



মিণিষ্ট্ৰী অফ এডুকেশ্যন (মণি)

**DEPARTMENT OF EDUCATION (S)**

Government of Manipur

**CLASS X  
BIOLOGY  
CHAPTER 16  
HEREDITY AND EVOLUTION**

**SOLUTIONS**

**TEXTUAL QUESTIONS AND ANSWERS**

**Let us answer (Page 305)**

**1. What is a gene?**

**Ans.** A segment of DNA molecule which provides information for one trait is called a gene.

**2. Why did Mendel select garden pea for his experiments?**

**Ans.** Mendel selected garden pea for his experiments because a number of contrasting visible characters such as round and wrinkled seeds, tall and dwarf plants and so on are found. Moreover, in pea plants petals entirely enclosed the reproductive structures and can be cross-pollinated experimentally.

**3. What is the genotypic ratio of F<sub>2</sub> generation in monohybrid cross?**

**Ans.** The genotypic ratio of F<sub>2</sub> generation in a monohybrid cross is 1:2:1

**4. What are back cross and test cross?**

**Ans.** A cross between F<sub>1</sub> offspring and one of its parents is known as **back cross** while a cross between F<sub>1</sub> offspring and its recessive parent is known as test cross.

**5. How many perfect pairs of chromosomes are found in the father of a girl?**

**Ans.** The father of a girl has 22 perfect pairs of chromosomes and one pair of sex chromosome (XY) is present.

**Let us answer (Page 306)**

**1. Who had first proposed the chemical origin of life?**

**Ans.** Alexander Ivanovich Oparin (1894) first proposed an account for chemical origin of Life.

**2. Name three gases that were present on the primitive atmosphere of the earth.**

**Ans.** Ammonia (NH<sub>3</sub>), Hydrogen sulphide (H<sub>2</sub>S) and Methane (CH<sub>4</sub>).



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Let us answer (Page 311)

1. Trace the migratory root of human species.

**Ans.** The members of *Homo sapiens* evolved in Africa about 300,000 years ago. They slowly spread across the planet and migrate from Africa to West Asia, then to Central Asia, Eurasia, South Asia and East Asia. They travelled down to Indonesia and the Philippines to Australia. They didn't go in a single line but went forwards and backwards.

2. From where the earliest fossil of human species was discovered in India?

**Ans.** In India, the earliest fossil remains of *Homo sapiens* was discovered in **Bhimbetka** near Bhopal.

TEXTUAL EXERCISES

1. What is the phenotypic ratio in  $F_2$  generation of a dihybrid cross?

**Ans.** The phenotypic ratio of  $F_2$  generation in a dihybrid cross is **9:3:3:1**

2. What supportive evidence for evolution is provided by comparative embryology?

**Ans.** It is difficult to differentiate a human embryo from the other vertebrate embryos at their early stages of embryogenesis. The early embryonic stages of vertebrates shows a close relationship in having gill cleft, notochord, tail, rudimentary eyes, ears and limb buds, etc. It gives a clear idea about the evolution of different vertebrates. Thus, comparative embryology provides an evidence for evolution.

3. What is heredity? What are the laws of inheritance?

**Ans.** The transmission of traits from parents to their offspring is called heredity.

The laws of inheritance are - *Law of segregation and Law of Independent assortment*

4. Explain the term adaptation and how it is related to evolution?

**Ans.** The occurrence of genetic changes in a species or population as a result of natural selection so that it adjusts to the new environmental change is called **adaptation**. Thus, variation in the species results in adaptation and complex organs or features may have evolved leading to evolution of complex design. Those individuals who fail to adapt will perish.



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

**Ans.** Variations arising as a result of mutation can be inherited. All variations do not have equal chance of survival. It may lead to increase survival of an individual. Selection of variants by environmental factors forms the basis of evolutionary processes.

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

**Ans.** Mendel selected garden pea for his breeding experiment. He performed cross pollination in which anthers are removed from female parent before they are ripened and dusted over the pistil of another flower. The progeny of the cross is called  $F_1$  generation and the parental traits which are transmitted unchanged in the  $F_1$  generation is called **dominant traits** whereas traits that remain hidden in  $F_1$  but reappeared in  $F_2$  generation is called **recessive trait**. Thus, Mendel's experiment shows that traits may be dominant or recessive.

**7. How is the sex of a child determined in human being?**

**Ans:** Sex is determined at the time of fertilization. When X-containing sperm fertilizes an egg, it develops into female. Similarly when Y-containing sperm fertilizes an egg it develops into a male. Thus, male have (22+ XY) and female have (22 +XX) component.

**8. What factors could lead to the formation of a new species?**

**Ans.** The geographical isolation leads to reproductive isolation due to which there is no flow of genes between separated groups of population. When genetic variation is combined with geographical isolation it leads to the formation of new species.

**9. How does the study of fossils provide an evidence in favour of organic evolution?**

**Ans. Palaeontology** (Study of fossils) provides evidence in favour of organic evolution as follow:

- a) Fossils are the remains of organisms preserved inside the earth's crust.
- b) The process of fossilization involves the conversion of an organism or its parts into a hard structure or rock.
- c) The fossils closer to the surface are more recent than the fossils found in deeper layer.
- d) The study of fossils helps us to understand life forms of the past.
- e) It enables us to trace the origin and trend of evolution of several groups of plants and animals.



**10. Explain the theory of organic evolution proposed by Charles Darwin.**

**Ans.** The theory of organic evolution by natural selection proposed by Charles Darwin is one of the most accepted theories of organic evolution and can be explained as:

**Over production of offspring and a consequent struggle for existence:** Organisms reproduce in a geometrical proportion but limited resources causes the struggle for existence and consequently the number of individuals in a species remain more or less the same.

**Variations and their inheritance:** As a result of struggle for existence only those individuals showing variation in the right direction survive and these variations are transmitted to the offspring.

**Natural selection:** The survival of fittest and proliferation of only those organisms which are most suitably adapted to the environment and most successful in mating is known as natural selection.

**Formation of new species (speciation):** The evolution of a new species from the pre-existing one is known as speciation, when segments of a population are isolated geographically over a period of a number of generations they might gather enough genetic differences resulting in the production of a new species.

**11. Explain three evidences of organic evolution.**

**Ans.** The evidences of organic evolution are as follows:

**Fossils** – the remains of plants and animals of the past, and the process of formation it is known as fossilization. The study of fossil enables us to understand about the life forms existed in the past as well as enable to trace the origin and trend of evolution of several groups of plants and animals.

**Homologous and Analogous organs-** Homologous organ suggests evolution in several directions from a common ancestral type while analogous organ shows adaptation to perform the same function during the course of evolution.

**Embryonic development-** There is a close relationship among the early embryonic stages of vertebrates that can give us a clear idea about the evolution of different vertebrates.



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12. Give three points of difference between homologous and analogous organs with suitable examples.

**Ans.** The differences between homologous and analogous organs are listed below:

<b>HOMOLOGOUS ORGANS</b>	<b>ANALOGOUS ORGANS</b>
1. They have similar basic structure and embryonic origin.	1. They have different basic structure and embryonic origin.
2. They may or may not perform the same function.	2. They perform the same function.
3. They suggest evolution in several directions from a common ancestral type. <b>e.g.</b> Flipper of whale, Wings of bird, forelimb of sheep, human hand etc.	3. They show adaptation to perform the same function during the course of evolution. <b>e.g.</b> Wing of dragon fly, Wing of eagle, etc.

13. How does the experiment of Miller and Urey provide some support to the hypothesis of Oparin?

**Ans.** Oparin first produced an account for the chemical origin of life and was supported by the experiment of Miller and Urey in the following ways:

Miller and Urey assembled a mixture of gases, such as ammonia ( $\text{NH}_3$ ), Methane ( $\text{CH}_4$ ) and hydrogen sulphide ( $\text{H}_2\text{S}$ ) all believed to be present in atmosphere of primitive Earth in a closed flask at a temperature just below  $100^\circ\text{C}$ . Electric sparks were passed through the mixture and simulate lightning. They found the formation of mixtures of amino acid at the end of the week which was converted to self-replicating DNA and nucleic acid. Thus, life is originated through chemical evolution from in-organic molecule

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

**Ans.** It has been proved by using tools for tracing evolutionary relationship like excavating, time dating and studying fossil as well as determining DNA sequence.





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15. Draw neat labelled diagrams of two homologous organs in animals.

Ans.

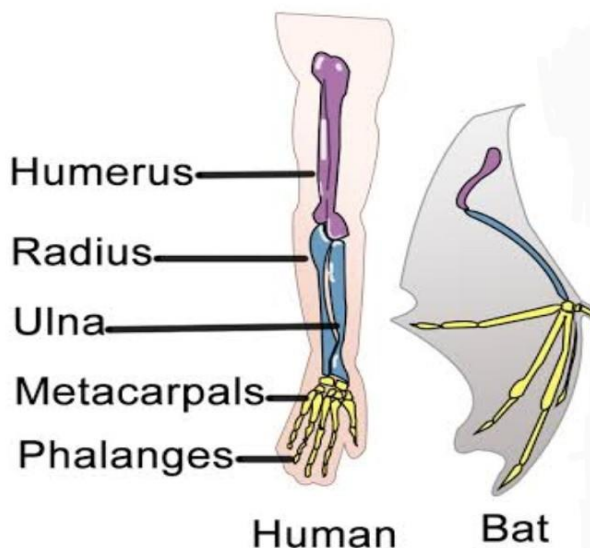


Fig: Homologous Organ

### EXTRA QUESTIONS AND ANSWERS

1. What is phenotype?

Ans. The characters that we can see through our naked eyes are called **phenotype**.

2. Which should have been the home of first life on earth?

Ans. The sea should have been the home of first life on earth.

3. Give one example of homologous organs of plant.

Ans. The **thorn** in *Bougainvillea* and a **tendrils** in *Cucurbita* are examples of homologous organs in plant.

4. What is monohybrid cross? Write the law of segregation.

Ans. A genetic cross in which only one pair of contrasting characters is taken into consideration at a time is called monohybrid cross. The law of segregation states that allelic genes in a hybrid do not blend or contaminate each other but segregate and pass into different gametes.



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5. “If the tails of a group of mice are surgically removed the offspring of those tailless mice will have tails.” Illustrate the statement.

**Ans.** If the tails of a group of mice are surgically removed the offspring of those tailless mice will have tails because changes in the non-reproductive tissues cannot be passed on to the DNA of the germ cells. So, the removal of the tails cannot change the genes of the germ cells of the mice.

6. What is dihybrid cross? Define the law of inheritance derived from this cross. Write the phenotypic ratio of  $F_2$  generation in dihybrid cross.

**Ans.** A genetic cross in which two pairs of contrasting characters are taken into consideration at a time is called dihybrid cross. The law of inheritance derived from dihybrid cross is **law of independent assortment**.

- a) It states that the segregation in one pair of allele is independent of the segregation in any other pair of allele.
- b) The phenotypic ratio of  $F_2$  generation in dihybrid cross is 9:3:3:1.

7. How does monohybrid cross differ from dihybrid cross? Explain it by giving phenotypic and genotypic ratios.

**Ans.** The differences of monohybrid and dihybrid cross are listed below:

MONOHYBRID CROSS	DIHYBRID CROSS
1. One pair of contrasting character is taken into consideration at a time.	1. Two pairs of contrasting characters are taken into consideration at a time.
2. The phenotypic ratio in $F_2$ generation = 3:1	2. The phenotypic ratio in $F_2$ generation = 9:3:3:1
3. The genotypic ratio in $F_2$ generation = 1:2:1	3. The genotypic ratio in $F_2$ generation = 1:2:2:4:1:2:1:2:1



8. **“Study of fossils can understand about the life forms of the past.” Give five points in support of this statement.**

**Ans.** The fossil provides an evidence to organic evolution because:

- a) Fossils are the remains of organisms preserved inside the earth's crust
- b) The process of fossilization involves the conversion of an organism or its parts into a hard structure or rock.
- c) The fossils closer to the surface are more recent than the fossils found in deeper layer.
- d) The study of fossils helps us to understand life forms of the past.
- e) It enables us to trace the origin and trend of evolution of several groups of plants and animals.

9. **“The study of embryology is helpful in understanding the process of organic evolution.” Give five points in support of this statement.**

**Ans.** The study of embryology is helpful in understanding the process of organic evolution as:

- a) Embryology is the study of the development of the embryos of different organisms.
- b) There is a close relationship among the early embryonic stages of vertebrates.
- c) It is difficult to differentiate a human embryo from the other vertebrate embryos of rabbit, chick, tortoise, salamander and fish at their early stage of embryogenesis.
- d) There are similarities in having gill clefts, notochord, tail, rudimentary eyes and ears, limb buds, etc.
- e) The study of embryonic development among the vertebrates can give a clear idea about the evolution of different vertebrates.

10. **Explain the evidence of evolution from comparative anatomy and morphology.**

**Ans.** The comparative study of the internal and external features of different organisms is known as comparative anatomy and morphology. Complex organs may evolve because of survival advantage. Homologous organs are similar in their basic structure and embryonic origin but may or may not perform different functions. They represent evolution of new life forms in several directions from a common ancestral type. Similarly, analogous organs perform same function though they do not bear close phylogenetic link. They show adaptation to perform the same function during the course of evolutionary history.

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