Chapter 30  Nonvertebrate Chordates, Fishes, and Amphibians

Vocabulary Review

Matching  In the space provided, write the letter of the definition that best matches each term.

____  1. cartilage  a. a segment of the backbone
____  2. cerebellum  b. part of the brain that coordinates body movements
____  3. notochord  c. fishes whose eggs develop inside the mother’s body and whose young are born alive
____  4. ovoviviparous  d. long, supporting rod that runs through the body just below the neve cord
____  5. vertebra  e. strong tissue that supports the body and is more flexible than bone

Completion  Use the words below to fill in the blanks with terms from the chapter.

atrium   chords"eats  tympanic membrane
          cerebrum  cloaca  viviparous

6. Fishes, amphibians, reptiles, birds, and mammals are all ____________________.

7. A large muscular chamber of the heart called a(an) ____________________ serves as a one-way compartment.

8. Voluntary activities of the body are controlled by the ____________________, a portion of the brain.

9. In ____________________ animals, the embryos stay in the mother’s body after fertilization and obtain the nutrients they need from the mother’s body.

10. The large muscular cavity at the end of an amphibian’s large intestine is the ____________________.

11. Another name for eardrum is___________________.
Section 30–2 Fishes (pages 771–781)

Key Concepts
- What are the basic characteristics of fishes?
- What were the important developments during the evolution of fishes?
- How are fishes adapted for life in water?
- What are the three main groups of fishes?

What Is a Fish? (page 771)
1. Write the function of each characteristic of fishes.
   a. Paired fins ________________
   b. Scales ________________
   c. Gills ________________

2. Is the following sentence true or false? The characteristics of living fishes are very uniform and almost no diversity exists among fishes. ________________

Evolution of Fishes (pages 772–773)
3. Circle the letter of each sentence that is true about the evolution of fishes.
   a. Fishes were the first vertebrates to evolve.
   b. Fishes arose directly from tunicates and lancelets.
   c. Fishes changed little during the course of their evolution.
   d. Early fishes were jawless and covered with bony plates.

4. Which period is known as the Age of Fishes?
   a. Cambrian
   b. Ordovician
   c. Silurian
   d. Devonian

5. Jawless fishes with little armor of the Devonian Period were the ancestors of modern ________________ and ________________.

6. Why were jaws an extremely useful adaptation? ________________

7. A strong tissue that supports the body and is more flexible than bone is ________________

8. Is the following sentence true or false? Paired fins gave fishes less control over their movement. ________________

Form and Function in Fishes (pages 774–778)
9. What are the different modes of feeding found in fishes? ________________
10. Is the following sentence true or false? A single fish may exhibit only one mode of feeding. ________________

Match the internal organ with its function.

<table>
<thead>
<tr>
<th>Internal Organ</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Pyloric ceca</td>
<td>a. Short tube connecting the fish’s mouth to the stomach</td>
</tr>
<tr>
<td>12. Intestine</td>
<td>b. Where food is first partially broken down</td>
</tr>
<tr>
<td>13. Pancreas</td>
<td>c. Fingerlike pouches in which food is processed and nutrients absorbed</td>
</tr>
<tr>
<td>14. Esophagus</td>
<td>d. Adds digestive enzymes and other substances to food as it moves through the gut</td>
</tr>
<tr>
<td>15. Anus</td>
<td>e. Completes the process of digestion and nutrient absorption</td>
</tr>
<tr>
<td>16. Stomach</td>
<td>f. Opening through which undigested material is eliminated</td>
</tr>
</tbody>
</table>

17. What does the capillary network in each gill filament provide? ________________

18. Describe how fishes with gills exchange gases. ________________

19. The protective bony cover over the gill slit from which water is pumped out of a fish’s body is called a(an) ________________.

20. How do lungfishes survive in oxygen-poor water? ________________

21. Is the following sentence true or false? Fishes have an open circulatory system. ________________

Match each chamber of the heart in fishes with its function.

<table>
<thead>
<tr>
<th>Heart Chamber</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>22. Ventricle</td>
<td>a. Collects oxygen-poor blood from the veins</td>
</tr>
<tr>
<td>23. Sinus venosus</td>
<td>b. Large muscular cavity that serves as a one-way compartment for blood entering the ventricle</td>
</tr>
<tr>
<td>24. Bulbus arteriosus</td>
<td>c. Thick-walled, muscular chamber that is the actual pumping portion of the heart</td>
</tr>
<tr>
<td>25. Atrium</td>
<td>d. Large, muscular tube that connects to the ventricle and moves blood through the aorta toward the gills</td>
</tr>
</tbody>
</table>
26. What form of nitrogenous waste do most fishes excrete?

27. How does the function of kidneys in saltwater fishes differ from their function in freshwater fishes?

33. Circle the letter of each sentence that is true about the sense organs of fishes.
   a. Fishes have poorly developed sense organs.
   b. Many fishes have chemoreceptors that sense tastes and smells.
   c. Fishes have a lateral line system used for sensing sounds.
   d. Some fishes can sense low levels of electric current.

34. What are two ways that fins help fish to move?
   a. _____________________________
   b. _____________________________

35. The streamlined body shapes of most fishes help reduce the amount of __________________________ as they move through the water.

36. What is the function of the swim bladder?
   _____________________________

37. In which mode of fish reproduction do the embryos develop inside the mother’s body using the egg yolk for nourishment?
   a. oviparous  
   b. ovoviviparous  
   c. viviparous  
   d. herbivorous

Groups of Fishes (pages 778–780)

38. Fishes are divided into groups according to _______________ structure.
39. Complete the table about the groups of fishes.

**GROUPS OF FISHES**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cartilaginous fishes</td>
<td>No true teeth; skeletons made of fibers and cartilage; keep their notochord as adults</td>
<td>Sharks, rays, skates</td>
</tr>
<tr>
<td></td>
<td>Ray-finned fishes, such as flounder, angelfish, and flying fish and lobe-finned fishes, such as lungfishes and the coelacanth</td>
<td></td>
</tr>
</tbody>
</table>

40. Is the following sentence true or false? Hagfishes are filter feeders as larvae and parasites as adults. ________________

41. Circle the letter of each characteristic of a shark.
   a. torpedo-shaped body
   b. secretes slime
   c. many teeth
   d. winglike fins

42. Is the following sentence true or false? Lobe-finned fishes have fleshy fins supported by bones that are sometimes jointed. ________________

**Ecology of Fishes (page 781)**

43. Fishes that spend most of their lives in the ocean but migrate to fresh water to breed are called ________________.

44. Fishes that live in fresh water but migrate to the ocean to breed are called ________________.
Section 30–3 Amphibians (pages 782–789)

Key Concepts
• What is an amphibian?
• How are amphibians adapted for life on land?
• What are the main groups of living amphibians?

What Is an Amphibian? (page 782)
1. Is the following sentence true or false? Amphibian adults are fishlike aquatic animals that respire using gills. ________________
2. Circle the letter of each characteristic of amphibians.
   a. scales  b. claws  c. moist skin  d. mucous glands

Evolution of Amphibians (pages 782–783)
3. List three challenges that had to be overcome by vertebrates colonizing land habitats.
   a. ________________________________
   b. ________________________________
   c. ________________________________
4. List three adaptations that evolved in amphibians that helped them live at least part of their lives out of water.
   a. ________________________________
   b. ________________________________
   c. ________________________________
5. Amphibians became the dominant form of animal life during the ________________ Period, also known as the Age of Amphibians.
6. Why did most amphibian groups become extinct by the end of the Permian Period?
   ___________________________________________________________________

Form and Function in Amphibians (pages 784–787)
8. Circle the letter of each characteristic of a tadpole.
   a. carnivore
   b. herbivore
   c. long intestines
   d. short intestines
9. Circle the letter of each characteristic of an adult amphibian.
   a. carnivore  b. herbivore  c. sticky tongue  d. long intestines

10. Briefly describe the path of food in a frog’s digestive system.

11. Circle the letter of each sentence that is true about respiration.
   a. In tadpoles, gas exchange occurs only through the skin.
   b. Lungs replace gills when an amphibian becomes an adult.
   c. Gas exchange in adults can also occur through the skin.
   d. All adult amphibians have lungs.

12. Amphibians have _______________ that filter wastes from the blood.

13. Complete the captions in the diagram about the stages in the life cycle of a frog.

   Adult Frog

   Frog eggs are laid in water and undergo fertilization.

   Fertilized Eggs

   The eggs hatch into a few days to several weeks later.

   Tadpoles gradually grow limbs, lose their ___________ and ___________, and develop into terrestrial adults.
14. How is the first loop in the circulatory system of an adult amphibian different from the second loop? 

Match the type of amphibian with its method of movement.

<table>
<thead>
<tr>
<th>Amphibian</th>
<th>Method of Movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. Tadpoles</td>
<td>a. Flattened tail for propulsion</td>
</tr>
<tr>
<td>16. Adult salamanders</td>
<td>b. Well-developed hind limbs for jumping</td>
</tr>
<tr>
<td>17. Frogs and toads</td>
<td>c. Legs push backward against the ground</td>
</tr>
</tbody>
</table>

18. Circle the letter of each sentence that is true about response in amphibians.
   a. An amphibian’s brain is structured very differently from a fish’s.
   b. An amphibian’s eye is protected from damage and kept moist by the nictitating membrane.
   c. Frogs probably do not see color as well as fishes.
   d. Amphibians hear through tympanic membranes, or eardrums.

Groups of Amphibians (page 788)

19. Circle the letter of each characteristic of salamanders.
   a. tail                  c. herbivore
   b. carnivore             d. short body

20. Circle the letter of each characteristic of frogs and toads.
   a. tail                  c. able to jump
   b. no tail               d. adults have gills

21. Circle the letter of each characteristic of caecilians.
   a. legless               c. able to jump
   b. long legs             d. some scales

Ecology of Amphibians (page 789)

22. What are two ways in which amphibians protect themselves from predators?
   a. 
   b. 

23. Is the following sentence true or false? For the past several decades, the number of living species of amphibians has been increasing. 

Chapter 31 Reptiles and Birds

Section 31–1 Reptiles (pages 797–805)

Key Concepts

• What are the characteristics of reptiles?
• How are reptiles adapted to life on land?
• What are the four living orders of reptiles?

What Is a Reptile? (page 797)

1. List three characteristics shared by all reptiles.
   a. 
   b. 
   c. 

2. What is the disadvantage of reptilian scaly skin?

Evolution of Reptiles (pages 798–799)

3. Circle the letter of each sentence that is true about the evolution of reptiles.
   a. Reptiles evolved rapidly in the warm, humid climate of the Carboniferous Period.
   b. Mammal-like reptiles dominated many land habitats until near the end of the Triassic Period.
   c. All dinosaurs were enormous.
   d. Some dinosaurs may have had feathers.

4. Is the following sentence true or false? The extinction of dinosaurs opened up new niches on land and in the sea, providing opportunities for other kinds of organisms to evolve.

Form and Function in Reptiles (pages 800–802)

5. How do ectotherms control their body temperature?

6. Is the following sentence true or false? All reptiles are herbivores.

7. Circle the letter of each adaptation reptiles have for respiration.
   a. lungs    c. strong rib muscles
   b. moist skin d. gill slits

8. Circle the letter of each sentence that is true about circulation in reptiles.
   a. Reptiles have a double-loop circulatory system.
   b. All reptile hearts have only one atrium.
   c. Most reptiles have one ventricle with partial internal walls.
   d. Crocodiles have the least developed heart of living reptiles.
9. What is the advantage of uric acid to terrestrial reptiles?  

10. Circle the letter of each sentence that is true about response in reptiles.
   a. The reptilian cerebrum is smaller than that of amphibians.
   b. Reptiles that are active during the day tend to have complex eyes.
   c. Reptiles do not have ears.
   d. Snakes sense vibrations in the ground through bones in their skulls.

11. Explain why reptiles are able to carry more body weight than amphibians.

12. All reptiles reproduce by ______________ fertilization in which the male deposits sperm inside the body of the female.

13. In the diagram below, label the four membranes in the amniotic egg that surround the developing embryo.

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**Groups of Reptiles** *(pages 803–805)*

14. What are the four living orders of reptiles?
15. Is the following sentence true or false? Both snakes and lizards have scaly skin and clawed toes. ________________

16. Circle the letter of each characteristic of crocodilians.
   a. long snout  c. herbivore
   b. long legs  d. protective of young

17. Members of the order Testudines that live on land are referred to as ________________.

18. How do most turtles and tortoises protect themselves? ________________

19. Circle the letter of each characteristic of turtles and tortoises.
   a. teeth  c. strong limbs
   b. strong jaws  d. long, broad snout

20. Describe how tuataras differ from lizards. ________________

Ecology of Reptiles (page 805)

21. Circle the letter of each sentence that is true about the ecology of reptiles.
   a. Reptiles are in no danger of disappearing.
   b. Reptilian habitats have been expanding.
   c. Humans hunt reptiles for food, to sell as pets, and for their skins.
   d. Conservation programs are in place to help reptiles survive.

Reading Skill Practice

Flowcharts can help you to order the steps in a process or the stages in a series of events. Construct a flowchart that shows the stages in the evolution of reptiles, beginning at the end of the Carboniferous Period and ending with the extinction of dinosaurs at the end of the Cretaceous Period. See Appendix A in your textbook for more information about flowcharts. Do your work on a separate sheet of paper.
Section 31–2 Birds (pages 806–814)

Key Concepts
• What characteristics do birds have in common?
• How are birds adapted for flight?

What Is a Bird? (page 806)
1. Circle the letter of each characteristic of birds.
   a. feathers
   b. four legs
   c. wings
   d. scales
2. The single most important characteristic that separates birds from all other living animals is ________________.
3. List two functions of feathers.
   a. ____________________________________________
   b. ____________________________________________
4. Identify each type of feather diagrammed below.
   __________________________  __________________________

Evolution of Birds (page 807)
5. In what ways is the early bird *Archaeopteryx* different from modern birds?
   ____________________________________________
6. Is the following sentence true or false? Scientists know for certain that birds evolved directly from dinosaurs. ____________
Form, Function, and Flight (pages 808–812)

7. What adaptations do birds have that enable them to fly?

8. For what two things do birds require energy?
   a. 
   b. 

9. Is the following sentence true or false? Birds have a low metabolic rate compared to reptiles.

Match the type of bird bill with the type of food it is adapted to eat.

<table>
<thead>
<tr>
<th>Bird Bill</th>
<th>Food</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Short and fine</td>
<td>a. Flower nectar</td>
</tr>
<tr>
<td>11. Short and thick</td>
<td>b. Seeds</td>
</tr>
<tr>
<td>12. Strong and hooked</td>
<td>c. Insects</td>
</tr>
<tr>
<td>13. Long and thin</td>
<td>d. Animal prey</td>
</tr>
</tbody>
</table>

14. What is the main function of the crop?

15. Why might a bird swallow gravel or small stones?

16. What is an advantage of the one-way airflow through a bird’s lungs?

17. What type of circulatory system do birds have?

18. Circle the letter of the form of nitrogenous waste excreted by birds.
   a. ammonia
   b. urea
   c. uric acid
   d. nitrate
19. Circle the letter of each sentence that is true about response in birds.
   a. Birds have brains that quickly interpret and respond to signals.
   b. The cerebrum controls behaviors, such as nest building.
   c. The cerebellum in birds is much like that in reptiles.
   d. Birds can sense tastes and smells quite well.

20. What are two ways in which the skeleton of a flying bird is strengthened for flight?
   a. ________________________________
   b. ________________________________

21. How are the amniotic eggs of birds different from the eggs of reptiles? ____________

22. Is the following sentence true or false? Bird parents do not ever care for their offspring. ____________

Groups of Birds (pages 812–813)

Match the bird group with its characteristics. Use Figure 31–19 as a guide.

<table>
<thead>
<tr>
<th>Bird Groups</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>23. Birds of prey</td>
<td>a. Largest order of birds, which includes songbirds</td>
</tr>
<tr>
<td>24. Ostriches and their relatives</td>
<td>b. Fierce predators with hooked bills, large wingspans, and sharp talons</td>
</tr>
<tr>
<td>25. Parrots</td>
<td>c. Flightless birds that move by running</td>
</tr>
<tr>
<td>26. Perching birds</td>
<td>d. Adapted to wading in aquatic habitats</td>
</tr>
<tr>
<td>27. Herons and their relatives</td>
<td>e. Colorful, noisy birds that use their feet to hold up food</td>
</tr>
<tr>
<td>28. Cavity-nesting birds</td>
<td>f. Birds found in all types of aquatic ecosystems; have four toes connected by a web</td>
</tr>
<tr>
<td>29. Pelicans and their relatives</td>
<td>g. Multicolored birds that live in holes made in trees, mounds, or underground tunnels</td>
</tr>
</tbody>
</table>
30. Circle the letter of each way in which birds interact with natural ecosystems.
   a. pollinate flowers
   b. disperse seeds
   c. control insects
   d. produce toxic wastes

31. Is the following sentence true or false? Some species of migrating birds use stars and other celestial bodies as guides. ________________

32. Is the following sentence true or false? Birds are not affected by changes in the environment. ________________

**Reading Skill Practice**

By looking at illustrations in textbooks, you can help yourself remember better what you have read. Look carefully at Figure 31–14 on page 809 in your textbook. What important information does the illustration communicate? Do your work on a separate sheet of paper.
Chapter 32 Mammals

Section 32–1 Introduction to the Mammals
(pages 821–827)

Key Concepts

• What are the characteristics of mammals?
• When did mammals evolve?
• How do mammals maintain homeostasis?

Introduction (page 821)

1. List the two notable features of mammals.
   a. _____________________________
   b. _____________________________

2. Circle the letter of each characteristic of mammals.
   a. breathe air                   c. ectotherm
   b. three-chambered heart        d. endotherm

Evolution of Mammals (page 821)

3. What three characteristics help scientists identify mammalian fossils?
   a. _____________________________
   b. _____________________________
   c. _____________________________

4. The ancestors of mammals diverged from ancient ________________ during the
   Permian Period.

5. Circle the letter of each sentence that is true about the evolution of mammals.
   a. The first true mammals were as large as dinosaurs.
   b. During the Cretaceous Period, mammals were probably nocturnal.
   c. After dinosaurs disappeared, mammals increased in size and filled many
      new niches.
   d. The Permian Period is usually called the Age of Mammals.

Form and Function in Mammals (pages 822–827)

6. List two ways in which mammals conserve body heat.
   a. _____________________________
   b. _____________________________

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7. Is the following sentence true or false? Mammals have a low rate of metabolism.

8. Circle the letter of each way mammals are able to rid themselves of excess heat.
   a. fat   c. sweat glands
   b. hair   d. panting

9. The ability of mammals to regulate their body heat from within is an example of

10. Is the following sentence true or false? Animals that are omnivores consume only meat.

11. As mammals evolved, the form and function of their _______ and _______ became adapted to eat foods other than insects.

12. Complete the table about the different kinds of teeth found in mammals.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canines</td>
<td>Chisellike incisors used for cutting, gnawing, and grooming</td>
</tr>
<tr>
<td>Molars and premolars</td>
<td></td>
</tr>
</tbody>
</table>

13. In which type of animal would you expect to find sharp canine teeth?

14. How are herbivores’ molars adapted for their diet?

15. Is the following sentence true or false? Carnivores have a shorter intestine than herbivores.
16. Complete the flowchart to show how cows digest their food.

Newly swallowed food is stored and processed in the ______________________.

Symbiotic bacteria in the rumen digest the ______________________ of most plant tissues.

The cow ______________________ the food from the rumen into its mouth, and food is chewed and swallowed again.

The food is swallowed again and moves through the rest of the ______________________ and ______________________.

17. How does the diaphragm work to help move air into and out of the lungs?

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

18. Is the following sentence true or false? Mammals have a four-chambered heart that pumps blood into two separate circuits around the body. ________________

19. Where does the right side of the heart pump oxygen-poor blood? ____________________

20. After blood picks up oxygen in the lungs, where does it go? ____________________
21. How do mammalian kidneys help to maintain homeostasis? 

Match each part of the mammalian brain with its function.

<table>
<thead>
<tr>
<th>Part of the brain</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>22. medulla oblongata</td>
<td>a. Involved in thinking and learning</td>
</tr>
<tr>
<td>23. cerebral cortex</td>
<td>b. Controls muscular coordination</td>
</tr>
<tr>
<td>24. cerebrum</td>
<td>c. Regulates involuntary body functions</td>
</tr>
<tr>
<td>25. cerebellum</td>
<td>d. Part of the cerebrum that is the center of thinking and other complex behaviors</td>
</tr>
</tbody>
</table>

26. What are endocrine glands? 

27. What body system helps to protect mammals from disease? 

28. Is the following sentence true or false? Mammals have a rigid backbone, as well as rigid shoulder and pelvic girdles for extra stability. 

29. Mammals reproduce by fertilization. 

30. Is the following sentence true or false? All mammals are viviparous, or live-bearing. 

31. What do young mammals learn from their parents?