

Student Learning Outcomes

After Studying this chapter, students will be able to:

- Explain the theory of evolution by natural selection with examples.
- Define species.
- Discuss briefly the observations Darwin made during his voyage on HMS Beagle.
- Describe sources of variation which can lead to speciation and evolution.
- Describe evidence of evolution with regards to the following:
 - Paleontology (fossil record)
 - Comparative anatomy (homologous structures, vestigial structures)
 - Selective breeding

Subjective Type Questions

Long Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

10.1

Darwin's Observations

Q1. Define Evolution. Who laid the foundations of theory of Evolution by natural selection?

Ans. Evolution: Evolution is the change in heritable traits of population over the course of successive generations.

- It involves the gradual changes in characteristics passed from one generation to the next.

In 1850s, English naturalist Charles Darwin (1809-1882) He explained the mechanism of evolution in a comprehensive way. He went on five year trip around the world on his Majesty's Ship (HMS) Beagle.

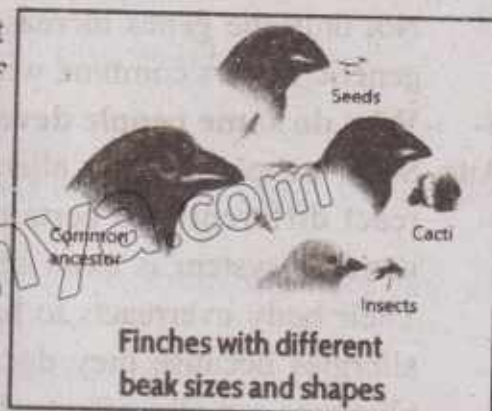
During his voyage, Darwin made a lot of important observations that laid the foundations of his theory of Evolution by natural selection.

Q2. Write a note on the observations Darwin made during his voyage.

Ans: Key observations made by Darwin:

The following are some important observations made by Darwin:

- (i) **Unique species:** He observed a variety of unique plant and animal species in different regions. He observed that different islands and environments had their own distinct sets of species.



(ii) **Variations in same species:** Darwin observed variations among same species living in different environments.

He noticed that these were adaptations i.e., special variations in an organism's body or behaviour that help it survive in its environment. He was convinced on the role of adaptations in the survival of species.

(iii) **Beaks of finches:** On the Galapagos Islands, he noticed that different species of finches had different sizes and shapes of beaks in different islands. He noticed that different foods e.g., seeds, cacti and insects were available at different islands. The beaks of finches were suited according to the food sources available on specific island.

(iv) **Fossils of extinct animals:** When he observed the fossils of extinct animals, he found their resemblance with modern species. This suggested that species could change overtime.

After returning from his voyage, Darwin analysed his observations and gathered more evidence to support his ideas. Eventually, in 1859, Darwin published his work in the form of a book, "On the Origin of Species". In this book, he presented his "theory of evolution by natural selection".

10.2 Theory of Evolution By Natural Selection

Q3. Explain the theory of evolution by natural selection.

Ans. Natural Selection:

Natural selection is the process through which the individuals with better characteristics (variations) are more likely to live, reproduce and pass those variations to their offspring.

Steps of natural selection:

Natural selection works in following steps:

(i) **Variations:** In every species, individuals are slightly different from one another. These differences may be in colour, size, speed, strength or ability to find food.

For example: Some beetles are green and some are brown.

(ii) **Struggle for Survival:** Living things compete for limited resources such as food, water, space, and mates. Also, they face threats from predators, diseases, and harsh environments. For example: Birds eat beetles, so beetles must survive by hiding or blending in.

(iii) **Survival of the Fittest:** The individuals with better variations are more likely to live and reproduce. "Fittest" means best suited, not necessarily the strongest. For example: Brown beetles blend in with the soil better than green beetles. So, they will be difficult to be preyed upon by birds.

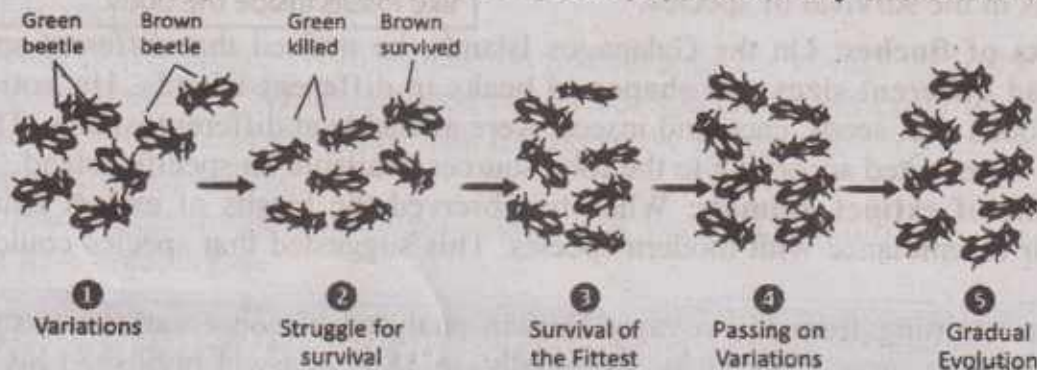
Q. What is evidence of evolution of whale?

Ans. Some whales have tiny leg bones buried deep inside their bodies! These bones no longer serve a purpose in swimming. These are powerful clues to the whale's evolutionary past. They're like fossils inside the body.



(iv) **Reproduction and Passing on Variations:** The surviving individuals reproduce and pass their useful variations to their offspring. Over time, these helpful variations become more common in the population. For example: More brown beetles are born because the green ones were eaten more often.

(v) **Gradual Evolution Over Time:** After many generations, small changes build up. The species slowly changes. If the environment continues to favour certain variations, new species may eventually form. For example: If only brown beetles survive and reproduce over many generations, the whole beetle population may become brown.



Process of natural selection

Q4. Define Natural Selection. Describe the process of natural selection using the example of giraffe.

Ans. Natural Selection: Natural selection is the process through which the individuals with better characteristics (variations) are more likely to live, reproduce and pass these variations to their offspring.

Examples of Natural selection:

Giraffe's Long Neck:

(i) **Variations:** Some giraffes had slightly longer necks than others.

(ii) **Struggle for Survival:** Food (leaves on tall trees) were hard to reach, especially during dry seasons.

(iii) **Survival of the Fittest:** Giraffes with longer necks could eat leaves from taller trees and survived better during harsh conditions.

(iv) **Reproduction and Passing on Traits:** These long-necked giraffes reproduced and passed the long-neck trait to their babies.

(v) **Gradual Evolution Over Time:** Over many generations, most giraffes in the population had long necks.

Q. Why do giraffes have such long necks?

Ans. It's not just about reaching high leaves. Some scientists suggest long necks also helped male giraffes fight each other.

Q5. Explain the process of natural selection using the example of peppered moth during industrial revolution.

Ans. Peppered Moth (During Industrial Revolution in England)

(i) **Variations:** Some moths were light-coloured, and some were dark-coloured.

(ii) **Struggle for Survival:** Birds hunted the moths during the day as they rested on tree bark.

- (iii) **Survival of the Fittest:** After pollution darkened the tree bark, dark-coloured moths blended in and survived better than light ones.
- (iv) **Reproduction and Passing on Variations:** Dark moths reproduced more and passed on the dark colour trait.
- (v) **Gradual Evolution Over Time:** Over time, the population had more dark-coloured moths than light ones.

10.3

Species and Speciation

Q6. Write different types of speciation.

Ans. Types of speciation: There are two main types of speciation:

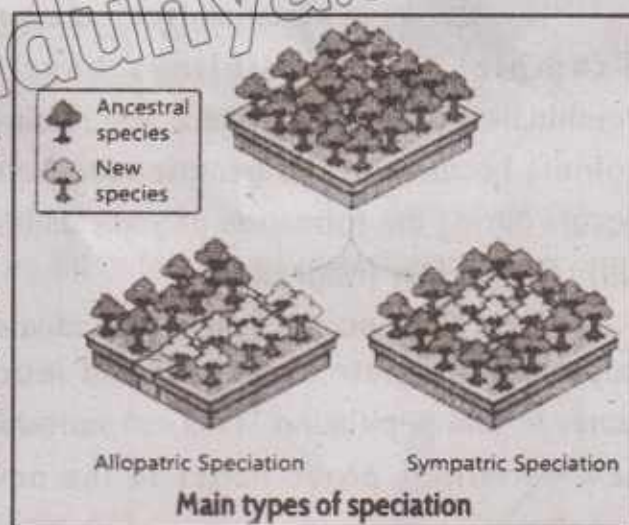
- (i) Allopatric speciation (ii) Sympatric speciation

1. **Allopatric Speciation:** This speciation occurs when a population is geographically separated into two or more populations. The physical barrier (such as a mountain range, river, or ocean) prevents individuals from different groups from breeding. Over time, the isolated populations evolve differently and become distinct species.

For example: In the case of the finches of Galapagos Islands, different islands provided unique environment. Over time, populations of finches adapted to each environment, eventually becoming separate species.

(ii) **Sympatric Speciation:** This speciation occurs when reproductive isolation happens within the same geographical area due to habitat preference or behaviour.

For example: Groups of fishes of same species live in the same lake. Both the groups are reproductively isolated due to dietary preferences or mate selection. Over time, the groups remain reproductively isolated, resulting in the emergence of new species.



Q7. Explain briefly about species and speciation.

Ans. Species: A species is a group of organisms that can interbreed and produce fertile offspring under natural conditions. Members of the same species are similar and are reproductively isolated from other species. For example, Lions (*Panthera leo*) and Tigers (*Panthera tigris*) are distinct species. They do not naturally interbreed with each other.

Speciation: Speciation is the process by which new species arise by evolution.

10.4

Sources of Variations

Q8. Describe the sources of variations.

Ans. Variations:

Variations are the inheritable differences among individuals in a population on which natural selection can act.

Sources of variations: The following are the main sources of variations.

(i) Mutations:

Mutation is a permanent change in the DNA of an organism that can pass on to the offspring. Mutations can occur spontaneously or by environmental factors such as radiations or chemicals. Mutations result in new characteristics (variations) in organism. Most mutations are neutral or harmful. Some mutations can be beneficial and provide better variations to the organism.

Example: In a population of bacteria, a mutation may produce antibiotic resistance in some individuals. These resistant bacteria have more chances to survive and reproduce in the presence of antibiotics. They can pass on this variation to future generations.

Q. Why you don't look exactly same, to your parents?

Ans. You probably look similar to your parents and siblings. However, you don't look exactly the same, and this is due to variations.

(ii) Genetic Recombination:

In sexually reproducing organisms, genetic recombination occurs during the formation of gametes through meiosis. The mixing of genetic material from two parents produces offspring with new combinations of genes.

This results in variation by creating new combinations of characteristics.

Example: Human siblings have different combinations of characteristics (e.g., hair colour, eye colour) because of the genetic recombination that occurs during the formation of gametes in parents.

Q. Discuss Bananas have numerous mutations.

Ans. Many bananas are triploid, meaning they have three sets of chromosomes. It makes them sterile. They can't reproduce normally. So, every banana is a clone i.e., grown from a cutting of another plant.

(iii) Gene Flow (Migration):

Gene flow occurs when individuals from one population migrate to another and introduce new genes in that population. This can introduce new variations within a population. If these new variations prove better in the new population, they can spread through the population.

Example: When plants from one area cross-pollinate with plants from a different region, they introduce new characteristics into the population, such as improved drought resistance varieties.

(iv) Random Pairing of Gametes:

During sexual reproduction, the pairing (fusion) of egg and sperm is random. It means that any sperm can fertilize any egg. It increases variation by producing offspring with unique combinations of genes inherited from both parents.

Example: In humans, the random pairing of an egg and one sperm from millions of possibilities leads to children in the same family having different characteristics, even though they share the same parents.

Q9. Justify how fossil record provides an evidence of evolution.

Ans. Palaeontology:

Palaeontology is the study of fossils, which serves as a primary tool for scientists to reconstruct the history of life on earth.

Visual record of change: Fossils provide a direct visual record of evolutionary changes that have occurred among various organisms over time.

Sequential observations: Palaeontologists use fossils to observe the specific sequence in which different groups of organisms appeared.

Vertebrate Evolution: The fossil record reveals a clear chronological sequence of vertebrate classes, starting with fishes, followed by amphibians, reptiles and then birds and mammals.

Bridging Evolutionary Gaps: Fossils show the characteristics of both ancestors and their subsequent generations acting as a "bridge" to fill gaps in evolutionary history.

Evidence of Gradualism: The study of these remains provides physical evidence of the gradual history of various species, proving that change happens over long periods rather than all at once.

For example: Fossils of *Archaeopteryx* (a bird-like dinosaur) provides evidence that birds evolved from a tetrapod dinosaur (a reptile).

Q. What are fossils?

Ans. Fossils are the remains, impressions or traces of organisms that lived in the past. Most fossils are found in sedimentary rocks.



Archaeopteryx

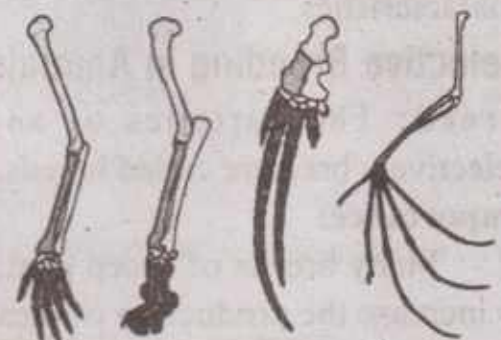
Q10. Write a note on homologous structures as an evidence of evolution.

Ans. Evolution:

Homologous structures: The similar structures in different species that perform different functions are called homologous structures.

For example: The forelimbs of mammals (arm of human, legs of cat, flippers of whale and wings of bat) all have the same structure but different functions.

Conclusion: The basic similarity of structure of these forelimbs is the evidence that they evolve from a common ancestor.



Arm of Human Leg of Cat Flipper of Whale Wing of Bat

Homologous structures

Q11. What are vestigial structures? Explain how they provide evidence of evolution.

Ans. Vestigial organs:

Vestigial organs are body parts that have no apparent function but were fully functional in a organism's ancestors.

Examples of vestigial organs:

- **Human appendix:** It is a small, tube-like structure attached to the cecum. In humans, it is a vestigial structure. It might have played a more important role in the

digestive system of ancestors.

- **Ear muscles in humans:** In many animals, such as cats and dogs, ear muscles move their ears to detect sounds from different directions. However, in humans, these ear muscles are largely non-functional. So, these are vestigial structures in humans.
- **Pelvic bones in whales:** Modern whales have small, non-functional pelvic bones even though they do not have legs.
- **Wings in flightless birds:** Birds like ostriches have wings, but they do not use them for flight.



Human Appendix



Pelvic bones in whale

Vestigial Organs

Q12. What is selective breeding? Describe how humans use selective breeding in plants and animals.

Ans. Selective Breeding:

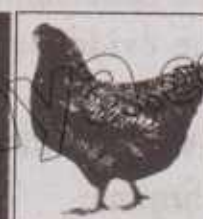
Selective breeding means the process in which humans select varieties of plants or animals and breed them to produce offspring with required characteristics.

Selective Breeding in Animals:

Breed: The varieties of animals which are selectively bred are called breeds.

Importance:

- Many breeds of sheep goat, cow hen etc. have been produced by selective breeding to increase the production of meat, milk, eggs, wool etc.



Different Breeds of Hen

Q. Difference between Homologous organs and Analogous organs.

Ans. Homologous organs are structurally same but functionally different. Analogous organs are functionally same but structurally different e.g. wings of bat, birds and insects etc.

Selective Breeding in Plants:

Varieties or cultivars: The varieties of plants which are selectively bred are known as varieties or cultivars.

Importance:

- Many plant varieties have been produced for better quantity and quality of food. This process has proved very successful for the improvement of yields in economically important plants like wheat, rice, potato and apple etc.



Varieties (cultivars) of Potato and apple

Q13. Write down the advantages of selective breeding.

Ans. Advantages of selective breeding:

Selective breeding:

- (i) Improves desirable traits.
- (ii) Increases yield of crops and animals.
- (iii) Produces disease-resistant varieties.
- (iv) Improves quality of products.
- (v) Helps organisms adapt to environments.

Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

10.1

Darwin's Observations

- _____ is the change in heritable traits of population over the course of successive generations.
(a) Genetics (b) Variations (c) Evolution (d) Respiration
- Charles Darwin explained the mechanism of evolution in a comprehensive way during which decade?
(a) 1750s (b) 1800s (c) 1850s (d) 1950s
- What was the name of ship Darwin traveled on during his five-year voyage?
(a) HMS victory (b) HMS endeavor (c) HMS Beagle (d) HMS Titanic
- Darwin observed that different islands had their own distinct sets of species. This falls under which observation category?
(a) Unique species (b) Selective breeding
(c) Artificial selection (d) Instant mutation
- The "special variations" in an organism's body or behavior are known as:
(a) Mutations (b) Adaptations (c) Generations (d) Successions

6. Darwin noticed that finch species had different beak sizes and shapes depending on:
- The age of the birds
 - The food sources available of specific Island
 - The colour of flowers on island
 - The temperature of island
7. In which year did Charles Darwin finally publish his famous book?
- 1809
 - 1850
 - 1859
 - 1882
8. What is the title of the book Darwin published to present his findings?
- The descent of man
 - On the origin of species
 - The voyage of beagle
 - Natural selection and evolution

10.2 Theory of Evolution By Natural Selection

9. According to the theory of natural selection "fittest" refers to organisms that are:
- The physically strongest in the group
 - The fastest runners in a population
 - Best suited to their environment
 - The largest in size
10. Which of the following is the first step in the mechanism of evolution?
- Struggle for survival
 - Survival of the fittest
 - Variations in population
 - Gradual evolution
11. Living things compete for resources:
- Food and water
 - Water and space
 - Space and food
 - All of these
12. In a population of beetles, if birds prefer to eat green beetles, which beetles are most likely to survive and reproduce?
- Green beetles
 - Brown beetles
 - Both colors equally
 - None of these
13. "Living things compete for limited resources such as food, water and mates". This statement describes:
- Variations
 - Struggle for survival
 - Passing on traits
 - Fossilizations
14. "Passing on variations" directly leads to:
- Struggle for survival
 - Variations in population
 - Gradual evolution
 - Immediate mutation
15. Variations in a species can include differences in:
- Colour and size
 - Speed and strength
 - Ability to find food
 - All of these

10.3 Species and Speciation

16. Speciation begins when:
- Organisms migrate to same place
 - A population becomes reproductively isolated
 - All individuals share the same traits
 - Mutations stop occurring
17. Allopatric speciation occurs mainly due to:
- Behavior differences
 - Geographical isolation
 - Change in diet
 - Change in chromosome number
18. Which is an example of a geographical barrier in allopatric speciation?
- Mating season
 - Food preference

- (c) River or mountain range (d) Aggressive behavior
19. Darwin's finches on the Galapagos Islands are an example of:
 (a) Artificial selection (b) Allopatric speciation
 (c) Breeding between species (d) Random pairing
20. Sympatric speciation occurs when:
 (a) Populations are separated by distance (b) Organisms migrate to new islands
 (c) Reproductive isolation happens within the same area
 (d) New predators appear
21. Which of the following may cause sympatric speciation?
 (a) Change in food preference (b) Change in climate
 (c) Physical barriers (d) Increase in predators

10.4

Sources of Variations

22. Which one of the following are the inheritable differences among individuals in a population on which natural selection can act:
 (a) Evolution (b) Mutations (c) Sources (d) Variations
23. A mutation is best defined as:
 (a) Temporary change in body features (b) Permanent change in DNA
 (c) Change in behavior (d) Change in population size
24. Why do mutations create variations?
 (a) They increase population size (b) They reduce genetic diversity
 (c) They introduce new traits into a population
 (d) They stop genetic recombination
25. Genetic recombination happens during:
 (a) Fertilization only (b) Mitosis
 (c) Formation of gametes during meiosis (d) Aging
26. Gene flow occurs when:
 (a) Individuals migrate and interbreed with another population
 (b) Only mutation appears
 (c) Species become extinct (d) Gametes randomly fuse
27. When plants cross-pollinate with plants from another region, they introduce:
 (a) Chromosome damage (b) New genes into population
 (c) Less variation (d) No change
28. Which of the following is NOT a source of variation?
 (a) Mutation (b) Genetic recombination
 (c) Gene flow (d) Same environment

10.5

Evidences of Evolution

29. Fossils are important in studying evolution because they:
 (a) Show only the external shape of organisms
 (b) Provide a visual record of past life forms
 (c) Show only living species (d) Tell us about future species
30. Which fossil is considered a link between reptiles and birds?
 (a) Trilobite (b) Archaeopteryx (c) Ammonite (d) Pterodactyl

31. Comparative anatomy helps scientists understand evolution by studying:
 (a) Behavior of organisms (b) DNA sequence only
 (c) Similarities and differences in body structures
 (d) Age of the Earth
32. Homologous structures show evidence of:
 (a) Different ancestors (b) A common ancestor
 (c) Identical functions (d) No relationship between species
33. Which of the following is a vestigial organ in humans?
 (a) Heart (b) Appendix (c) Kidney (d) Stomach
34. Analogous organs are:
 (a) Structurally same (b) Structurally different
 (c) Functionally different (d) Both (a) and (b)
35. Examples of analogous organs are:
 (a) Wings of bat (b) Wings of birds (c) Wings of insects (d) All of these
36. Small pelvic bones in whales are evidence that whales:
 (a) Never had legs (b) Evolved from ancestors
 (c) Use the bones for swimming (d) Are closely related to fish
37. The varieties of animals which are selectively bred are called:
 (a) Varieties (b) Cultivars (c) Breeds (d) Vectors
38. The varieties of plants which are selectively bred are called:
 (a) Breeds (b) Cultivars (c) Vectors (d) Breeders
39. All are examples of cultivars except:
 (a) Wheat (b) Rice (c) Potato (d) Hen

Answers

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|---------|---------|---------|---------|---------|---------|---------|
| 1. (c) | 2. (c) | 3. (c) | 4. (a) | 5. (b) | 6. (b) | 7. (c) |
| 8. (b) | 9. (c) | 10. (c) | 11. (d) | 12. (b) | 13. (b) | 14. (c) |
| 15. (d) | 16. (b) | 17. (b) | 18. (c) | 19. (b) | 20. (c) | 21. (a) |
| 22. (d) | 23. (b) | 24. (c) | 25. (c) | 26. (a) | 27. (b) | 28. (d) |
| 29. (b) | 30. (b) | 31. (c) | 32. (b) | 33. (b) | 34. (b) | 35. (d) |
| 36. (b) | 37. (c) | 38. (b) | 39. (d) | | | |

Additional Short Questions

Short Answer Questions prepared in the light of new Examination Techniques
 (Knowledge, Understanding, Application, Analytical & Conceptual)

10.1

Darwin's Observations

1. Define evolution.

Ans. Evolution: Evolution is the change in heritable traits of population over the course of successive generations.

It involves gradual changes in characteristics passed from one generation to the next.

2. Describe the journey that led Charles Darwin to his findings on evolution.

Ans. English naturalist Charles Darwin (1809-1882) went on five-year trip around the world on his majesty's ship (HMS) beagle.

During his voyage, Darwin made a lot of important observations that laid the foundations of his theory of evolution by natural selection.

3. What did Darwin observe regarding "unique species" on different islands?

Ans. Darwin observed variety of unique plant and unique animal species in different regions. He observed that different islands and environments had their own distinct set of objects.

4. Explain how the beaks of Galapagos finches varied according to their environment.

Ans. Darwin noticed that finch specie had different sizes and shapes of beaks depending on the food sources available on their specific island such as seeds, cacti or insects.

5. What conclusion did Darwin drawn from studying fossils of extinct animals?

Ans. Darwin found that fossils of extinct animals shared a strong resemblance with modern species. This led him to suggest that species are not fixed and could change over long periods of time.

6. State the name and publication year of Darwin's famous book.

Ans. After analyzing his evidence for many years, Darwin published his work in 1859 in a book titled "on the origin of species". In this book, he presented his "theory of evolution by natural selection".

10.2 Theory of Evolution By Natural Selection

7. State the theory of evolution by natural selection.

Ans. The theory of evolution by natural selection states that "living things change over time. Those with helpful characteristics (variations) survive, reproduce and pass those characteristics to their young over many generations, these favourable characteristics become more common in the population. It lead to the evolution of new species."

8. What is meant by variations in a species?

Ans. Variations refer to slight differences between individuals of the same species. These differences may include colour, size, speed, strength or the ability to find food.

9. Briefly explain the "survival of the Fittest" in natural selection.

Ans. The individuals with better variations are more likely to live or reproduce. "Fittest" means best suited, not necessarily the strongest.

For example: Brown beetles blend in with the soil better than green beetles. So, they will be difficult to be preyed upon birds.

10. How does natural selection explain the long necks of giraffe?

Ans. Some giraffes had slightly longer necks than others. During dry seasons, food on tall trees was hard to reach, so long-necked giraffes survived better, reproduced and pass that trait to their babies.

11. What are species?

Ans. **Species:** A species is a group of organisms that can interbreed and produced fertile offspring's under natural conditions.

12. Define speciation. Write down the names of its two types.

Ans. **Speciation:** Speciation is the process by which new species arise by evolution.

Types of speciation: There are two main types of speciation:

- i- Allopatric Speciation ii- Sympatric Speciation

13. Which are the main sources of variations?

Ans. The following are the main sources of variations:

- i- Mutations ii- Genetic recombination
- iii- Gene flow iv- Random pairing of gametes

14. How does mutation act as a source of variation?

Ans. A mutation is the permanent change in the DNA sequence of an organism. These changes are caused by environmental factors or errors during DNA replication. Most mutations are neutral or harmful some mutations can be beneficial.

15. How variation occurs through genetic recombination?

Ans. In sexually reproducing organisms, genetic recombination occurs during the formation of gametes through meiosis. The mixing of genetic material from two parents produces offspring's with new combinations of genes. This results in variations by creating new combinations of characteristics.

16. Discuss how gene flow effect the population?

Ans. When individuals from one population migrates to another they introduce new genes in the population. This can introduce new variations within a population. If these new variations prove better in a new population, they can spread through the population.

17. What is palaeontology?

Ans. **Palaeontology:** Palaeontology is the study of fossils.

18. Why palaeontologists study fossils?

Ans. Palaeontologist study fossils:

- i- To observe evolutionary sequences ii- To track vertebrate history
- iii- To link ancestors to new generations iv- To bridge evolutionary gaps
- v- To provide evidence of gradual change

19. What is comparative anatomy?

Ans. Comparative anatomy involves the similarities and differences in the structures of different organisms.

20. What do you know about vestigial organs?

Ans. Vestigial organs: Vestigial organs are the body parts that have no apparent function but were fully functional in an organism's ancestor.

For example: Appendix is a vestigial structure in humans. It might have played a more important role in the digestive system of ancestors.

21. Differentiate between breeds and cultivars.

Ans. Breeds: The varieties of animals which are selectively bred are called breeds.

For example: Many breeds of sheep, goat and hen etc. have been produced by selective breeding to increase the production of meat, milk, eggs and wool etc.

Cultivars: The varieties of plants which are selectively bred are known as varieties or cultivars.

For example: Plants like wheat, potato, rice and apple are selectively bred.

Exercise Questions (Solved)



A. Select the correct answers for the following questions.

- The survival and reproduction of individuals with advantageous traits is called:**
(a) Mutations (b) Gene flow
(c) Natural selection (d) Asexual reproduction
- A population is split by a river. After many generations, both population evolve into different species. What type of speciation may occur?**
(a) Sympatric (b) Genetic drift (c) Mutation (d) Allopatric
- Which characteristics in whales supports that their ancestors lived on land?**
(a) Big body (b) Fins
(c) Pelvic bones (d) Stream-lined body
- Farmers choose best cows to breed. It is an example of:**
(a) Natural selection (b) Selective breeding
(c) Adaptation (d) Genetic mutation
- Darwin's observation of finches proved that:**
(a) Climate was same on all islands (b) All finches were identical
(c) They adapted to different foods on different islands
(d) Finches never migrated
- A new variation appears suddenly and helps survival. What happens next?**
(a) It disappears (b) It spreads through population
(c) It causes disease (d) It's removed by natural selection
- Which of these is a vestigial structure?**
(a) Human ear muscles (b) Wings of Sparrow
(c) Beak of duck (d) Tail of cat
- Which pair are homologous structures?**
(a) Bird wings and butterfly wings (b) Dolphin fins and shark fins
(c) Human arms and dolphin fins (d) bat wings and bird wings
- Human appendix is a vestigial organ because it:**
(a) Has a major digestive function (b) Is part of the immune system

- (c) Is no longer useful for digestion (d) Helps in absorbing nutrients
10. Artificial selection is similar to natural selection because;
- (a) Environmental conditions play role in both
 - (b) Both occur over millions of years
 - (c) Both are carried out by humans
 - (d) Both depend upon variations among individuals

Answers

- | | | | | |
|--------|--------|--------|--------|---------|
| 1. (c) | 2. (d) | 3. (c) | 4. (b) | 5. (c) |
| 6. (b) | 7. (a) | 8. (c) | 9. (c) | 10. (d) |

B. Write short answers.

1. Write a short note on selective breeding.

Ans. Selective Breeding: Selective breeding means the process in which humans select varieties of plants or animals and breed them to produce offsprings with required characteristics.

- Selective breeding increases yield, improves quality and produce disease and pest resistance of plants and animals.

2. What are the two types of speciation?

Ans. i- Allopatric speciation: This speciation occurs when a population is geographically separated into two or more populations.

- The physical barriers are mountains, rivers or oceans.

Examples: Darwin's finches becoming different on different islands.

ii- Sympatric speciation: This speciation occurs when reproductive isolation happens within reproductive isolation happens within the same geographical area.

- It is due to habitat preference or behaviors.

Example: Group of fish in the same lake developing different dietary or mate preferences.

3. Provide examples of homologous structures.

Ans. Examples of homologous structures are forelimbs of mammals (arms of human, legs of cat) flippers of whale and wings of bat) all have some same structure but different functions.

4. List the steps in the process of natural selection.

Ans. Natural selection works in following steps:

- | | | |
|--|--------------------------------|------------------------------|
| i- Variations | ii- Struggle for survival | iii- Survival of the fittest |
| iv- Reproduction and passing on variations | v- Gradual evolution over time | |

C. Write answers in detail.

1. Explain the theory of evolution by natural selection.

Ans. For answer see Q's 3

2. Write a note on the observations Darwin made during his voyage.

Ans. For answer see Q's 2

3. Describe the sources of variation.

Ans. For answer see Q's 8

4. Justify how fossil record provides an evidence of evolution.

Ans. For answer see Q's 9

5. Write a note on homologous structures as an evidence of evolution.

Ans. For answer see Q's 10

6. What are vestigial structures? Explain how they provide evidence of evolution.

Ans. For answer see Q's 11

D. Inquisitive questions

1- Why is variation among individuals important for evolution?

Ans. Variation is the raw material for evolution.

- (i) It ensures that some individuals in a population possess traits that allow them to survive environmental changes such as diseases or climate shifts.
- (ii) Without variation all individuals would be identical
- (iii) A population with high genetic variation is less likely to go extinct because it is more adaptable to diverse challenges.

2- How do fossils help scientists understand the history of life on Earth?

Ans. Fossils help scientist understand the history of life on earth because they provide direct evidence of organisms that lived millions of years ago. By studying fossils scientists can:

- (i) Identify ancient species and compare them with present.
- (ii) Understand how organism changed over time, showing patterns of evolution.
- (iii) Determines the age of rock layers.
- (iv) Reconstruct past environments such as whether an area was underwater, forested or desert.
- (v) Trace the appearance and disappearance of species, helping to understand extinction and the formation of new species.

3- Why can isolation lead to the formation of new species??

Ans. Isolation (especially geographic or allopatric isolation) is a key driver of speciation because:

Interruption of gene flow: When a population is split (e.g. by a river or mountain range), the two groups can no longer breed with each other, this stops the exchange of genetic information.

Independent Evolution: Each isolated group faces different environmental pressures and food sources. Each isolated group develop unique variations. Natural selection acts differently. Their traits gradually become more and more different.

Reproductive Incompatibility: Eventually, the genetic differences are so significant that even if the group meet again, they can no longer interbreed to produce fertile offspring's.