

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- How are vertebrates different from invertebrates?
- How do vertebrate organ systems work?
- How do vertebrate embryos develop?



California Science Standards

7.1.f, 7.2.a, 7.5.a, 7.5.b, 7.5.c, 7.5.g

What Are the Characteristics of Vertebrates?

All vertebrates have a structure called a backbone. The backbone is part of a skeleton that is made of bone. Bone is a type of very hard tissue found only in vertebrates.

All vertebrates also have a head protected by a skull. The skull is made of either cartilage or bone. **Cartilage** is a flexible material made of cells and proteins. All vertebrate embryos have skeletons made of cartilage. However, as most vertebrates grow, bone replaces the cartilage. ✓



Summarize As you read, make an outline of the characteristics of vertebrates.



1. List Name two characteristics of vertebrates.

BODY COVERINGS

The bodies of vertebrates are covered with skin. Skin protects the body from the environment. The structure of skin is different in different vertebrates.

Body Coverings in Vertebrates



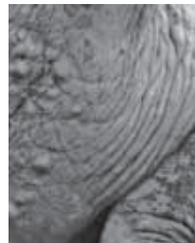
Scales
Reptiles and fish are covered with thin, small plates called scales.



Feathers
Feathers on birds, like hairs on mammals, help keep the body temperature stable.



Fur Some body coverings have colors and patterns that help vertebrates hide from prey or predators.



Skin Skin protects the body from the environment.

TAKE A LOOK

2. List Name three different types of body coverings that protect vertebrate bodies.

SECTION 4 Vertebrates *continued*

BODY SYMMETRY

All vertebrates have bilateral symmetry. A bilaterally symmetrical body has four main parts. (Though we are vertebrates, it helps to think of bilateral symmetry in an animal that walks on four legs.) The upper surface, or back, is the *dorsal* side. The lower surface, or belly, is the *ventral* side. The head is in the front of the body, or *anterior*. The tail is in the back of the body, or *posterior*.

CALIFORNIA STANDARDS CHECK

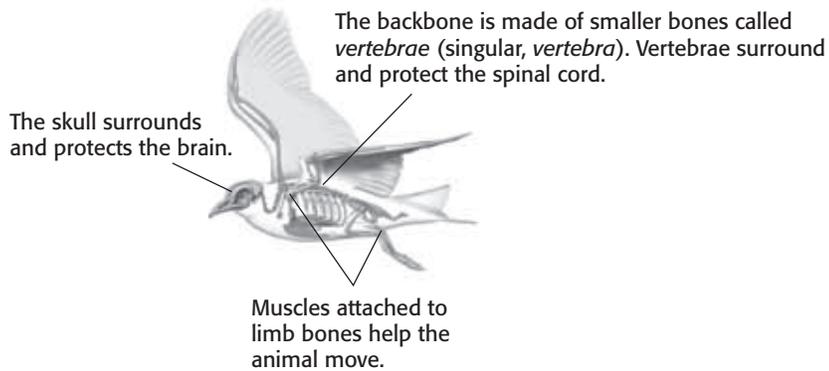
7.5.c Students know how bones and muscles work together to provide a structural framework for movement.

Word Help: framework
a basic structure that supports something

3. Explain How do bones and muscles work together to help vertebrates move?

SUPPORT OF THE BODY

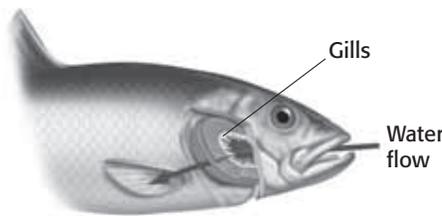
The body of a vertebrate is supported by an endoskeleton. An endoskeleton has three main parts: a skull, a backbone, and limb bones. Vertebrates need large bones and muscles for support and movement if they don't live in the water.



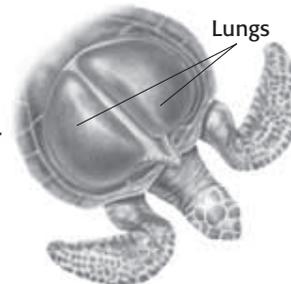
RESPIRATORY SYSTEM

The respiratory system in vertebrates brings oxygen into the body and takes carbon dioxide out. The main respiratory organs in vertebrates are either lungs or gills. ✓

Vertebrates that breathe air, rather than water, have their respiratory organs inside the body. This protects them from drying out.



In fish, water flows into the mouth and over the gills. Oxygen from the water moves across the gills and into the blood. Carbon dioxide moves from the blood, across the gills, and into the water.



The inside surfaces of lungs have many small pockets. These pockets make more surface area for the exchange of oxygen and carbon dioxide.

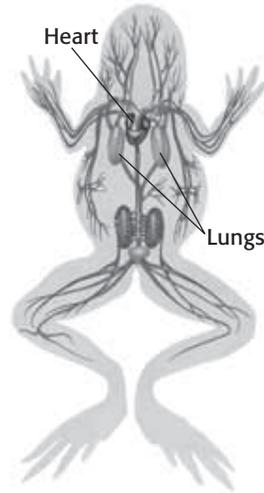
READING CHECK

4. Identify What are the two main respiratory organs in vertebrates?

SECTION 4 Vertebrates *continued*

CIRCULATORY SYSTEM

The circulatory system moves nutrients and other substances around the body. Vertebrates have closed circulatory systems made up of blood, blood vessels, and a heart. Arteries are vessels that carry blood away from the heart. Veins are vessels that carry blood to the heart. Tiny vessels called capillaries connect veins and arteries. ✓

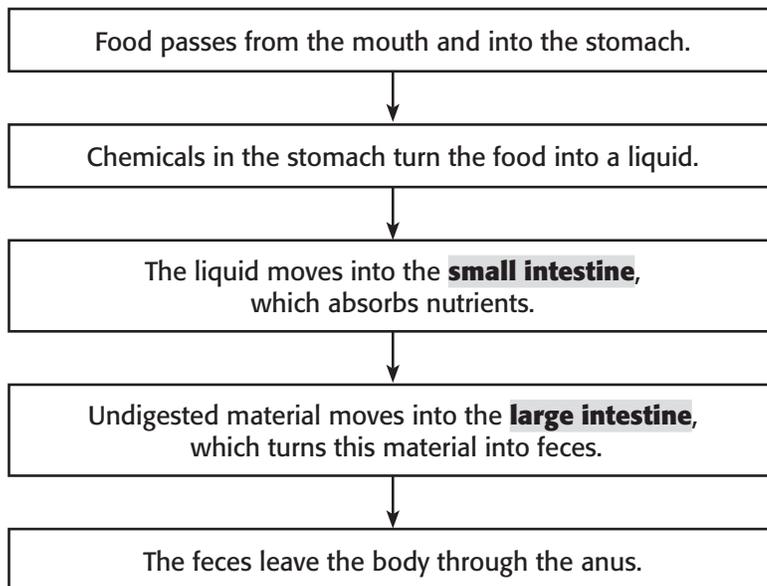


READING CHECK

5. Identify What kind of circulatory system do vertebrates have?

DIGESTIVE SYSTEM

Vertebrates have digestive systems to break down food and absorb nutrients. The digestive system is made up of a long tube called the *digestive tract*. Food moves through the digestive tract from the mouth to the anus. ✓



READING CHECK

6. Identify What is the beginning and what is the end of the vertebrate digestive tract?

SECTION 4 Vertebrates *continued*

EXCRETORY SYSTEM

The digestive system produces waste from the food that animals eat. However, cells also produce waste. In vertebrates, these wastes are removed by the *excretory system*. One of these wastes is ammonia. In mammals, the liver turns ammonia into urea. Then, the kidneys filter the urea from the blood. Urea combines with water to form urine.

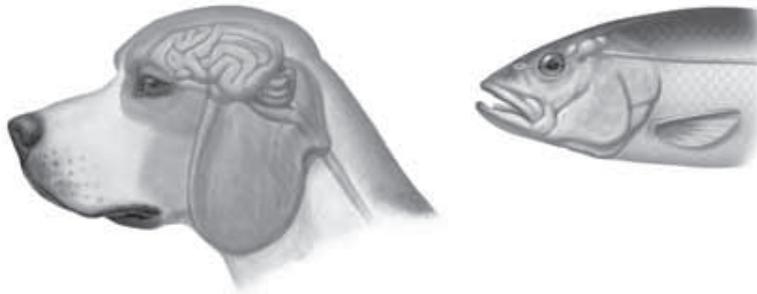
NERVOUS SYSTEM

The nervous system allows vertebrates to sense and respond to the environment. The brain is part of the spinal cord. The brain acts as the body’s control center.

Nerves from the spinal cord branch throughout the body. Nerves carry impulses, or signals, between the brain and the rest of the body. For example, when a sound reaches a dog’s ear, the ear sends a signal through *sensory nerves* to the brain. Then, the brain sends signals to the body through *motor nerves*, which cause the body to react. Some nerves connect to the body’s muscles. Signals sent to these muscles cause them to contract.

Brain size is very different in different kinds of vertebrates. Although all vertebrates use instinct to react, those with larger brains depend more on learning. An *instinct* is a behavior or reaction that an animal is born with. *Learning* is a behavior in which new experiences change the way an animal reacts.

Nervous Systems in Vertebrates



REPRODUCTION

Most vertebrates reproduce sexually. Fertilization happens when the nucleus of a sperm cell joins with the nucleus of an egg cell. A fertilized egg cell divides many times. It becomes a multicellular embryo. As an embryo develops, its cells differentiate. That is, the cells develop different structures so that they can perform different functions.



Say It

Discuss Work with a partner to discuss how the five senses—touch, taste, sight, hearing, and smell—are all important to animal survival. Prepare a short presentation to tell your classmates how an animal uses each sense.

TAKE A LOOK

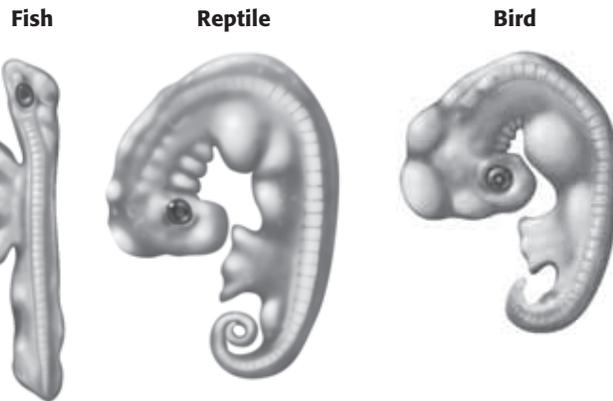
7. Explain Which of these animals probably relies more on learning than instinct? Explain your answer.

SECTION 4 Vertebrates *continued*

DEVELOPMENT

Most fish and amphibians have a larval stage in their life cycles. A *larva* (plural, *larvae*) is a newly hatched animal that must go through metamorphosis to become an adult. The larvae of fish and amphibians usually hatch in the water and live on their own. Over time, larvae develop new structures or lose old structures to become adults.

Reptiles, birds, and mammals do not have a larval stage in their life cycles. These animals make eggs that are protected by special membranes. The eggs of reptiles, birds, and some mammals also have a shell. Shelled eggs are laid on land. However, most mammals do not lay eggs. Their embryos develop inside the female until the offspring are born.



Embryos of different species look similar at early stages of development. Embryos begin to look more like their own species as they develop.

PARENTAL CARE

Human babies need a great deal of care from their parents for many years. However, not all vertebrates need as much parental care. Many fish, for example, simply lay their eggs and leave. These animals lay so many eggs that at least a few survive. Some fish and reptiles guard a nest until the young hatch. Usually, once they hatch, the young are on their own.

Birds and mammals generally show more parental care than other vertebrates. They have fewer offspring but spend more time feeding and protecting them. More parental care gives each offspring a better chance of survival.

READING CHECK

8. Identify How do most vertebrates reproduce?

Critical Thinking

9. Infer Why are birds more likely to care for their young than frogs are?

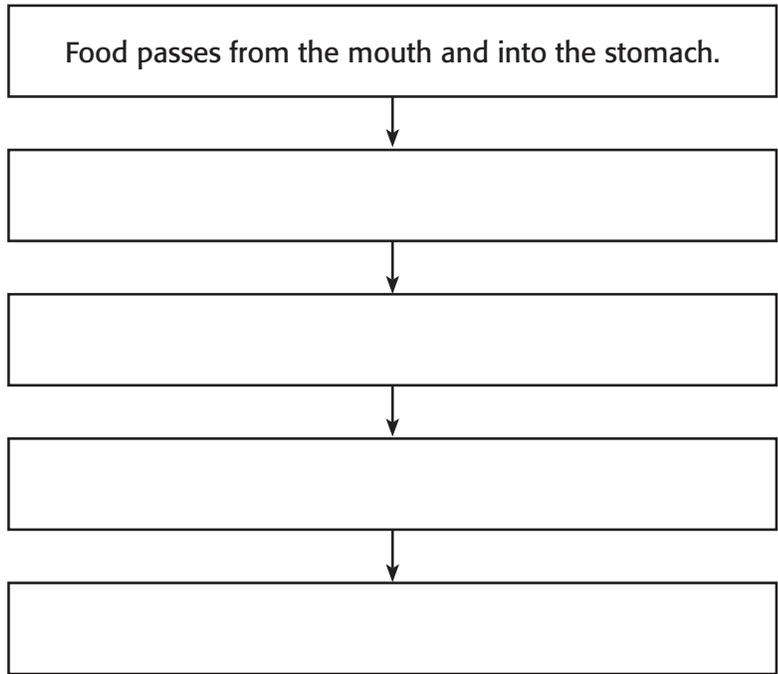
Section 4 Review

7.1.f, 7.2.a, 7.5.a, 7.5.b, 7.5.c, 7.5.g 

SECTION VOCABULARY

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|---|--|
| <p>cartilage a flexible and strong connective tissue</p> <p>large intestine the wider and shorter portion of the intestine that removes water from mostly digested food and that turns the waste into semisolid feces, or stool</p> | <p>small intestine the organ between the stomach and the large intestine where most of the breakdown of food happens and most of the nutrients from food are absorbed</p> |
|---|--|

1. **Summarize** Complete the Flow Chart to show how food passes through the digestive system.



2. **List** What are the three main parts of an endoskeleton?

3. **Explain** Why do cells in a developing embryo differentiate?

4. **Compare** How does parental care differ in fish and mammals?
