

Homology and Analogy of Plants and Animals

Introduction

- **Evolution:** It may be defined as the formation of wide varieties of organisms which have been evolved from pre-existing organisms through their gradual changes since the beginning of life.
- The fossil records, vestigial organs, homologous and analogous organs provide evidence for common ancestry.
- The embryological studies of the early developmental stages in all the vertebrates show some common similarities like notochord, gill slits, embryonic tail, etc.
- Vestigial organs are those organs which were functional earlier but now are rudimentary. These are important in tracing the evolutionary relationship with other vertebrates. For example, nictitating membrane and appendix in human beings.
- Divergent evolution and convergent or homology and analogy helps us to trace evolutionary relationship with other organisms.
Convergent evolution: Type of evolution when two unrelated species undergo several changes and adaptations to become more similar, this is called convergent evolution. Usually, these two species live in similar climates and environments in different parts of the world that favour the same adaptations.
- **Analogy:** Analogy, or analogous structures, is actually the one that indicates there is no common ancestor between two organisms. The anatomical structures may look similar and may perform the same functions but they are actually a product of convergent evolution.
- **Analogy in animals:**
 1. The bats, flying insects and birds use their wings to fly, but bats are actually mammals and not related to birds or flying insects.
 2. The fins of a shark and a dolphin are favourable adaptations for animals that need to swim and move in the water. But sharks are classified within the fish family while dolphins are mammals.
- **Analogy in plants:** Potato and sweet potato perform same function, i.e., storage of food but one is modified stem while the other is modified root.
- **Divergent evolution:** Type of evolution where closely related species become less similar in structure and function due to the adaptations they acquire during the natural selection process. Migration to new climates, competition for niches with other species, and even micro-evolutionary changes like DNA mutations can contribute to divergent evolution.
- **Homology:** The study of organisms with similar anatomical structures is called homology. The homologous organs did evolve from a recent common ancestor. Organisms with homologous structures are more closely related to each other in the evolution tree.
- **Homology in animals:** The forelimbs of humans and wings of bat have similar structure though they perform different functions.

- **Homology in plants:** The prickly spines on a cactus and the leaves on an oak tree look very dissimilar, but they are actually homologous structures. They have very different functions. In cactus spines are primarily for protection and to prevent water loss in its hot and dry environment, the oak tree does not have these adaptations.

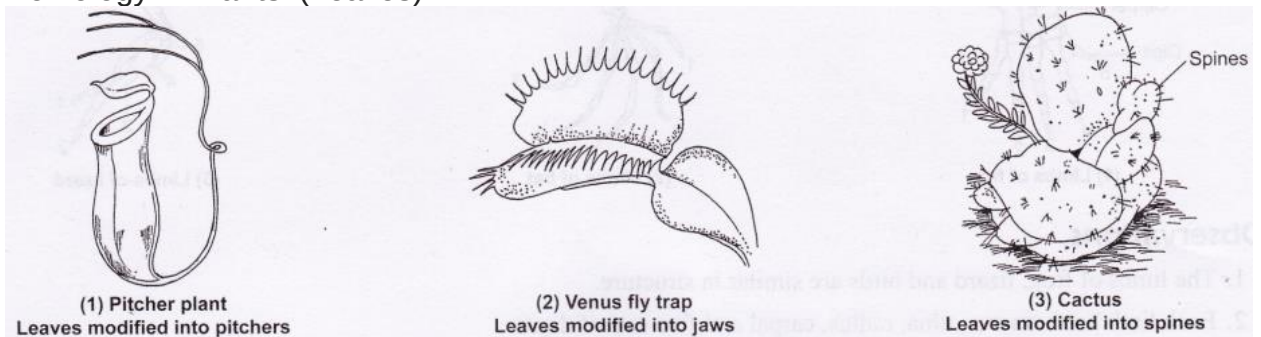
Science Lab Manual Experiment – 5

Aim

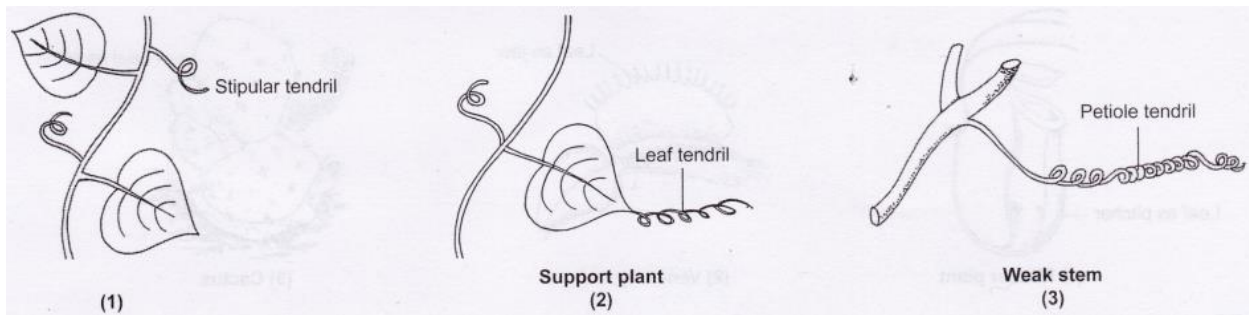
To study homology and analogy with the help of models/charts/specimens of either animals or plants.

Theory

- Homologous organs: The organs which perform different functions in different species but have similar basic structure and similar embryonic origin are called homologous organs. E.g., limbs of human being, frog, bird and lizard.
- Homology: Similar in characteristics resulting from shared ancestry.
- Homologous features arise from adaptive behaviour, to adapt to different environmental conditions and modes of life.
- Homology in Plants: (Leaves)



- Analogous Organs: The organs which are quite different in fundamental structure and embryonic origin but perform same function and may superficially look alike are called analogous organs. For e.g., wings of bird, bat, insects are used for flying but the internal structure is different.
- Analogy: The organisms showing analogy do not share common ancestors.
- Analogous features arise when two unrelated species adapt themselves to similar climate and environmental condition.
- Analogy in Plants: Thorns and spines are modified organs seen in plants are analogous structures. Thorn is modification of stem and spine is modification of leaf.
- Tendrils in plant show similar function but they are different in origin.



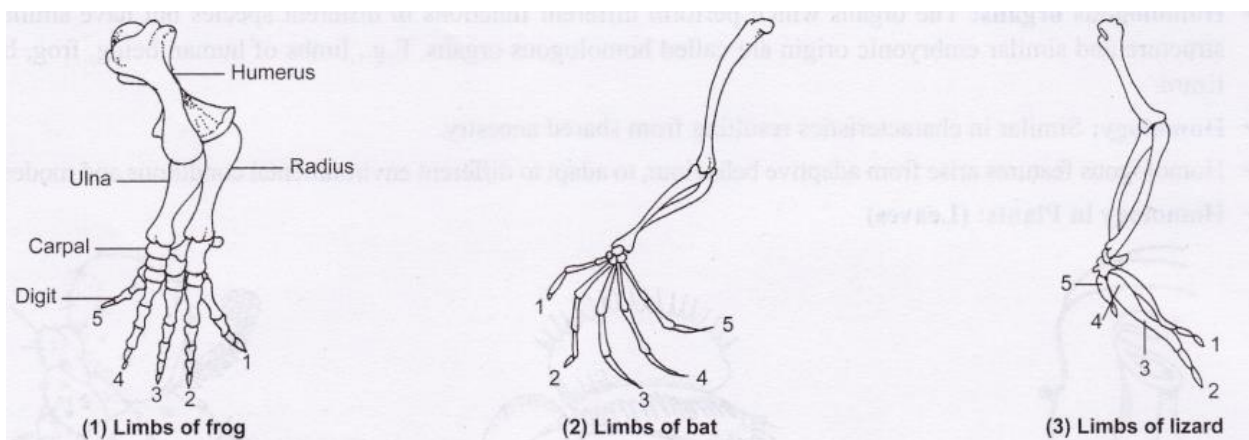
Materials Required

- Preserved specimens
- **Animals:** Limbs of frog, lizard and bat. Wings of insect, bat and bird.
- **Plants:** Pitcher plant, venus fly trap and cactus Plants with tendrils:
Pea plant – Leaf tendril
Grape plant – Stem tendril
Smilax – Stipular tendril

A. TO STUDY HOMOLOGY I. IN ANIMALS

Procedure

1. Observe carefully the preserved specimens of limbs of frog, limbs of lizard and limbs of bat.
2. Draw diagrams and record your observations.



Observations

1. The limbs of frog, lizard and birds are similar in structure.
2. Each limb has humerus, ulna, radius, carpal and five sets of digits.

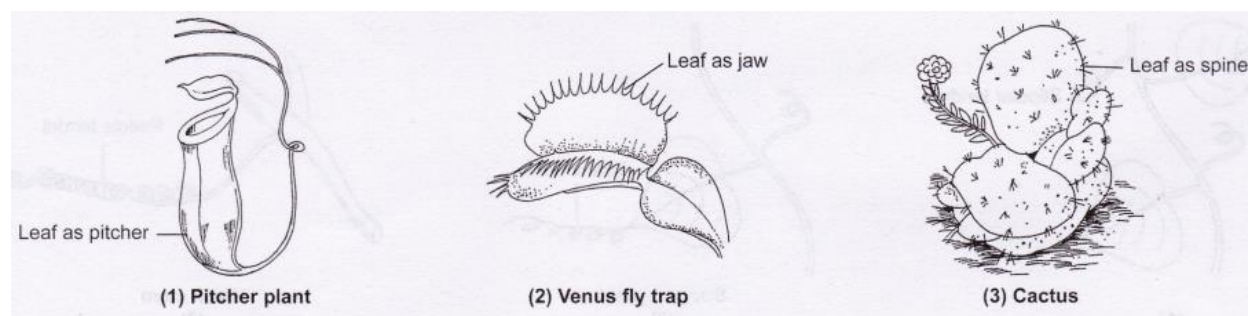
Conclusion

The similarity in structure but difference in function proves that all these homologous organs are evolved from common ancestor.

II. IN PLANTS

Procedure

1. Observe carefully the given specimens of pitcher plant, venus fly trap and cactus plant.
2. Record your observations to study the homologous organs and draw diagrams.



Observations

1. The leaves are modified for different functions, but the structure is similar.
2. In pitcher plant, the leaves are modified into pitchers to trap insects.
3. In venus fly trap plant the leaves are modified into jaws to trap insects.
4. In cactus plant, the leaves are modified into spines to reduce water loss through transpiration.

Conclusion

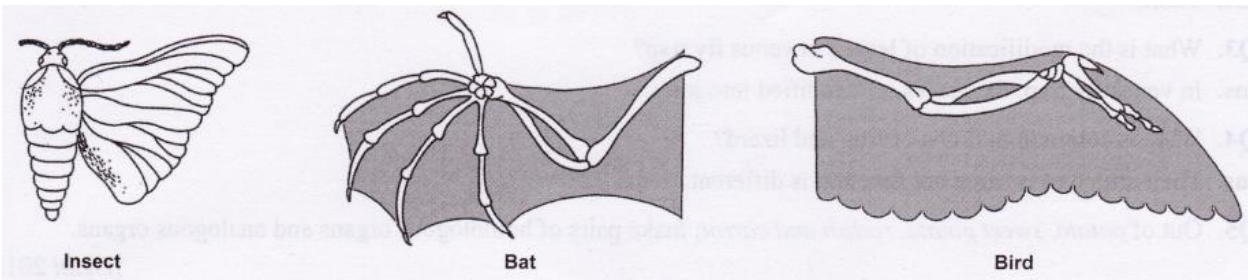
The modification of leaves in different plants showing similar origin but different functions shows the homology in plants.

B. TO STUDY ANALOGY

I. IN ANIMALS

Procedure

1. Observe carefully the preserved specimens of wings of insect, bat and bird.
2. Draw diagrams and record your observations.



Observations

1. The function of wings in all the three specimens is same but the structure is different.
2. The wings of insect has no limbs.
3. The wings of bat has limbs with five digits whereas the wings of bird has only three digits.

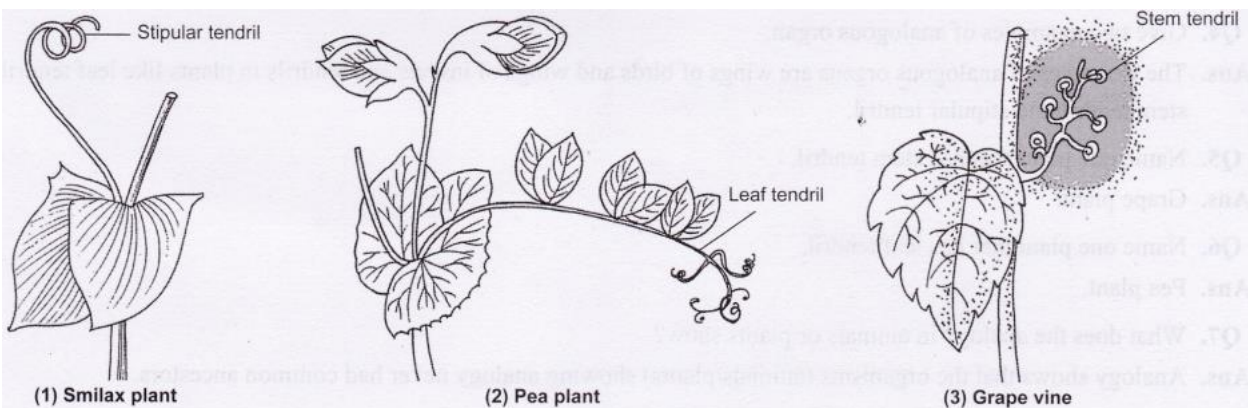
Conclusion

The wings of birds, insects and bats has common use, i.e., flying but the structure is different. These organs are called analogous organs.

II. IN PLANTS

Procedure

1. Observe the specimens/samples of plants showing leaf tendril, stem tendril and stipular tendril.
2. Record your observations with the help of diagram.



Observations

1. The function of all the three types of tendrils is same.
2. The structure of each tendril and its origin is different.

Conclusion

The types of tendril in plants show the analogy in plants and all these tendrils are analogous organs seen in plants.

Science Lab Manual Viva Voce

Question 1:

What does the similarity in organs due to homology prove?

Answer:

Common ancestors.

Question 2:

Name an analogous organ of spine.

Answer:

Thorn

Question 3:

What is the modification of leaves in venus fly trap?

Answer:

In venus fly trap, the leaves are modified into jaws.

Question 4:

What is common in limbs of frog and lizard?

Answer:

Their structure is same but function is different.

Question 5:

Out of potato, sweet potato, radish and carrot; make pairs of homologous organs and analogous organs.[Delhi 2012]

Answer:

Radish and carrot both are homologous organs as these are modified roots.

Homologous structures are similar in origin but perform different functions. Carrot and radish are underground roots. So, they represent the correct homologous structures.

But potato is a stem and sweet potato is an underground modified root, so they represent the analogous organs.

Science Lab Manual Practical Based Questions

Question 1:

What are homologous organs?

Answer:

Homologous organs are those organs which are similar in structure but different in function.

Question 2:

Give two examples of homologous organs.

Answer:

Limbs of frog, lizard and bat, and leaves of cactus, pitcher plant and venus fly trap.

Question 3:

What are analogous organs?

Answer:

Analogous organs have same function but different structures.

Question 4:

Give two examples of analogous organ.

Answer:

The examples of analogous organs are wings of birds and wings of insects and tendrils in plants like leaf tendril, stem tendril and stipular tendril.

Question 5:

Name one plant that has stem tendril.

Answer:

Grape plant.

Question 6:

Name one plant that has leaf tendril.

Answer:

Pea plant.

Question 7:

What does the analogy in animals or plants show?

Answer:

Analogy shows that the organisms (animals/plants) showing analogy never had common ancestors.

Question 8:

Give an example of analogous organs in marine animals.

Answer:

Fins of fish and flipper of whale are analogous organs.

Question 9:

Give an example of analogous organs in flying creatures.

Answer:

Wings of bird and wings of insect are analogous organs.

Question 10:

Name two homologous organs in plants.

Answer:

The storage organs, i.e., potato and ginger (store food for plants) are homologous.

Science Lab Manual Multiple Choice Questions (MCQs)

Questions based on Procedural and Manipulative Skills

Question 1:

The forelimbs of human and wings of bat are an example of:

- (a) vestigial organs
- (b) analogous structures
- (c) homologous structures
- (d) none of these

Question 2:

Wings of insects and birds are an example of

- (a) vestigial organs
- (b) homologous organs
- (c) analogous organs
- (d) none of these

Question 3:

The similarity of bone structure in the forelimbs of many vertebrates is an example of

- (a) diversity
- (b) homology
- (c) analogy
- (d) variations

Question 4:

Similar structures that evolved independently are called

- (a) homology
- (b) analogy
- (c) both (a) and (b)
- (d) none of these.

Question 5:

Pitcher plant and venus fly trap plant represent the examples of:

- (a) analogous organs
- (b) homologous organs
- (c) vestigial organs
- (d) none of these

Question 6:

Potato and sweet potato are the examples of:

- (a) analogous organs
- (b) vestigial organs
- (c) homologous organs
- (d) none of these

Question 7:

Potato and ginger are the examples of:

- (a) analogous organs
- (b) homologous organs
- (c) vestigial organs
- (d) both (a) and (b)

Question 8:

Potato and sweet potato are respectively the modified form of:

- (a) root and stem
- (b) stem and leaf
- (c) stem and root
- (d) stem and flower

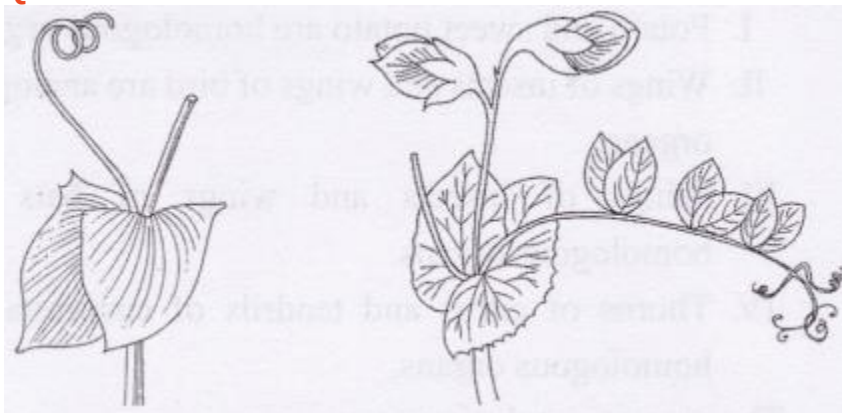
Question 9:

Thorns of citrus and tendrils of cucurbits are the examples of:

- (a) analogous organs
- (b) homologous organs
- (c) vestigial organs
- (d) both (a) and (c)

Questions based on Observational Skills

Question 10:

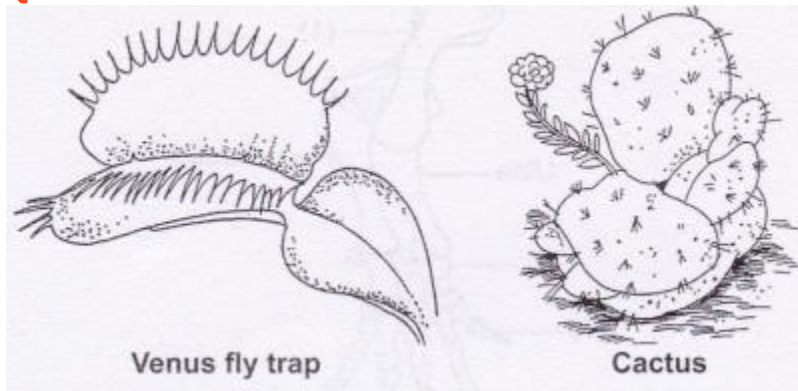


The above figures demonstrate

- (a) analogy
- (b) homology

- (c) adaptation
- (d) vestigial organs

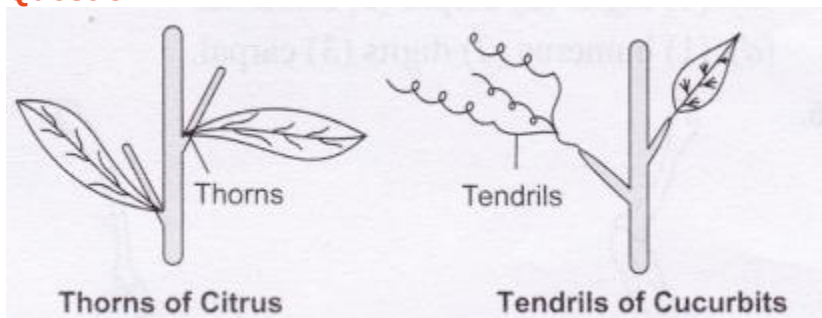
Question 11:



The figures given above show

- (a) modification in leaves
- (b) plants with similar origin
- (c) homology in plants
- (d) all of the above

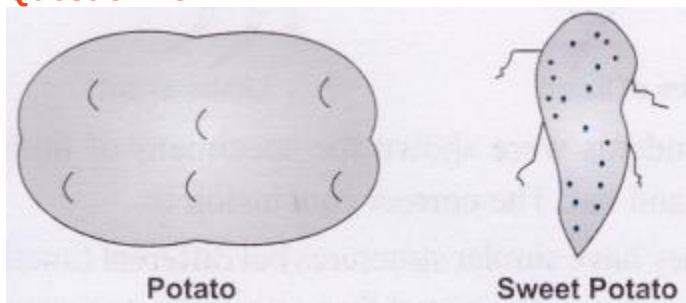
Question 12:



The thorn and the tendril is the modified organ of:

- (a) stem
- (b) bud
- (c) leaf
- (d) thorn

Question 13:



Both potato and sweet potato store food in plants, they are the modified parts of:

- (a) potato – stem
sweet potato – stem
- (b) potato – root
sweet potato – root
- (c) potato – stem
sweet potato – root
- (d) potato – root
sweet potato – stem

Questions based on Reporting and Interpretation Skills

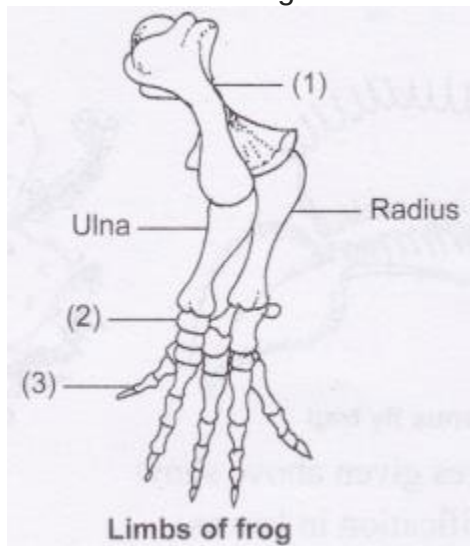
Question 14:

During the early stage of development, the embryo of reptiles, birds and mammals look very similar. This suggests that reptiles, birds and mammals

- (a) have a common functions
- (b) live in same environment
- (c) have shown evolution
- (d) have common vestigial organs

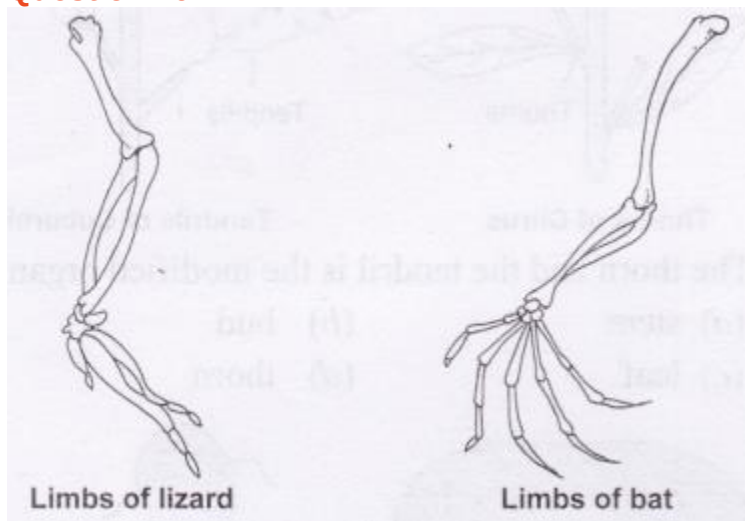
Question 15:

The correct labelling is



- (a) (1) carpal (2) humerus (3) digits
- (b) (1) humerus (2) carpal (3) digits
- (c) (1) digits (2) carpal (3) humerus
- (d) (1) humerus (2) digits (3) carpal.

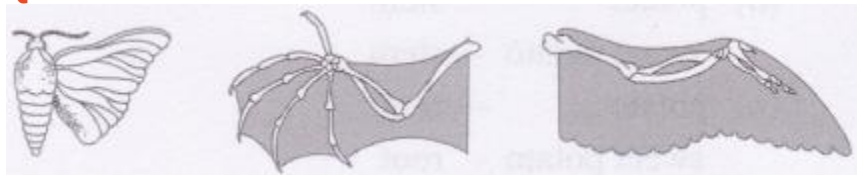
Question 16:



The students were shown the specimens of limbs of lizard and bat. The correct conclusion is

- (a) they have similar structures but different functions.
- (b) they have originated from common ancestors.
- (c) these are homologous organs.
- (d) all of the above.

Question 17:



The above specimens were shown to students for recording the observations and conclusion. The correct answer is

Observations	Conclusion
(a) Wings of animals	common structure, common function
(b) Wings of variety of animals	different structures but same function
(c) Analogous organs	structures with common ancestor
(d) Analogous organs	organs with same structure and function

Question 18:

In pea plant, the tendrils are the modification of:

- (a) stem
- (b) leaf

- (c) root
- (d) flower.

Question 19:

In grape plant, the tendrils are the modification of:

- (a) stem
- (b) leaf
- (c) root
- (d) flower

Question 20:

The correct examples of homologous organs are:

- (a) limbs of bat, frog and lizard
- (b) sweet potato, carrot and raddish
- (c) leaves of pitcher, venus fly trap and cactus
- (d) all of these

Question 21:

One of the examples of two analogous organs can be the wings of parrot and [Delhi 2011]

- (a) flipper of whale
- (b) foreleg of horse
- (c) front leg of frog
- (d) wings of housefly

Question 22:

Study the different conclusions drawn by students of a class on the basis of observations of preserved available specimens of plants and animals. [Delhi 2013]

- I. Potato and sweet potato are analogous organs in plants.
- II. Wings of insects and wings of birds are homologous organs in animals.
- III. Wings of insects and wings of bats are analogous organs in animals.
- IV. Thoms of citrus and tendrils of cucurbita are analogous organs in plants.

The correct conclusions are:

- (a) I and II
- (b) II and IV
- (c) I and III ,
- (d) III and IV

Question 23:

Study the different conclusions drawn by students on the basis of their observations of fresh available specimens of plants and animals: [Outside Delhi 2013]

- I. Potato and sweet potato are homologous organs.
- II. Wings of insects and wings of bird are analogous organs.
- III. Wings of insects and wings of bats are homologous organs.

IV. Thorns of citrus and tendrils of cucurbita are homologous organs.

The correct conclusions are:

- (a) I and II
- (b) II and IV
- (c) I and III
- (d) III and IV

Question 24:

You have a basket of vegetables which contains carrot, potato, tomato, ginger, radish, sweet potato. Select two vegetables to represent the correct homologous structures.

[Outside Delhi 2013]

- (a) Potato and sweet potato
- (b) Carrot and radish
- (c) Potato and carrot
- (d) Carrot and tomato

Question 25:

Study the following statements: [Outside Delhi 2014]

- I. Wings of birds and wings of bats are homologous organs.
- II. Wings of birds and wings of insects are modified forelimbs.
- III. Wings of birds and wings of insects are analogous organs.
- IV. Wings of birds and forelimbs of horse are homologous organs.

The correct statements are:

- (a) I and II
- (b) II and III
- (c) III and IV
- (d) I and IV

Question 26:

Which one of the following pairs of vegetables is an example of homologous structures?

[Delhi 2014]

- (a) Potato and sweet potato
- (b) Carrot and radish
- (c) Carrot and tomato
- (d) Tomato and radish

Answers:

1. (c)	2. (c)	3. (b)	4. (a)	5. (b)
6. (a)	7. (b)	8. (c)	9. (b)	10. (a)
11. (d)	12. (a)	13. (c)	14. (c)	15. (b)
16. (d)	17. (b)	18. (b)	19. (a)	20. (d)
21. (d)	22. (c)	23. (b)	24. (b)	25. (c)
26. (b)				

Science Lab Manual Scoring Key With Explanation

1. (c) These organs are similar in structure but different in function.
2. (c) These organs have same function but different structures.
3. (b) Same structures.
4. (a) Same structures.
5. (b) Same structures of leaves but different functions.
6. (a) Both have different structures (stem and root) but same function (stores food).
7. (b) Both are stems (same structure) but different functions.
8. (c) Potato is stem and sweet potato is root (modified in both cases).
9. (b) Similar structures but different functions.
10. (a) Different structures (tendrils of stem and leaf) but same function.
11. (d) These are leaves of cactus and venus fly trap.
12. (a) In both, stem is modified.
13. (c) Potato is stem and sweet potato is root.
14. (c) The embryonic stage is same for all.
15. (b) Option (b) has correct order of labels.
16. (d) These organs have same structures with one origin.
17. (b) The designs of the three wings, their structure and components are very different. They look similar because they have a common use for flying.
18. (b) Pea plant has leaf tendril.
19. (a) Grape tendril is from stem.
20. (d) All are correct.
21. (d) Analogous means same function, wings have same function.
22. (c) Analogous organs.
23. (b) Homologous and analogous organs.
24. (b) Both are roots. Homologous structures are similar in origin but perform different functions. Carrot and radish are underground roots. So, they represent the correct homologous structures.
25. (c) Examples of homologous and analogous organs.
- 26. (b)** Both are roots.