) Genetic drift: Sudden change in the frequency of genes.

b) Mutation: Sudden change in genetic makeup of any organism.

c) Natural selection: It is selection of particular type of species.

d) Migration: Shifting of one particular organism of a species in the other group of organisms of the same population but with different characteristics.

56. What is genetic drift? Or when can speciation occur?

Speciation can happen if two groups of the same species are somehow prevented from interbreeding for several generations. This can happen because of geographical segregation or because of some genetic changes. Evolution of new species, because of geographical segregation is called genetic drift.

57. What is the result of genetic drift between two sub-populations?

The outcome of genetic drift between two sub-populations is the formation of new species or speciation which are incapable of reproducing with each other.

58. There is a sub-population A and another sub-population B. Both are separated by a natural barrier. What will happen is such a case?

When two sub-populations are separated by natural barrier then after few generations this genetic drift will accumulate different variations in each of the two geographically isolated sub-populations. In due course of time, these two sub-populations become more and more different from each other. Due to reproductive isolation they become unable to reproduce together even if they are allowed to do so. These two groups (sub-populations) transform into two new species.

59. What factors could lead to the rise of a new species?

Natural selection, genetic drift and acquisition of traits during the life time of an individual can give rise to new species.

60. Will geographical isolation be a major factor in the speciation of a self-pollinating plant species? Why or why not?

Geographical isolation can prevent the transfer of pollens among different plants. However, since the plants are self-pollinating, which means that the pollens are transferred from the anther of one flower to the stigma of the same flower or of another flower of the same plant, geographical isolation cannot prevent speciation in this case.

61. Will geographical isolation be a major factor in the speciation of an organism that reproduces asexually? Why or why not?

Geographical isolation prevents gene flow between populations of a species whereas asexual reproduction generally involves only one individual. In an asexually reproducing organism, variations can occur only when the copying of DNA is not accurate. Therefore, geographical isolation cannot prevent the formation of new species in an asexually reproducing organism.

62. Give an example of characteristics being used to determine how close two species are in evolutionary terms.

The presence of feathers in dinosaurs and birds indicates that they are evolutionarily related. Dinosaurs had feathers not for flying but instead these feathers provided insulation to these warm-blooded animals. However, the feathers in birds are used for flight. This proves that reptiles and birds are closely related and that the evolution of wings started in reptiles.

63. When do organisms have a common ancestor?

The more characteristics two species will have in common, the more closely they are related. And the more closely they are related, the more recently they will have had a common ancestor.

64. What are homologous organs?

Organs which have common design but serve different functions in different animals are called homologous organs.
For example: The forelimbs of frogs are adapted to a jumping movement, the forelimbs of birds are used for flying and those of humans are used for handling tools. This shows that frogs, birds and humans have evolved from a common ancestor.

65. Give an example to show that all similarities simply in organ shape are not necessarily because of common ancestry.

Wings of bats are skin folds stretched mainly between elongated fingers. But the wings of birds are a feathery covering all along the arm. The designs of the two wings, their structure and components, are thus very different. They look similar because they have a common use for flying, but their origins are not common.

66. What are analogous organs?

Organs which have different design but serve a common function in different animals are called analogous organs.

67. Explain analogous organs with an example.

The wings of bird and an insect perform the same function of flying. The wings of a bird have a support of skeleton, flesh and feathers but insects have a fold of membrane as wing associated with a few muscles. Wings of birds and an insect are structurally different. So they are analogous organs.

68. Suggest with reason, which of the following are homologous and which are the analogous organs?

i) Scales of fishes and shell of mollusc.

Scales of fish and shell of mollusk are analogous structure because both are protective in structure in nature but differ in origin.

ii) Trunk of elephant and hand of chimpanzee.

Trunk of elephant and hand of chimpanzee are analogous organs because both perform the same function but differ in origin and structure.

iii) Wings of bird and wings of bat.

Wings of bird and wings of bat are analogous organs because they are similar in function but differ in functioning.

iv) Nails of human and claw of cat.

Nails of human and claw of cat are homologous organs because they are similar in origin but differ in functioning.

v) Ginger and sweet potato.

Ginger and sweet potato are analogous structures because both are storage structures but ginger is stem modification while potato is root modification.

69. Differentiate between homologous organs and analogous organs.

Homologous organs	Analogous organs
1. Organs with similar origin but different in function	1. Organs with similar function but different in function.
2. They show divergent evolution.	2. They show convergent evolution.

70. a) What are the function performed by human arm, forelimb of dog and forelimb of whales?
b) Which type of organs are these?

a) Human arm performs different functions such as writing, picking objects,, touching, etc. Forelimbs of dog are used for walking, running. Forelimbs of whales are used for swimming.

b) These organs are homologous organs.

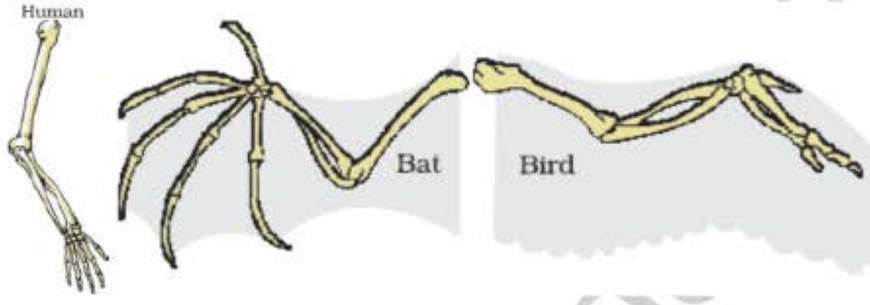
71. a) Which type of organs are shown in the figure?

The figure shows the wings of butterfly and fore limb of bird which are examples of analogous organs.

b) Which type of origin and structure do these organs have?

The wings of insects are the folds of membrane which are supported with few muscles. The wings of a bird are formed of limb bones which are covered with muscles, skin and feathers. Both are modified to perform the same function i.e. flying.

72. From the set of figures given below, make a pair of a) homologous organs b) analogous organs. State the reason in each case to justify your answer.



Human forelimb and bird wings are homologous organs. Reason: Both have common origin, basic structure and components. They are modified for different functions.

73. What are fossils?

The preserved remains of animals or plants or other organisms from the distant past are called fossils.

74. How are fossils formed?

When organisms die, their bodies will decompose and be lost. But body or at least some parts may be in an environment that does not let it decompose completely. For example, if a dead insect gets caught in hot mud, it will not decompose quickly, and the mud will eventually harden and retain the impression of the body parts of the insect.

75. How do we know how old the fossils are?

There are two methods of finding the age of fossils:
a) Relative depth method: If we dig into the earth and start finding fossils, suppose that the fossils we find closer to the surface are more recent than the fossils we find in deeper layers.

b) Dating of fossil: Dating fossils is by detecting the ratios of different isotopes of the same element in the fossil material.

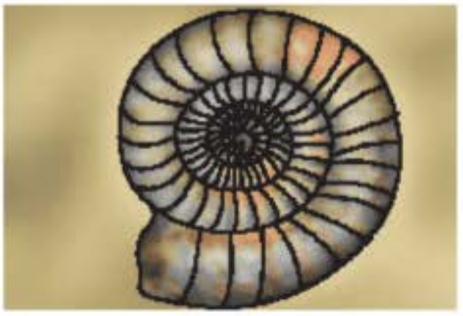
76. What do fossils tell us about the process of evolution?

They represent the ancestors of plants and animals that are alive today. They provide evidences of evolution by revealing the characteristics of the past organism and the changes that have occurred in these organisms to give rise to the present organisms.

77. Trilobite, ammonite are which type of fossils?

Invertebrate

78. Look at the given picture and identity. List its any two significance in relation to evolution of life.



The picture is fossil of invertebrate (Ammonite).

Significance: i) Mud got compressed and formed rock over the area containing invertebrates fossils or other animals. ii) dating these fossils exhibit that vertebrates emerged after invertebrates.

79. Birds and reptiles are closely related. a) Name the connecting link between the two. b) Mention two features of each to show that it is a link between birds and reptiles.

a) Archaeopteryx.

b) Reptiles: i) Presence of tail ii) Presence of teeth in mouth.

Birds: i) Presence of feathers ii) presence of beak.

80. "Evolution has occurred in stages" – Justify.

The process of evolution has took place over a long period time. The complex organs are created bit-by-bit over generations. There was increasing complexity of the organs. For example, eye was present in the earliest organism as eyespot which got development into a more complex and evolved eye.

There are some organs in the human body which are present in the reduced form and do not perform any function. Ex: Nictitating membrane, vermiform appendix, wisdom tooth.

81. Differentiate between eye and eyespots.

Eye is a complex structure made up of different tissues whereas eyespots are dot-like structure to sense light. Ex: Planaria have eyespots.

82. In evolutionary terms which among bacteria, spider, fish and chimpanzee have a better body design? Give reason to support your answer.

Among bacteria, spider, fish and chimpanzee – chimpanzee has better body design because: i) Bacteria belong to prokaryotes are unicellular organisms and one of the most primitive forms. ii) Mammals are at the top of the evolutionary tree. iii) Mammals have the most advance body structure adapted to the environment having four chambered heart, warm blooded body and largest brain capacity.

83. Chimpanzees, gorillas and humans are closely related. On what basis do we come to know that they are closely related?

Chimpanzees, gorillas and humans all had a common ancestor a long time ago. This common ancestor diverged into different forms due to which they all evolved in their own way to give rise to present forms. They all are warm blooded, with four chambered heart, having external ear, give birth to young ones. Since they all have common characteristics, they are said to be close relatives.

84. Taking example of eyes of Planaria, explain evolution by stages.

If complicated organs, such as the eye, are selected for the advantage they provide. This cannot be generated by a single DNA change. Such complex organs will be created bit-by-bit over generations. Rudimentary eye can be useful to some extent. This might be enough to give fitness advantage. The eye-like wings is a popular adaptation. Insects, octopus and vertebrates have them. Structure of eye in each of these organisms is different for them to have separate evolutionary origin.

85. Farmers generated different vegetables from wild cabbage by artificial selection. Name the vegetables obtained for the following desired traits.

a) **Arrested flower development** - Broccoli
b) **Sterile flowers** - Cauliflower
c) **Very short distance between leaves** - Cabbage
d) **Swollen parts** - Kohlrabi
e) **Larger leaves** - Kale

86. Humans have cultivated the wild cabbage for a long time ago. Then by artificially selecting the traits a variety of plants have been obtained. Write the characteristic feature of each of the following:

a) **Kohlrabi, Cauliflower, Broccoli, Cabbage**

Kohlrabi – swollen parts, Cauliflower – Sterile flowers, Broccoli – arrested flower development, Cabbage – Very short distance between leaves.

b) **Since how long cabbage has been cultivated?**

Over more than two thousand years.

87. Differentiate between natural selection and artificial selection.

Natural selection	Artificial selection
The process by which nature selects the favourable traits for the species in its environment.	The process by which the human selects the useful trait to be inherited in the next generation
It is a natural phenomenon.	It is an artificial process.
The traits selected for evolution are beneficial to the species.	The traits selected are for improvement of species and beneficial to man.
It takes place over a long period of time.	It takes place in a short period.

88. Classification of species is a reflection of evolutionary relationship. Explain with the help of example. OR "Evolution & classification are interlinked" – Justify.

In classification of species, the characteristics of organisms is compared with the other species. Then the species is placed at suitable level of classification. By identifying the hierarchical level of characteristics between species, we can identify the evolutionary relationship of species.

89. An organ like a wing in birds are an advantage to the organism. Did they appear in different stages or were formed due to a single sudden change in them?

The wings of a bird have been originated in different stages as a sequence of changes called evolution. Feathers would have started out as providing insulation in cold weather. But later, they might become useful for flight. Some dinosaurs had feathers, although they could not fly using the feathers. Birds have later adapted the feathers to flight.

90. Give an example of characteristics being used to determine how close two species are in evolutionary terms.

Homologous organs, analogous organs, vestigial organs, etc.

91. Can the wing of a butterfly and the wing of a bat be considered homologous organs? Why or why not?

Wings of a butterfly are composed of membrane, while wings of a bat are composed of bony skeleton. Thus, both butterfly and bat are not homologous but analogous in wing structure, i.e., have similar functions not similar structure.

92. What is human evolution?

Human evolution is a part of biological evolution concerning the emergence of humans as a distinct species.

93. How is evolutionary relationships traced?

One method of tracing evolutionary relationships is changes in DNA during reproduction. It is a basic events in evolution. Comparing the DNA of different species should give us a direct estimate of how much the DNA has changed during the formation of these species. This method is now extensively used to define evolutionary relationships.

94. "Evolution is not progress from lower to higher forms". Comment.

Evolution is simply the generation of diversity and the shaping of the diversity of environmental selection. There is no real progress in the idea of evolution. The only progressive trend in evolution seems to be that more complex body designs have emerged over time. It is not as if the older designs are inefficient. So many of the older and simpler designs still survive.

95. Name the tools that can be used to study human evolution.

Excavating, time-dating, studying fossils, determining DNA sequences have been used for studying human evolution.

96. Identification of human race was done by a particular trait. Name the trait.

Skin colour

97. The modern human being have originated in Africa. a) Which evidence suggest this fact? a) If an animal is similar to its ancestors, what does it imply?

a) Excavating, time dating and study of fossils as well as determining DNA sequences suggest that the modern beings have originated in Africa.

b) The animal has evolved from its ancestors and both have the same common ancestor.

98. Why are human beings who look so different from each other in terms of size, colour and looks said to belong to the same species?

A species is a group of organisms that are capable of interbreeding to produce a fertile offspring. Skin colour, looks, and size are all variety of features present in human beings. These features are generally environmentally controlled. Various human races are formed based on these features. However, there is no biological basis to this concept of races. Therefore, all human beings are a single species as humans of different colour, size, and looks are capable of reproduction and can produce a fertile offspring.

99. In evolutionary terms, can we say which among bacteria, spiders, fish and chimpanzees have a 'better' body design? Why or why not?

Evolution cannot always be equated with progress or better body designs. Evolution simply creates more complex body designs. However, this does not mean that the simple body designs are inefficient. In fact, bacteria having a simple body design are still the most cosmopolitan organisms found on earth. They can survive hot springs, deep sea, and even freezing environment. Therefore, bacteria, spiders, fish, and chimpanzees are all different branches of evolution.

100. A study found that children with light-coloured eyes are likely to have parents with light-coloured eyes. On this basis, can we say anything about whether the light eye colour trait is dominant or recessive? Why or why not?

Let us assume that children with light - coloured eyes can either have LL or Ll or ll genotype. If the children have LL genotype, then their parents will also be of LL genotype.

LL × LL

↓

LL

If the children with light coloured eyes have ll genotype, then their parents will also have ll genotype.

ll × ll

↓

ll

Therefore, it cannot be concluded whether light eye colour is dominant or recessive.

101. How are the areas of study – evolution and classification – interlinked?

Classification involves grouping of organism into a formal system based on similarities in internal and external structure or evolutionary history.

Two species are more closely related if they have more characteristics in common. And if two species are more closely related, then it means they have a more recent ancestor. For example, in a family, a brother and sister are closely related and they have a recent common ancestor i.e., their parents. A brother and his cousin are also related but less than the sister and her brother. This is because the brother and his cousin have a common ancestor i.e., their grandparents in the second generation whereas the parents were from the first generation.

With subsequent generations, the variations make organisms more different than their ancestors. This discussion clearly proves that we classify organisms according to their resemblance which is similar to creating an evolutionary tree.

102. Explain the terms analogous and homologous organs with examples.

Homologous organs are similar in origin (or are embryologically similar) but perform different functions. For example, the forelimbs of humans and the wings of birds look different externally but their skeletal structure is similar. It means that their origin is similar (as wings in birds are modifications of forearm) but functions are different - the wings help in flight whereas human forearm helps in various activities.

Analogous organs, on the other hand, have different origin but perform similar functions. For example, the wings of a bird and a bat are similar in function but this similarity does not mean that these animals are more closely related. If we carefully look at these structures, then we will find that the wings of a bat are just the folds of skin that are stretched between its fingers whereas the wings of birds are present all along the arm. Therefore, these organs are analogous organs.

103. Outline a project which aims to find the dominant coat colour in dogs.

Dogs have a variety of genes that govern coat colour. There are at least eleven identified gene series (A, B, C, D, E, F, G, M, P, S, T) that influence coat colour in dog. A dog inherits one gene from each of its parents. The dominant gene gets expressed in the phenotype. For example, in the B series, a dog can be genetically black or brown. Let us assume that one parent is homozygous black (BB), while the other parent is homozygous brown (bb).

		BB	
		B	B
bb	b	Bb	Bb
	b	Bb	Bb

In this case, all the offsprings will be heterozygous (Bb). Since black (B) is dominant, all the offsprings will be black. However, they will have both B and b alleles.

If such heterozygous pups are crossed, they will produce 25% homozygous black (BB), 50% heterozygous black (Bb), and 25% homozygous brown (bb) offsprings.

	B	**b**
B	BB	Bb
b	Bb	Bb

104. Explain the importance of fossils in deciding evolutionary relationships.

The preserved remains of animals or plants or other organisms from the distant past are called fossils.

Fossils provide the evidence that the present animal have originated from previously existing ones through the process of continuous evolution.

Fossils can be used to reconstruct evolutionary history of an organism. The distribution pattern of fossils shows that the ancient fossils present in the bottom rocks are simple, while the most recent fossils found in the upper strata are more highly evolved. It means fossils form and become more and more complex as we proceed from earliest to recent rocks. It gives us an idea of time in history when different species were formed or became extinct. Fossil also help to trace the evolutionary history of some animals. Fossils also indicate connecting link between the two groups of organisms. For example, Archaeopteryx is a connecting link between reptiles and birds.

105. What evidence do we have for the origin of life from inanimate matter?

Life must have developed from the simple inorganic molecules which were present on Earth soon after it was formed. Conditions on Earth could have given rise to more complex organic molecules that were necessary for life. The first primitive organism would have arisen from further chemical synthesis. The organic molecules were assembled in an atmosphere similar to that thought to exist on early Earth over water. This was maintained at a temperature just below 100°C and sparks were passed through the mixture of gases to stimulate lightning. At the end, carbon was converted to simple compounds of carbon including amino acids which make up protein molecules. This experiment set up demonstrates that life originated from inorganic molecules.

106. Explain how sexual reproduction gives rise to more viable variations than asexual reproduction. How does this affect the evolution of those organisms that reproduce sexually?

Sexual reproduction involves fusion of gametes. The offsprings show variations from their parents due to crossing over and exchange of gene segments. They are not carbon copies of their parents, due to recombination of parental genes and produce better offsprings. Also, due to environmental factors certain favourable variations are also produced. Due to production of variations, sexually reproducing animals show very quick evolution. Whereas in asexual reproduction, organisms raised are the exact copies of parents. They rarely show any variation.

107. How is the equal genetic contribution of male and female parents ensured in the progeny?

The male and female reproductive cells divide by meiosis to form haploid gametes. These gametes have equal genetic material. The zygote is formed by the fusion of male and female gamete, i.e., it has equal genetic contribution from male and female parents. The individual is developed from the zygote these after.

108. Only variations that confer an advantage to an individual organism will survive in a population. Do you agree with this statement? Why or why not?

All the variations in a species do not have equal chances of surviving in the environment. Depending on the nature of variations different individuals would have different kinds of advantages. Selection of variants by environmental factors forms the basis of evolutionary process. The variations which confer disadvantages to an individual organism will not survive because the environmental factor cannot support this.

Fill in the blanks:

1) Each trait in humans is influenced by <u>both paternal and maternal DNA</u>.
2) <u>Selection of variants</u> by environmental factors forms the basis for <u>evolutionary processes</u>.
3) <u>Genes</u> control characteristics, or traits.

4) In human beings, the sex of the individual is largely genetically determined.
5) Women have a perfect pair of sex chromosomes, both called X.
6) Men have a mismatched pair of sex chromosomes XY.
7) The sex of the children will be determined by what they inherit from their father.
8) A child who inherits an X chromosome from her father will be a girl.
9) A child who inherits a Y chromosome from her father will be a boy.
10) Homologous characteristic helps to identify an evolutionary relationship between apparently different species.
11) Preserved traces of living organisms are called fossils.
12) Evolution is simply the generation of diversity and the shaping of the diversity by environmental selection.

Multiple Choice questions:

1. **A Mendelian experiment consisted of breeding tall pea plants bearing violet flowers with short pea plants bearing white flowers. The progeny all bore violet flowers, but almost half of them were short. This suggests that the genetic make-up of the tall parent can be depicted as**

   A) TTWW B) TTww **C) TtWW** D) TtWw

2. **An example of homologous organs is**

   A) Our arm and a dog's fore-leg. B) Our teeth and an elephant's tusks.

   C) Potato and runners of grass. D) all of the above.

3. **In evolutionary terms, we have more in common with**

   A) A Chinese school-boy. B) A chimpanzee.

   C) A spider. D) A bacterium.

4. **Exchange of genetic material takes place in**

   A) vegetative reproduction B) asexual reproduction

   C) sexual reproduction D) budding

5. **Two pink coloured flowers on crossing resulted in 1 red, 2 pink and 1 white flower progeny. The nature of the cross will be**

   A) double fertilization B) self pollination

   C) cross fertilization D) no fertilisation

6. **A cross between a tall plant (TT) and short pea plant (tt) resulted in progeny that were all tall plants because**

   A) tallness is the dominant trait B) shortness is the dominant trait

   C) tallness is the recessive trait D) height of pea plant is not governed by gene 'T' or 't'

7. **Which of the following statement is incorrect?**

   A) For every hormone there is a gene.

   B) For every protein there is a gene.

   C) For production of every enzyme there is a gene.

   D) For every molecule of fat there is a gene

8. **If a round, green seeded pea plant (RR yy) is crossed with wrinkled, yellow seeded pea plant, (rr YY) the seeds produced in F1 generation are**

A) round and yellow B) round and green

C) wrinkled and green D) wrinkled and yellow

9. **In human males all the chromosomes are paired perfectly except one. This/these unpaired chromosome is/are**

(i) large chromosome (ii) small chromosome

(iii) Y-chromosome (iv) X-chromosome

A) (i) and (ii) B) (iii) only **C) (iii) and (iv)** D) (ii) and (iv)

10. **The maleness of a child is determined by**

A) the X chromosome in the zygote

B) the Y chromosome in zygote

C) the cytoplasm of germ cell which determines the sex

D) sex is determined by chance

11. **A zygote which has an X-chromosome inherited from the father will develop into a**

A) boy **B) girl**

C) X- chromosome does not determine the sex of a child D) either boy or girl

12. **Select the incorrect statement**

A) Frequency of certain genes in a population change over several generations resulting in evolution

B) Reduction in weight of the organism due to starvation is genetically controlled

C) Low weight parents can have heavy weight progeny

D) Traits which are not inherited over generations do not cause evolution

13. **New species may be formed if**

(i) DNA undergoes significant changes in germ cells
(ii) chromosome number changes in the gamete

(iii) there is no change in the genetic material

(iv) mating does not take place

A) (i) and (ii) B) (i) and (iii) C) (ii), (iii) and (iv) D) (i), (ii) and (iii)

14. **Two pea plants one with round green seeds (RRyy) and another with wrinkled yellow (rrYY) seeds produce F1 progeny that have round, yellow (RrYy) seeds. When F1 plants are selfed, the F2 progeny will have new combination of characters. Choose the new combination from the following**

(i) Round, yellow (ii) Round, green (iii) Wrinkled, yellow (iv) Wrinkled, green

(A) (i) and (ii) (B) (i) and (iv) **(C) (ii) and (iii)** (D) (i) and (iii)

15. **A basket of vegetables contains carrot, potato, radish and tomato. Which of them represent the correct homologous structures?**

A) Carrot and potato B) Carrot and tomato

C) Radish and carrot D) Radish and potato

16. **Select the correct statement**

A) Tendril of a pea plant and phylloclade of Opuntia are homologous

B) Tendril of a pea plant and phylloclade of Opuntia are analogous

C) Wings of birds and limbs of lizards are analogous

D) Wings of birds and wings of bat are homologous

17. **If the fossil of an organism is found in the deeper layers of earth, then we can predict that**

A) the extinction of organism has occurred recently

B) the extinction of organism has occurred thousands of years ago

C) the fossil position in the layers of earth is not related to its time of extinction

D) time of extinction cannot be determined

18. **Which of the following statements is not true with respect to variation?**

A) All variations in a species have equal chance of survival

B) Change in genetic composition results in variation

C) Selection of variants by environmental factors forms the basis of evolutionary processes.

D) Variation is minimum in asexual reproduction

19. **A trait in an organism is influenced by**

A) paternal DNA only B) maternal DNA only

C) both maternal and paternal DNA D) neither by paternal nor by maternal DNA

20. **Select the group which shares maximum number of common characters**

A) two individuals of a species B) two species of a genus

C) two genera of a family D) two genera of two families

21. **According to the evolutionary theory, formation of a new species is generally due to**

A) sudden creation by nature

B) accumulation of variations over several generations

C) clones formed during asexual reproduction

D) movement of individuals from one habitat to another

22. **From the list given below, select the character which can be acquired but not inherited**

A) colour of eye B) colour of skin **C) size of body** D) nature of hair

23. **The two versions of a trait (character) which are brought in by the male and female gametes are situated on**

A) copies of the same chromosome **B) two different chromosomes**

C) sex chromosomes D) any chromosome

24. **Select the statements that describe characteristics of genes**

(i) genes are specific sequence of bases in a DNA molecule

(ii) a gene does not code for proteins

(iii) in individuals of a given species, a specific gene is located on a particular chromosome

(iv) each chromosome has only one gene

A) (i) and (ii) **B) (i) and (iii)** C) (i) and (iv) D) (ii) and (iv)

25. **In peas, a pure tall plant (TT) is crossed with a short plant (tt). The ratio of pure tall plants to short plants in F2 is**

A) 1 : 3 B) 3 : 1 **C) 1 : 1** D) 2 : 1

26. **The number of pair (s) of sex chromosomes in the zygote of humans is**

A) one B) two C) three D) four

27. **The theory of evolution of species by natural selection was given by**

A) Mendel **B) Darwin** C) Morgan D) Lamarck

28. **Some dinosaurs had feathers although they could not fly but birds have feathers that help them to fly. In the context of evolution this means that**

A) reptiles have evolved from birds B) birds have evolved from reptiles

C) there is no evolutionary connection between reptiles and birds

D) feathers are homologous structures in both the organisms