

SECTION 12-2

SECTION SUMMARY

Fishes

Guide for Reading

- ◆ How do fish use their gills?
- ◆ What are the three groups of fishes?

A fish is a vertebrate that lives in the water and has fins, which are structures used for moving. Most fishes are ectotherms, have scales, and obtain oxygen through their gills. Scales are overlapping plates made of a hard substance. Nearly half of all vertebrate species are fishes. They evolved more than 500 million years ago.

Fishes get their oxygen from water. Water flows into a fish's mouth and over its gills. Gills contain many blood vessels. **As water flows over the gills, oxygen moves from the water into the fish's blood, while carbon dioxide, a waste product, moves out of the blood and into the water.**

Like all vertebrates, fishes have a closed circulatory system in which blood flows through blood vessels to all regions of the body. Most fishes have external fertilization.

Biologists classify fishes into three major groups: jawless fishes, cartilaginous fishes, and bony fishes. They are distinguished from one another by the structure of their mouths and the types of skeletons they have.

Jawless fishes have skeletons composed of cartilage. They have no scales, paired fins, or jaws. They feed by scraping, stabbing, and sucking their prey.

Sharks and their flat relatives—the rays and skates—are cartilaginous fishes. Their skeletons are made of cartilage, but unlike jawless fishes, they have scales, paired fins, and jaws. Cartilaginous fishes are carnivores.

Bony fishes make up 95 percent of all fish species. Exploring a Bony Fish shows the major characteristics of this group. Bony fishes have skeletons made of hard bone. The other major characteristics of bony fishes are tail fins, gills, paired fins, scales, a lateral line and a **swim bladder**.

A swim bladder is an internal gas-filled sac that helps a fish stabilize its body at different depths. The volume of gases in the swim bladder affects the **buoyant force** on the fish. Buoyant force is the force that water exerts upward on any underwater object. By changing the volume of gas in its swim bladder, a bony fish adjusts its buoyancy and can float at different depths without using a large amount of energy.

Fishes are a valuable food resource for humans. Recently, overfishing has led to the decline of populations of some fishes. Some nations set limits on the amounts of certain fishes that can be caught. Also, some kinds of fishes are being raised in “fish farms.”

SECTION 12-2**REVIEW AND REINFORCE**

Fishes

◆ Understanding Main Ideas

Answer the following questions on a separate sheet of paper.

1. What function do gills perform?
2. How is the skeleton of a shark similar to the skeleton of a jawless fish?
3. What are the three main groups of fishes?
4. What kind of fertilization do most fish have?
5. What is the function of a swim bladder?
6. What is one way that people are trying to alleviate the problem of overfishing?

Determine whether each statement is true or false. If it is true, write true. If it is false, change the underlined word or words to make the statement true.

- _____ 7. Sharks are bony fishes.
- _____ 8. Most fishes are endotherms.
- _____ 9. Fishes spend most of their time hunting for food or feeding.
- _____ 10. Most species of fishes belong to the bony fishes group.

◆ Building Vocabulary

Fill in the blank to complete each statement.

11. Most bony fishes have a gas-filled organ called a(n) _____, which helps stabilize the fish at different levels in the water.
12. A balloonfish that swallows air will float because it weighs less than the _____ that water exerts upward against it.

SECTION 12-3

SECTION SUMMARY

Amphibians

Guide for Reading

- ◆ What is the life cycle of an amphibian like?
- ◆ How are amphibians adapted for movement on land?

An amphibian is an ectothermic vertebrate that spends its early life in water. **After beginning their lives in water, most amphibians spend their adulthood on land, returning to water to reproduce.** Amphibian eggs hatch into larvae that swim and have gills for obtaining oxygen. Most adult amphibians have lungs rather than gills.

The circulatory system of adult amphibians has two loops. In the first loop, blood flows from the heart to the lungs and skin. In this loop blood picks up oxygen. In the second loop, the oxygen-rich blood flows to the rest of the body, where it delivers oxygen to body cells.

The hearts of most amphibians have three inner spaces, or chambers. The two upper chambers of the heart, called **atria** (singular *atrium*), receive blood. From the atria, blood moves into the lower chamber, the **ventricle**, which pumps blood out to the lungs and body.

Most frogs and toads have external fertilization. A female frog releases eggs into the water. Then the male's sperm fertilize the eggs. Most salamanders have internal fertilization. The eggs are fertilized inside the female's body before they are laid. Amphibian eggs are coated with clear jelly that keeps moisture in and helps protect them from infection. Frog larvae are called tadpoles and look very different from the adults. In contrast, the larvae of salamanders resemble adults.

Most adult amphibians have strong skeletons and muscular limbs adapted for movement on land. Frogs and toads have powerful hind-leg muscles for jumping. Some frogs have webbed feet that help them move through the water. Others have toe pads with adhesive suckers that help them climb and leap among twigs. Most adult frogs and toads are predators that feed on insects or other small animals. The skin of a frog is smooth and moist, whereas that of a toad is drier and bumpy.

Salamanders do not hop or jump as frogs do. Instead, they walk or run, and they catch their prey by stalking or ambushing it. Salamanders keep their tails as adults. Their bodies are long and usually slender. Most salamanders return to water each year to breed and lay their eggs.

Amphibian populations are declining all over the world. One reason is the destruction of their habitats. A **habitat** is the specific environment in which an animal lives. Other environmental factors, such as polluted water, are probably involved too.

SECTION 12-3

REVIEW AND REINFORCE

Amphibians

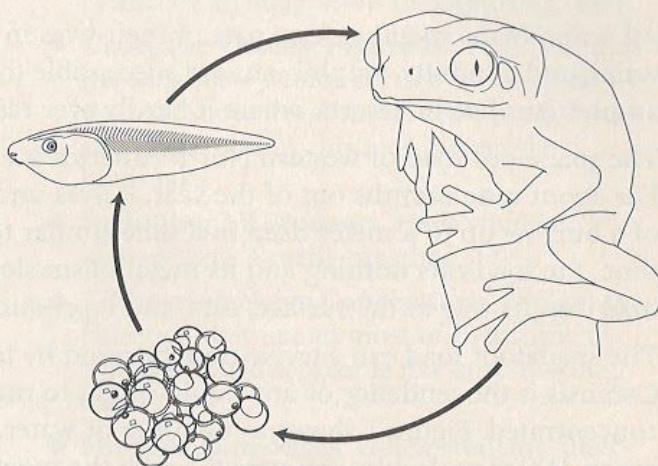
◆ Understanding Main Ideas

Mark the diagram as directed.

1. Correctly label each stage of an amphibian's life—eggs, larva, adult.
2. Draw an X on the stage during which the amphibian breathes with gills.
3. Draw a circle around the stage during which the amphibian breathes with lungs.

Answer the following questions on the back of this sheet or on a separate sheet of paper.

4. What are the two major groups of amphibians? Describe the characteristics of each group.
5. Identify two factors that are probably responsible for the decline in amphibian populations.
6. What are two adaptations amphibians have for moving on land?



◆ Building Vocabulary

Answer the following questions in the spaces provided.

7. What are the main characteristics of amphibians?

8. What is an animal's habitat?

9. In the amphibian heart, what part is the atrium and what is its function?

10. In the amphibian heart, what part is the ventricle and what is its function?

SECTION 12-4 **SECTION SUMMARY**

Reptiles

Guide for Reading

- ◆ What are some adaptations that allow reptiles to live on dry land?
- ◆ How is a reptile's egg different from an amphibian's egg?

A reptile is an ectothermic vertebrate that has lungs and scaly skin. Snakes, lizards, turtles, alligators, and crocodiles are all reptiles. Reptiles were the first vertebrates that were well adapted to live on land.

To live on land, an animal must be able to minimize water loss. **The eggs, skin, and kidneys of reptiles are adapted to conserve water.** Reptiles have dry, tough skin covered with scales that protects them and helps keep water in their bodies. The kidneys remove wastes from blood. The wastes are then excreted in a fluid called **urine**. Reptiles lose very little water in their urine.

The eggs of reptiles are fertilized internally. **Unlike an amphibian's egg, a reptile's egg has a shell and membranes that protect the developing embryo and keep it from drying out.** Most reptiles breathe entirely with lungs. Like adult amphibians, most reptiles have a three-chambered heart with two atria and one ventricle, and some mixing of oxygen-rich and oxygen-poor blood occurs.

Lizards usually are long and slender with long tails. Nearly all lizards are carnivores. Unlike snakes, lizards have external ears, movable eyelids, and most have four legs.

All snakes are carnivores. A snake's jawbones and skull bones can move to allow the snake to swallow an animal that is bigger around than it is. Some snakes kill their prey by injecting them with venom.

A turtle is a reptile whose body is covered by a protective shell. Some turtles can pull their legs and head into their shells for protection. While some turtles are carnivores, other turtles are herbivores. Turtles have sharp-edged beaks instead of teeth.

Alligators, crocodiles, and their relatives are the largest living reptiles. Alligators and crocodiles are carnivores that hunt mostly at night. Unlike most other reptiles, alligators and crocodiles care for their eggs and newly hatched young.

Reptiles, including dinosaurs, were the major form of vertebrate life on land from about 225 to 65 million years ago. Dinosaurs became extinct about 65 million years ago. Birds may be descended from dinosaurs.

SECTION 12-4 **REVIEW AND REINFORCE**

Reptiles

◆ Understanding Main Ideas

Write the letter of the word or phrase that completes each statement.

- Three adaptations that reptiles have for conserving water are _____, _____, and _____.
a. lungs
b. eyelids
c. eggs with shells
d. jaws
e. external ears
f. kidneys
g. yolk
h. thick skin
- The part of the egg that provides the reptile embryo with food is called the _____.
a. yolk
b. shell
c. membranes
d. scales
- Snakes have specialized _____ that enable them to eat large prey.
a. jaws
b. tongues
c. fangs
d. teeth
- All reptiles breathe with _____.
a. gills
b. lungs
c. skin
d. scales
- Snakes look a lot like lizards, but snakes don't have _____ or _____.
a. external ears
b. movable eyelids
c. four legs
d. sharp-edged beaks

◆ Building Vocabulary

Write a definition for each of the following terms.

- reptile

- urine

SECTION 13-1

SECTION SUMMARY

Birds

Guide for Reading

- ◆ What characteristics do birds have in common?
- ◆ How are birds adapted to their environments?

A bird is an endothermic vertebrate that has feathers and a four-chambered heart, and lays eggs. The bodies of birds are adapted for flight. For example, the bones of a bird's front limbs form wings. Many bones in the bird's body are hollow, which makes the skeleton light. Flying birds have large chest muscles. Finally, birds have feathers. Some modern birds cannot fly, but all modern birds evolved from ancestors that could fly.

All birds have feathers. A **contour feather** is a large feather that gives shape to a bird's body. The long contour feathers on the wings and tail are called flight feathers. When a bird flies, these feathers help it balance and steer. Birds also have short, fluffy **down feathers** specialized to trap air against the skin and keep the bird warm. Air is a good **insulator**—a material that does not conduct heat well and therefore helps prevent it from escaping.

Birds have no teeth. Instead, they have bills that are shaped according to the type of food they eat. For example, a finch has a short, thick bill that helps it crack open and eat seeds.

After a bird eats its food, digestion begins. Many birds have an internal storage tank, or **crop**, that allows them to store food inside the body after swallowing it. Birds also have a stomach where food is bathed in chemicals that help to break it down. This food then moves into a thick-walled, muscular part of the stomach, the **gizzard**, which squeezes and grinds the partially digested food.

Flying takes a lot of oxygen. Birds have a system of air sacs inside their bodies that connect to their lungs. Air sacs enable birds to get more oxygen from each breath than other animals can.

A bird's heart has four chambers—two atria and two ventricles. Because there is no mixing of oxygen-rich and oxygen-poor blood in a four-chambered heart, blood that arrives in the bird's tissues has plenty of oxygen.

Birds have internal fertilization and lay eggs. Bird eggs will develop only at a temperature close to the body temperature of the parent. Most parent birds care for their young at least until they are able to fly.

Birds are the most diverse land-dwelling vertebrates. **In addition to adaptations for flight, birds have adaptations—such as the shapes of their legs, claws, and beaks—for living in widely diverse environments.** Birds play important roles in the environment. They act as pollinators, seed dispersers, and predators.

SECTION 13-1

REVIEW AND REINFORCE

Birds

◆ Understanding Main Ideas

Answer the following questions in the spaces provided.

1. What are four characteristics that all birds share?

2. What are three adaptations that enable birds to fly?

3. What are two functions of feathers?

4. Briefly describe a bird's heart and circulatory system.

5. Give two examples that show how the bills of birds allow them to live in diverse environments.

◆ Building Vocabulary

From the list below, choose the term that best completes each sentence.

contour feather insulator crop
gizzard down feather

6. A bird's food is stored in its _____ before it is digested.
7. A _____ is soft and used for insulation.
8. Because air doesn't conduct heat well, it is a good _____.
9. The _____ is a muscular, thick-walled part of a bird's stomach where partially digested food is ground up.
10. A _____ gives shape to a bird's body and helps a bird balance and steer during flight.

SECTION 13-3

SECTION SUMMARY

What Is a Mammal?

Guide for Reading

- ◆ What characteristics do all mammals share?

Mammals are a diverse group of vertebrates that share many characteristics. **All mammals are endothermic vertebrates with a four-chambered heart, and skin covered with fur or hair. The young of most mammals are born alive, and every young mammal is fed with milk produced in its mother's body.** In addition, mammals have teeth of different shapes that are adapted to the type of food they eat.

The earliest mammals were small, mouse-sized animals that lived in habitats dominated by dinosaurs. Large mammals first evolved after the dinosaurs disappeared.

All mammals have fur or hair at some point in their lives. Thick fur provides lightweight insulation that prevents body heat from escaping. Mammals that live in cold climates usually have thicker fur than mammals that live in warm climates.

Most mammals have teeth of four different shapes to tear and chew their food. **Incisors** are flat-edged teeth used to bite off and cut parts of food. **Canines** are sharply pointed teeth that stab food and tear into it. **Premolars** and **molars** grind and shred food into tiny bits.

Mammals breathe with lungs. Mammals breathe in and out because of the combined action of rib muscles and a large muscle called the **diaphragm** located at the bottom of the chest. The lungs have a huge, moist surface area where oxygen can dissolve and then move into the bloodstream. Mammals have a four-chambered heart and a two-loop circulatory system like birds. One loop of the circulatory system carries blood from the heart to the lungs and back to the heart. The other loop carries blood to the rest of the body and back to the heart.

The brains of mammals enable them to learn, remember, and behave in complex ways. The senses of mammals are highly developed and adapted for the ways that individual species live. For example, many mammals that are active at night have eyes adapted for seeing in the dark. Most mammals also have highly developed senses of smell and hearing.

Mammals have internal fertilization. Some mammals lay eggs, but the young of most mammals develop inside their mothers' bodies. All mammals feed their young with milk produced in **mammary glands**. Young mammals usually stay with their mother or both parents for an extended time.

SECTION 13-3

REVIEW AND REINFORCE

What Is a Mammal?

◆ Understanding Main Ideas

Answer the following questions in the spaces provided.

1. What are four characteristics shared by all mammals?

2. If a mammal has a dense coat of fur, what might you infer about the climate where that mammal lives?

3. Where in a mammal's body does oxygen enter the bloodstream?

4. Briefly describe a mammal's heart and circulatory system.

5. What information can you infer from the size and shape of a mammal's teeth?

◆ Building Vocabulary

From the list below, choose the term that best completes each sentence.

canine molar premolar diaphragm
mammal incisor mammary gland

6. _____ teeth are used to stab and tear into food.

7. _____ teeth are used to bite off and cut parts of food.

8. _____ and _____ teeth are used to grind and shred food into tiny bits.

9. A large muscle called the _____ helps mammals breathe.

10. The _____ is a structure in which milk is produced for the young.

11. Every _____ has hair or fur, but sometimes not very much.

SECTION 14-1

SECTION SUMMARY

Why Do Animals Behave as They Do?

Guide for Reading

- ◆ What are the functions of most of an animal's behaviors?
- ◆ How does instinctive behavior compare with learned behavior?

An animal's **behavior** consists of all the actions it performs. Some behaviors are very complex. To understand an animal, you need to know about both its behaviors and its body structure.

Most behaviors help an animal survive or reproduce. For example, catching food is an important behavior for survival.

Behavior is a complicated process of response to a stimulus, a signal that causes an animal to react in some way. Some stimuli come from outside the animal's body, whereas other stimuli, like thirst, come from inside the animal's body. The animal's reaction to the stimulus is called a **response**.

Some animal behaviors must be learned, whereas others are inborn. Inborn behaviors are called **instincts**. Instincts are usually done correctly the first time.

Learning is the process that leads to changes in behavior based on practice or experience. **Unlike instincts, learned behaviors result from an animal's experience and are not usually done perfectly the first time.**

Learned behaviors depend in part on inherited traits. For example, a lion cub is born with an instinct to catch moving objects, but it learns how to do it well by imitating its mother and by practicing.

Animals learn new behaviors in different ways. These include **conditioning, trial-and-error learning, and insight learning**.

Learning to connect some sort of stimulus with a good or bad event is called **conditioning**. Conditioning is often used to train animals. **Trial-and-error learning** occurs when an animal, through repeated practice, learns to perform a behavior more and more skillfully. **Insight learning** occurs when an animal solves a problem or learns how to do something new by applying what it already knows.

Some computers can learn and solve problems. **Artificial intelligence** is the capacity of a computer to perform tasks beyond its programming.

Imprinting is a behavior in a newborn animal in which it learns to recognize and follow the first moving object it sees (usually its mother).

SECTION 14-1

REVIEW AND REINFORCE

Why Do Animals Behave as They Do?

◆ Understanding Main Ideas

Answer the following question.

1. What are two important functions of behavior?

Label the following behaviors L for "learned" or I for "instinctive."

2. _____ A dog sits when you command him to "sit."
3. _____ A spider spins a web.

In the table below, fill in the blanks in the left-hand column with one of the three types of learning. Fill in the blanks in the right-hand column with an example of the type of learning named on the left.

Type of Learning	Example
4. _____	5. _____ A bird stops eating orange butterflies because they taste bad.
Trial and error	6. _____
8. _____	7. _____ You stand on a chair to reach a jar of cookies.

◆ Building Vocabulary

Match each term with its definition by writing the letter of the correct definition on the line beside the term.

- | | |
|-----------------------------------|--|
| _____ 9. stimulus | a. A reaction to a stimulus |
| _____ 10. response | b. All the actions that an animal performs |
| _____ 11. imprinting | c. Allows computers to perform tasks beyond their programming |
| _____ 12. learning | d. The process that leads to changes in behavior, based on practice or experience |
| _____ 13. behavior | e. A signal that causes an organism to react |
| _____ 14. instinct | f. Inborn behavior |
| _____ 15. artificial intelligence | g. When a baby animal learns to recognize and follow the first moving object it sees |

SECTION 14-2

SECTION SUMMARY

Patterns of Behavior

Guide for Reading

- ◆ What is the function of courtship behavior?
- ◆ How do animals benefit from living in groups?
- ◆ How is migration important for an animal's survival?

Scientists classify patterns of behavior into different types. Aggression is a threatening pattern of behavior that one animal uses to gain control over another. Animals may be aggressive when they compete for limited resources such as food, water, space, shelter, or mates. Another reason animals may be aggressive is to protect their **territory**, an area that is occupied and defended by an animal or group of animals.

Courtship behavior is behavior in which males and females of the same species prepare for mating. **Courtship behavior ensures that the males and females of the same species recognize one another, so that mating can take place.**

Some animals live alone, whereas others live in groups. **Living in a group usually helps animals survive—group members protect each other and work together to find food.** A **society** is a group of closely related animals of the same species that work together for the benefit of the whole group.

Although animals don't use language, they do communicate. They use sounds, body positions, movements, and scents to communicate information. Communication is used for courtship, defense, aggression, and finding food.

Some animal behavior occurs in predictable patterns. For example, some animals are active at night, whereas others are active during the day. Daily behavior cycles are examples of **circadian rhythms**. Other behavior cycles are related to seasons. **Hibernation** is a state of greatly reduced body activity that occurs during the winter.

Migration is a periodic journey of an animal from one place to another and back again. Migration is usually related to the change of seasons. **Animals usually migrate to an area that provides abundant food, a favorable environment for reproduction, or both.** Sometimes, human activity interferes with animal migration. For example, dams interfere with the migration of salmon, and city lights can confuse migrating birds at night.

SECTION 14-2

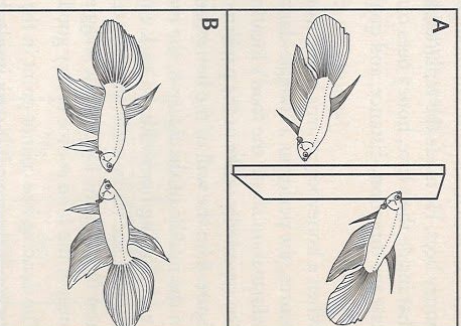
REVIEW AND REINFORCE

Patterns of Behavior

◆ Understanding Main Ideas

Answer the following questions on a separate sheet of paper.

1. What are two things animals might compete for?
 2. What are two ways that animals communicate?
 3. What are two reasons that some animals migrate?
 4. What two behaviors allow an animal to secure a territory?
 5. What is one function of courtship behavior?
 6. What are two benefits to animals of living in groups?
- Diagram A shows two male Siamese fighting fish separated by a board. In diagram B the board has been removed. On a separate sheet of paper, write a paragraph to answer the following questions about the behavior of the fish in diagram B.
7. How are the fish communicating? What might the fish be communicating?



◆ Building Vocabulary

Fill in the blank to complete each sentence.

8. The periodic journey by animals from one place to another and then back again is called _____.
9. A period of inactivity during the winter is _____.
10. A group of animals that work together for the benefit of the whole group is called a(n) _____.
11. Behavior cycles that occur over a period of about one day are called _____.
12. A dog will show _____ by barking and growling at other dogs that approach its territory.

