

# **Heredity And Evolution**

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## **Periodic Test**

**Q.1. Why is sexual reproduction considered to be superior to asexual reproduction in terms of evolution?**

**Answer:** Sexual reproduction, unlike asexual reproduction, provides room for a larger number of variations. In it, the intensity of variations maximises due to increased inaccuracies in the DNA copying mechanism because of involvement of two individuals in the reproductive process. Hence, greater diversity is observed in sexual reproduction, which favours evolution, and thus, it is considered superior to asexual reproduction.

**Q.2. Why the experiences of an individual during its lifetime cannot be passed on to its progeny and cannot direct evolution?**

**Answer:** The experiences of an individual during its lifetime are acquired traits. These are changes in the non-reproductive tissue of the individual, and do not affect the DNA of the germ cell of that individual. As in reproduction, only the germ cells participate, the changes in non-reproductive tissues are not passed on to the next generation.

**Q.3. What is the information source for making proteins in the cell?**

**Answer:** The source of information for making proteins is the DNA in the cells. The part of DNA which codes for a particular protein is the gene for that protein.

**Q.4. How will you define the gene of a particular protein?**

**Answer:** The part of cellular DNA, which provides information regarding a particular protein, i.e. codes for that protein, is called the gene for that protein.

**Q.5. What forms the basis for evolutionary processes?**

**Answer:** Genetic mutations and natural selection form the basis of evolution.

**Q.6. Why a child bears all the basic features of a human being but it does not look exactly like its parents?**

**Answer:** The DNA copying mechanism of sexual reproduction is precise, but it is not completely accurate. This allows for a good extent of variations to take place. But, the variations are not so large to change the basic structure of the human being. Thus, the child bears all basic features but doesn't look exactly like its parents.

**Q.7. How does the creation of variations in a species promote survival?**

**Answer:** The frequency of inherited traits, or the genes carrying those traits increases over generations. The variations that provide better adaptive advantage over others are

promoted, or say, naturally selected over others. Thus, creation of variations in a species promotes their survival.

**Q.8. What control characteristics or traits? How they control those characteristics?**

**Answer:** The genes present in the DNA control characteristics or traits. The phenotypic or physical expression of a character depends upon the genotypic constitution. The expressed traits are a result of the specific genotypic combination of the alleles, which are a pair of genes themselves. Also, particular genes code for specific proteins that determine the physical characteristics of an individual. This is how genes control the traits.

**Q.9 What will be the genotype for homozygous dominant black hair colour and homozygous recessive brown hair colour?**

**Answer:** Considering, B to stand for black hair, and b to stand for brown hair, Homozygous dominant black hair = BB

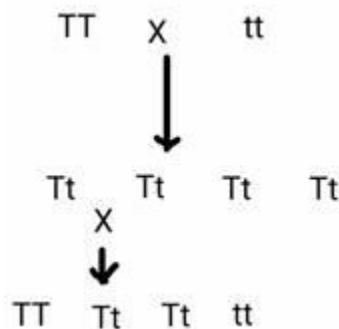
Homozygous recessive brown hair= bb.

**Q.10. What is the essence of the idea of evolution?**

**Answer:** The essence of the idea of evolution is that the frequency of certain genes that control traits, changes in a population over generations. This, in turn, changes the frequency of inherited traits or characters and some rare variations, become a common character in population.

**Q.11. How do Mendel's experiments show that traits may be dominant or recessive?**

**Answer:** Mendel used pea plants to conduct experiments demonstrating the inheritance of characters like height, colour, etc. When a tall plant was crossed with a dwarf plant, the progeny or first generation showed all tall plants. When two of these plants were crossed, the progeny showed three tall and one dwarf plant.



The above crosses show that only one T is enough to make the plant tall, that is, it dominates the inheritance of height. Thus, it is called the dominant trait. To make a plant dwarf, both the alleles must be t. Thus, it is the recessive trait.

**Q.12. What is meant by genetic drift? What is the notion of genetic drift?**

**Answer:** Genetic drift is a phenomenon that occurs in small populations. Here, there is a change in frequency of a gene or genes, due to a random event or chance when there is disappearance of certain part of population, or when reproduction does not take place.

The notion of genetic drift is that certain accidents can alter the frequency of some genes on a small population, even if they don't provide any survival advantage.

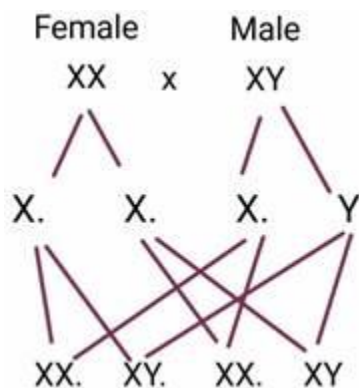
**Q.13. What are homologous organs? Give examples.**

**Answer:** The organs of different species, which are similar in structure, but are modified to perform different functions are called homologous organs.

**For example** Limbs of a human, frog, lizard and a bird.

**Q.14. How is the sex of the child determined in human beings?**

**Answer:** The sex of a child in human beings is genetically determined. The humans have 23 pairs of chromosomes, out of which 22 are a perfect pair of one paternal and one maternal copy. The last pair of chromosomes also called the sex chromosomes, is different for males and females. Females have a pair of X chromosomes, whereas males have XY chromosomal pair. The inheritance of these sex chromosomes that determine the gender of an individual is as follows :



**Q.15. What are Analogous organs? Give examples.**

**Answer:** The organs of different species, which are similar in function, but have different structural framework are called analogous organs.

**For example:** wings of a bat, and wings of a bird.

**Q.16. How do Mendel's experiments show that traits are inherited independently?**

**Answer:** In Mendel's experiments, when pea plants with two characters such as colour of seed and shape of seed were bred together, plants with Yellow coloured Round seeds were crossed with plants having Green coloured wrinkled seeds. The F1 progeny showed all plants with Yellow coloured Round seeds, showing that these were the dominant characters. However, when self-pollinated for second generation, certain progeny plants also exhibited new combinations like Yellow coloured Wrinkled seeds, or Green coloured Round seeds. This shows that both the characters were inherited independently.

**Q.17. What are the different ways in which individuals with a particular trait may increase in a population?**

**Answer:** There are two ways in which individuals with a particular trait can increase in a population.

**They are :** 1. Natural selection: Here the organisms which have a particular trait that enhances the survival rate or provides a survival benefit are selected naturally over others. 2. Genetic drift: This occurs in a small population where an accident or a chance event can change the frequency of genes, thus increasing a particular trait in a population, even if it provides no survival advantage.

**Q.18. Will geographical isolation be a major factor in the speciation of a self-pollinating plant species? Why or why not?**

**Answer:** No, geographical isolation will not be a factor in speciation of self-pollinated plants. Self – pollinating plants are those which have both the male and the female reproductive organs in one [d1] plant themselves. Thus, they don't require any other plant for reproduction. Hence, geographical isolation of such species will not change its genetic constitution.

**Q.19. Give an example of characteristics being used to determine how close two species are in evolutionary terms.**

**Answer:** The relative closeness of two species can be determined using characters called the homologous characteristics. These are similar in different species, because of their inheritance from a common ancestor. For example, the limbs of human, frog, lizard and bird are similar in structure, though they perform different functions, suggesting their evolutionary relationship.

**Q.20. Will geographical isolation be a major factor in the speciation of an organism that reproduces asexually? Why or Why not?**

**Answer:** No. Organisms which reproduce asexually, do not require mating or a partner for reproductive process. The reproduction process requires a single parent, that is the organism itself. Thus, geographical isolation does not affect the speciation process.

**Q. 21. What factors could lead to the rise of a new species?**

**Answer:** The factors that can lead to rise of new species are:

1. Variations inherited from one generation to the other
2. Natural selection
3. Genetic drift
4. Genetic mutations
5. Geographical isolation
6. Environmental factors acting on geographically isolated species.
7. Reproductive isolation for a longer time.

**Q.22. What are four different ways in which individuals with a particular trait may increase in population?**

**Answer:** The four ways in which individuals with a particular trait may increase in population are:

1. Natural selection
2. Genetic drift
3. Geographical isolation
4. Reproductive isolation or migration.

**Q.23. What are fossils? What do they tell us about the process of evolution?**

**Answer:** Sometimes when an organism dies, its body, or a part of it ends up in an environment which does not let it decompose. Thus, the impressions of body structures of these organisms are preserved. These preserved traces of organisms are called fossils.

Fossil dating helps in determining the order of appearance of organisms in the evolutionary process. There are two ways of fossil dating. They are:

1. Digging of fossils from Earth
2. By detecting the ratio of different isotopes of same element in fossil material.

**Q.24. Distinguish between acquired and inherited traits giving one example of each. Why are traits acquired during the lifetime of an individual not inherited?**

**Answer:** The changes in germ cells of reproductive tissue of a sexually reproducing organism, which can be passed on to the next generation are called inherited trait. For example colour of the eye.

The changes in non-reproductive tissue of an organism, which can not be passed on to the progeny, because they do not involve any change in the DNA of germ cells, are

called acquired traits. For example reduction in weight due to starvation. These are the traits acquired during lifetime of an individual and are not inherited because of lack of change in germ cells that participate in reproduction process.

**Q.25. Why are human beings who look so different from each other in terms of size, colour and look said to belongs to the same species?**

**Answer.** Human beings though different in size, colour and looks, belong to the same species because:

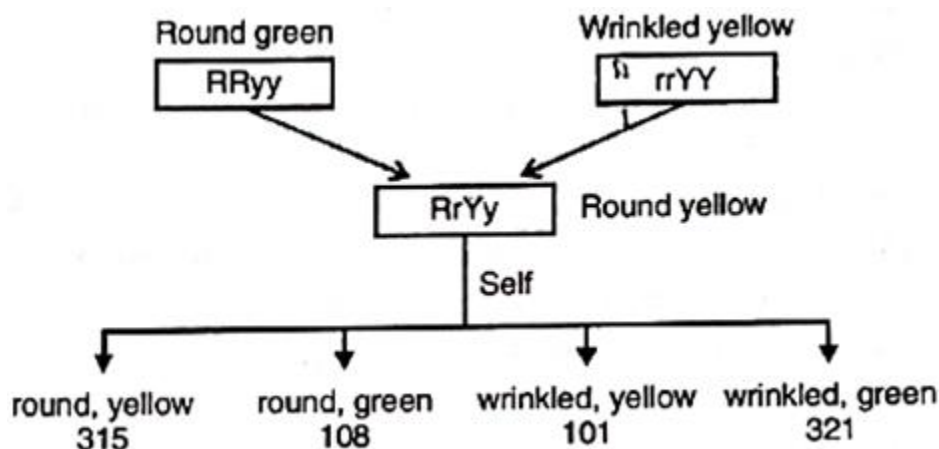
1. They have similarities in the DNA sequences
2. They have descended from the same ancestor
3. They can reproduce among themselves.

**Q.26. Given below is the experiment carried out by Mendel to study inheritance of two traits in garden pea.**

**(i) Fill in the boxes with appropriate answer.**

**(ii) Why did Mendel carry out an experiment with two traits?**

**(iii) What were his findings with respect to inheritance of traits in  $F^1$  and  $F^2$  generations?**



**Answer: (i)**  $RRyy$ ,  $rrYY$ ,  $RrYy$ ,

$RRYY$ ,  $RrYy$ ,  $RrYy$ ,  $RRyy$ ,  $rrYY$ ,  $rrYy$ ,  $rryy$ .

**(ii)** Mendel carried out an experiment with two traits to know if the inheritance of one trait depended on or affected the inheritance of another trait.

**(iii)** In  $F_1$  generation, the round and yellow traits appear, signifying that they are the dominant traits. In the second generation, new combinations of pea seeds, like round with green, and wrinkled with yellow appear, signifying that the two traits are inherited independently.

### Comprehensive Exercises (MCQ)

**Q.1. 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)

**Answer:** In human males, the 23<sup>rd</sup> pair of chromosomes, or the sex chromosomal pair, is not perfectly paired, and contains one X and one Y chromosome. This combination determines the gender of the individual.

**Q.2. The maleness of a child is determined by:**

- A. the X-chromosome in zygote
- B. the Y-chromosome in zygote
- C. the cytoplasm of germ cell which determines the sex
- D. sex is determined by chance

**Answer:** The Y chromosome is contributed by the father or the male partner during reproduction. It is a sex chromosome which pairs up with the X chromosome from mother, to provide maleness or male characters to the child.

**Q. 3. 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

**Answer:** In humans, the sex of the child is determined by the sex chromosomes inherited from parents. As females are XX, the mother can contribute only an X

chromosome to the child. The males are XY and thus the father can contribute either an X or a Y chromosome. If an X chromosome is inherited from father, the child is a female.

**Q. 4. 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 organisms due to starvation is genetically controlled**
- C. low weight parent can have heavyweight progeny**
- D. traits which are not inherited over generations do not cause evolution**

**Answer:** Reduction in weight of organisms due to starvation is a change in non-reproductive tissues of the organism, and does not change the genes of the germ cells. Thus, it is not genetically controlled.

**Q.5. 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)**

**Answer:** new species are formed due to change in genetic material of the reproductive tissues of the organism. Thus, changes in the DNA or chromosome number can lead to formation of new species.

**Q. 6. 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**

**Answer:** The size of an individual's body depends upon the lifestyle and not much on the genetic constitution. Hence, it is an acquired character.

**Q.7. 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**

**Answer:** Copies of same chromosome from the male and female gametes pair up to form a chromosomal pair or gene which combines the two versions of a trait from both the parents, so as to create a new version of the character in the child.

**Q.8. 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)**

**Answer:** Genes are specific sequences of bases on a DNA molecule, located on a particular chromosome, and code for proteins. A chromosome has more than one genes.

**Q. 9. In peas, a pure tall plant (TT) is crossed with a short plant (tt). The ratio of pure tall plants to short plants in F<sub>2</sub> is:**

- A. 1 : 3**
- B. 3 : 1**
- C. 1 : 1**
- D. 2 : 1**

**Answer:** In the F<sub>2</sub> progeny, there is one pure tall, one pure dwarf and two mixed tall plants.

**Q. 10. 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**

**Answer:** Radish and carrot are both roots. That is they are structurally similar. Thus they are homologous in nature.

**Q. 11. 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**

**Answer:** The tendril of a pea plant and phylloclade of Opuntia are both stem joints. They have similar basic structure and thus are homologous.

**Q. 12. 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 year 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**

**Answer:** The fossil digging is a direct method of determining the order of appearance and extinction of organisms on earth. The fossils found deeper are older than those found in the superficial layers of earth.

**Q.13. Which of the following statement is not true with respect to variation?**

- A. all variations in the 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**

**Answer:** All the variations occurring in species don't provide survival advantage or are due to natural selection. Some variations are lethal or may occur due to accident, not necessarily providing any survival benefit.

**Q. 14. 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**

**Answer:** Any trait in an individual, which can be genetically inherited is contributed equally by the maternal and paternal DNA during reproduction, as a version of a trait is received from both, then forming a pair.

**Q. 15. 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 fertilisation**
- B. self-pollination**
- C. cross-fertilisation**
- D. no fertilisation**

**Answer:** If such results are obtained from a cross, it is self-pollinated plant.

**Q. 16. 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'**

**Answer:** In heterozygous conditions such those of first progeny, only the dominant trait expresses itself in the phenotype. Thus, tallness is a dominant trait.

**Q.17. Which of the following statements is incorrect?**

- A. for every hormone there is a gene**
- B. for every protein there is a gene**
- C. for production of ever enzyme there is a gene**

**D. for every molecule of fat there is a gene**

**Answer:** Fat molecules are not formed under genetic monitoring that is, they are not coded by genes.

**Q.18. 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**

**Answer:** Accumulation of variations during DNA copying mechanism over several generations leads to formation of new species. Sudden creation by nature, asexual reproduction or movement of individuals, do not affect the evolutionary process much.

**Q. 19. 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. there is no evolutionary connection between reptiles and birds**

**C. feathers are homologous structures in both the organisms**

**D. birds have evolved from reptiles**

**Answer:** The presence of feathers in dinosaurs and their development as an appendage in birds shows the evolutionary process.

### **Comprehensive Exercises (T/F)**

**Q.1. Write true or false for the following statements:**

**In humans, there are two pairs of sex chromosomes.**

**Answer:** False

There is only one pair of sex chromosome in an individual, either XX or XY type.

**Q.2. Write true or false for the following statements:**

**In snails, individuals can change sex, indicating that sex is not genetically determined in them.**

**Answer:** True

Sex is not genetically determined in snails and can be changed.

**Q.3. Write true or false for the following statements:**

**A child who inherits an X-chromosome from father will be a boy.**

**Answer:** False

A child who inherits an X chromosome from father will be a girl.

**Q.4. Write true or false for the following statements:**

**A child who inherits a Y-chromosome from father will be a girl.**

**Answer:** False

A child who inherits a Y chromosome from father will be a boy.

**Q.5. Write true or false for the following statements:**

**There is an inbuilt tendency to variation during reproduction, both because of errors in DNA copying and as a result of sexual reproduction.**

**Answer:** True

The two factors that cause variations are errors in DNA copying and sexual reproduction

**Q.6. Write true or false for the following statements:**

**The frequency of certain genes in a population changed one generation. This is the essence of the idea of evolution.**

**Answer:** True

The change in frequency of certain genes brings about changes in a population. This is the essence of evolution.

**Q.7. Write true or false for the following statements:**

**Natural selection directs evolution as it results in adaptations in a given population.**

**Answer:** True

Natural selection permits the adoption of certain changes that benefit the survival of organisms and thus directs evolution.

**Q.8. Write true or false for the following statements:**

**An individual can pass on to its progeny the experiences of its lifetime.**

**Answer:** False

The experiences of an individual over lifetime are acquired characters and thus cannot be passed on to the progeny.

**Q.9. Write true or false for the following statements:**

**The preserved traces of all living organisms are called fossils.**

**Answer:** True

The preserved traces of all living organisms buried in an environment that does not allow decomposition are called fossils.

**Q.10. Write true or false for the following statements:**

**Relative method and carbon dating are the methods to known about evolution.**

**Answer:** True

Relative method and carbon dating help in fossil dating, which helps to know about evolution.