

You may choose to use models, charts, or videos as an alternative to an actual frog dissection. Refer to the section on Handling Ethical Issues in the front matter of this book.

## The Frog

You may want to refer students to pages 695–701 in the textbook for a discussion of frogs.

Time required: Part A—20 minutes  
Part B—20 minutes  
Part C—60 minutes

### Pre-Lab Discussion

Frogs belong to the class Amphibia. Amphibians have adaptations for living in terrestrial as well as aquatic environments. Frogs are among the most commonly studied organisms in biology. Although many differences exist between humans and frogs, the basic body plans are similar. Humans and frogs both belong to the phylum Chordata. By studying the anatomy of the frog, you will be better able to understand your own body.

In this investigation, you will observe the behavior of a live frog. You will examine the external features of a frog and identify parts of its external anatomy. In addition, you will dissect a preserved frog to observe its internal anatomy.

### Problem

How is a frog structured for survival?

### Materials (per group)

Live frog	Only a few live frogs are needed to do Part A. Students can work in groups to make their observations. Keep live frogs in an aquarium with some dry surfaces exposed.
Large glass jar	
Aquarium with water	
Preserved frog	Preserved frogs are available from a biological supply house. The same frog is to be used for Parts B and C of this investigation. Have students store their frogs in tightly sealed plastic bags labeled with their names.
Dissecting tray	
Scissors	
Probe	
Forceps	
Hand lens	
Plastic bag	
Scalpel	
Dissecting pins	
Dissecting needle	
Paper towels	
Medicine dropper	
Clock with second hand	

### Safety

Put on a laboratory apron if one is available. Handle all glassware carefully. Be careful when handling sharp instruments. Always use special caution when working with laboratory chemicals, as they may irritate the skin or cause staining of the skin or clothing. Never touch or taste any chemical unless instructed to do so. Follow your teacher's directions and all appropriate safety procedures when handling animals. Note all safety alert symbols next to the steps in the Procedure and review the meanings of each symbol by referring to the symbol guide on page 10.

## Procedure

### Part A. Observing a Live Frog

1. Line a large glass jar with moist paper towels. Place a live frog in the jar. Cover the jar so that the frog will not escape. **Note:** *Do not let the paper towels become dry. Sprinkle water on the towels if they begin to dry out.* The glass jar should be large enough to allow for some movement of the frog.
2. Observe the frog without disturbing it. Answer question 1 in Observations.
3. Closely observe the movement of the throat and nostrils as the frog breathes. Also observe the sides of the body. Answer questions 2 and 3 in Observations.
4. With your fingers, gently prod the frog and observe how it jumps. Observe the function of the front and back legs as the frog jumps and lands. Answer questions 4 and 5 in Observations.
5. Moisten your hands with water. Carefully pick up the frog and place it in an aquarium partially filled with room-temperature water. Observe how the frog swims and floats. Answer questions 6 through 10 in Observations.
6. Return the live frog to your teacher when you have completed your observations.

### Part B. External Anatomy of the Frog

1. Obtain a preserved frog. Rinse the frog with water to remove excess preservative. **CAUTION:** *The preservative used on the frog can irritate your skin. Avoid touching your eyes while working with the frog.* Dry the frog with paper towels and place it in a dissecting tray.
2. Identify the dorsal and ventral surfaces and the anterior and posterior ends of the frog. Answer question 11 in Observations.
3. Locate the forelegs and the hindlegs. Each foreleg, or arm, is divided into four regions: upper arm, forearm, wrist, and hand. Each hindleg also has four regions: thigh, lower leg, ankle, and foot. Identify the parts of the forelegs and hindlegs. Examine the hands and feet of the frog. If the hands have enlarged thumbs, the frog is a male. Answer questions 12 through 14 in Observations.
4. Locate the two large, protruding eyes. Lift the outer eyelid using a probe. Beneath the outer lid is an inner lid called the nictitating membrane. Answer question 15 in Observations.
5. Posterior to each eye is a circular region of tightly stretched skin. This region is the tympanic membrane, or eardrum. Locate the tympanic membranes on both sides of the head.
6. Anterior to the eyes, locate two openings called the external nares (singular, naris), or nostrils.
7. In the appropriate place in Observations, label the following external areas and structures of a frog: anterior, posterior, dorsal, ventral, forelimb, hand, hindlimb, foot, tympanic membrane, external nares, eye, nictitating membrane, and mouth.
8. Hold the frog firmly in the dissecting tray. Using scissors, make a small cut at each of the hinged points of the jaw, as shown in Figure 1. **CAUTION:** *To avoid injury, cut in a direction away from your hands and body.* Open the mouth as much as possible. Under running water rinse away any excess preservative.

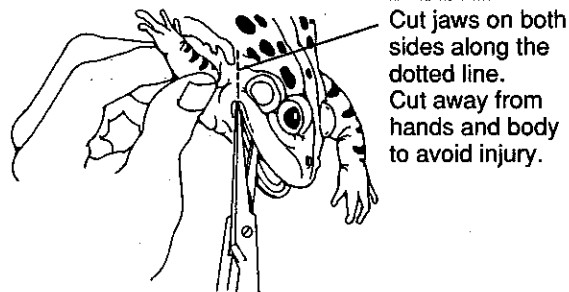
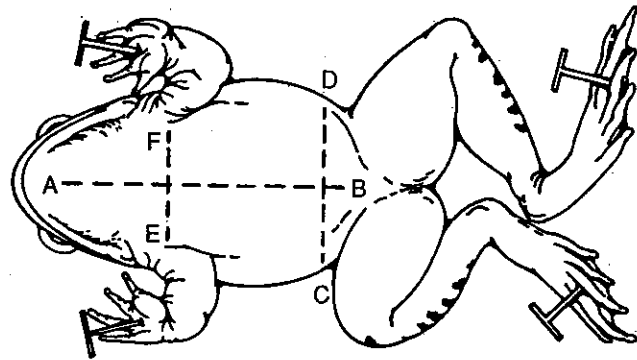


Figure 1

9. The tongue is the most noticeable structure in the mouth. Observe where the tongue is attached and note the two projections at the free end. Answer question 16 in Observations.
10. At the back of the mouth, locate the large horizontal opening, the gullet opening. In front of the gullet opening, find a vertical slit, the glottis.
11. Look for two openings on the back sides of the floor of the mouth. These are the openings to the vocal sacs. They are present in male frogs but not in female frogs.
12. Examine the roof of the mouth. Near the front center of the roof of the mouth are two small bumps. These bumps are the vomerine teeth. On either side of the vomerine teeth are the openings of the internal nares. Behind the vomerine teeth, observe two large bulges. These bulges are the eye sockets. Run your fingers along the top jaw. The teeth you feel are the maxillary teeth. The openings of the Eustachian tubes are on either side near the back of the mouth. Insert a probe into an opening of one Eustachian tube. Note where the probe stops.
13. In the appropriate place in Observations, label the following parts of a frog's mouth: vomerine teeth, internal nares, maxillary teeth, eye sockets, openings to Eustachian tubes, tongue, gullet opening, glottis, and openings to vocal sacs.

**Part C. Internal Anatomy of the Frog** You may want to dissect a frog and display it for students to refer to throughout the dissection.

1. Place your preserved frog in a dissecting tray with the ventral surface up. With dissecting pins, securely pin the frog's feet and hands to the bottom of the dissecting tray as shown in Figure 2. Angle the pins away from the body of the frog so that they will not interfere with your dissection.



**Figure 2**

2. With forceps, lift the loose skin of the abdomen. Carefully insert the tip of a pair of scissors beneath the skin. **CAUTION: To avoid cutting yourself, cut in a direction away from your hands and body.** Cut the skin along line *AB* as shown in Figure 2. Using forceps and scissors, continue cutting the skin along lines *CD* and *EF*.
3. With your fingers, carefully separate the skin from the underlying muscles. Open the flaps of skin as far back as possible and pin them to the bottom of the dissecting tray. Angle the pins away from the body of the frog so that they will not interfere with your dissection. Notice the blood vessels branching throughout the inner lining of the skin. Observe the abdominal and pectoral muscles. Note the direction of the muscle fibers.

4. Carefully lift the abdominal muscles with the forceps. Cut a second *AB* incision. **Note:** *Keep the cut through the muscles shallow so as not to damage underlying organs.* As the incision is made in the chest, or pectoral area, you will need to cut through bone. This bone is part of the pectoral girdle. **Note:** *Use extra force with the scissors when cutting through the bone. Be careful not to damage any of the internal organs below the bone.* Make cuts *CD* and *EF* through the abdominal muscle.
5. Remove the pins holding the skin in place. Stretch the abdominal opening as much as possible. At this time the hands and feet of the frog may need to be repinned.
6. Study the positions of the exposed organs. Notice that most of the organs are held in place by thin, transparent tissues called mesenteries.
7. If the frog is a mature female, the most obvious organs will be the ovaries. The ovaries are white sacs swollen with tiny black-and-white eggs. Carefully lift the ovaries from the body cavity, cut the attachments with scissors, and remove the ovaries from the frog. **Note:** *Be careful not to rupture the ovaries with the scissors. If the ovaries are ruptured, they can spill out a mess of eggs.*
8. The large reddish-brown organ in the upper part of the abdominal cavity is the liver. Answer question 17 in Observations.
9. With your fingers or a probe, lift and separate the lobes of the liver upward. Behind the middle lobe, look for a greenish, finger-shaped gland. This gland is the gallbladder. You may be able to locate the bile duct leading from the liver to the gallbladder.
10. With scissors, carefully remove the liver and gallbladder from the body. The remaining organs of the digestive system are easier to see with the liver removed.

#### DIGESTIVE SYSTEM

11. Locate the esophagus, which is a white tube leading from the mouth and connecting to the upper part of the white, muscular stomach. Notice the shape of the stomach. Look for a constriction at the lowest part of the stomach. This constriction is the pylorus. The pylorus leads into the long, coiled small intestine. Pull the loops of small intestine away from the body. Notice the mesentery that holds the intestines in place. Inside the first loop of the small intestine near the stomach, locate a thin, white organ called the pancreas. Also in the intestinal mesentery, locate a brown bean-shaped organ called the spleen. **Note:** *The spleen is an organ of the circulatory system.* Answer questions 18 and 19 in Observations.
12. The small intestine ends in a large bag-shaped organ, the large intestine. The last organ of the digestive system is the cloaca, a saclike organ at the end of the large intestine. Undigested food leaves the frog's body through an opening called the anus.
13. With scissors, cut the esophagus near the stomach. Cut through the large intestine just above the cloaca. With your fingers, carefully remove the digestive system from the body.
14. Stretch out the digestive system on the dissecting tray. With scissors, cut open the stomach along its outside curve. Open the stomach and examine its structure and contents. Answer questions 20 through 22 in Observations.
15. Dispose of the digestive system, liver, and ovaries according to your teacher's instructions.
16. In the appropriate place in Observations, label the following parts of the frog's digestive system and related organs: esophagus, stomach, pylorus, small intestine, large intestine, cloaca, liver, gallbladder, pancreas, mesentery, anus, and spleen.

**UROGENITAL SYSTEM**

17. The reproductive system and urinary system of the frog are closely connected and can be studied as the combined urogenital system. The two kidneys are reddish-brown organs located on the dorsal posterior wall of the abdominal cavity. The kidneys lie on either side of the backbone. **Note:** *The kidneys may be covered with a thin membrane. If so, carefully tear open the membrane with the point of a dissecting needle.* The yellow, fingerlike lobes attached to the kidneys are fat bodies. A small, twisted tube called the ureter leads from each kidney into the saclike urinary bladder. The bladder is connected to the cloaca.
18. Locate the reproductive organs of the frog. If your frog is a male, it possesses testes, tiny white or yellow oval organs found on the ventral surface of the kidneys.
19. If your frog is female, it possessed egg-filled ovaries that were removed in step 7. If your frog is an immature female, the pale oval ovaries are located ventral to the kidneys. Leading from each ovary is a long, coiled tube called the oviduct. The oviduct extends along the side of the body cavity. The oviduct eventually joins the cloaca.
20. In the appropriate place in Observations, label the following parts of the male and female urogenital systems: kidney, fat body, ureter, urinary bladder, cloaca, testes, ovary filled with eggs, and oviduct.

**RESPIRATORY SYSTEM**

21. Locate the two lungs. They are small, spongy brown sacs that lie to the right and left of the heart. Look for the bronchial tubes that extend from the anterior part of the lungs and join with the trachea, or windpipe.
22. Insert a dropper into the glottis of the frog. Pump air into the lungs and observe what happens. Answer question 23 in Observations.
23. With scissors and forceps, carefully remove the lungs from the frog's body. Dispose of the lungs according to your teacher's instructions.

**CIRCULATORY SYSTEM**

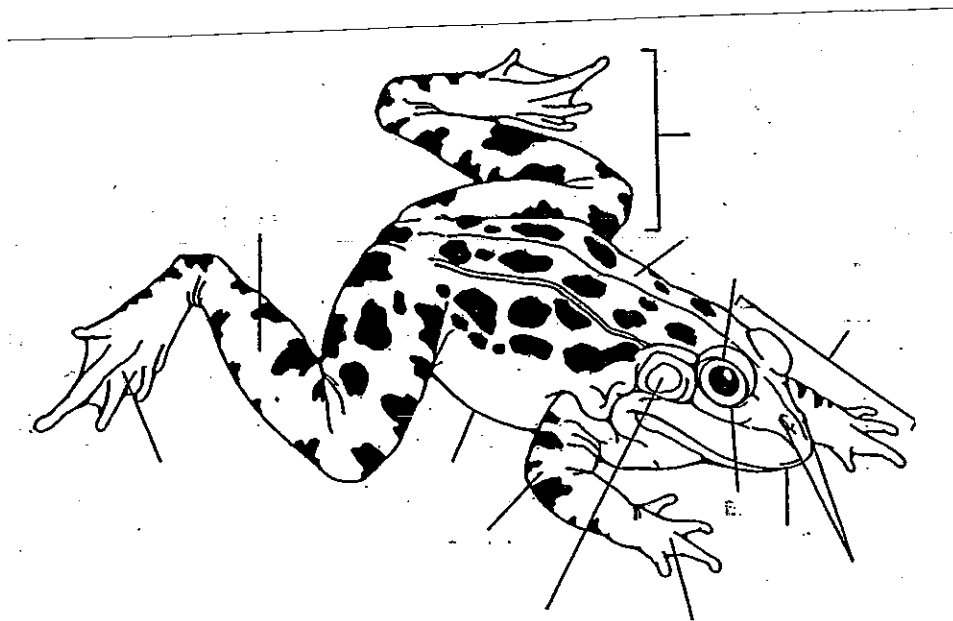
24. Locate the heart. The heart is encased in a membranous sac called the pericardium. With the tip of the scissors, carefully cut open the pericardium.
25. Note the vessels attached to the heart. The large artery on the ventral surface of the heart is the coronary artery. **Note:** *If the frog has been injected with red and blue latex paint, the veins and arteries will be obvious.*
26. Carefully cut the blood vessels leading to and from the heart. Remove the heart from the frog. Place the heart in the dissecting tray with the dorsal surface facing up. Identify the right and left atria and the ventricle. Touch and compare the walls of the two atria and the ventricle. Answer question 24 in Observations.
27. Observe the dorsal surface of the heart. Locate the thin-walled triangular sac called the sinus venosus. Locate the two veins leading from the top and the one vein leading from the bottom of the sinus venosus.
28. With a scalpel, cut the heart into anterior and posterior halves. Note the thickness of the walls and the types of heart chambers. **CAUTION:** *Be careful when using a scalpel. Always cut in a direction away from your hands and body.*
29. In the appropriate place in Observations, label the following structures of the frog's heart: right atrium, left atrium, ventricle, coronary artery, and sinus venosus.

## Muscular System

30. Remove the pins from the frog's feet and hands.
31. Cut the skin completely around the upper thigh of one leg, as if cutting off the leg of a pair of pants. With forceps, carefully pull the skin downward to the foot. Expose the thigh muscles, the knee, and the calf muscles.
32. Move the lower leg up and down to simulate the leg movement during a jump. Observe the various leg muscles involved in the leg movement. Answer question 25 in Observations.
33. Follow teacher's instructions for storing the frog for further use or properly disposing of the frog and its parts. Thoroughly wash, dry, and put away your dissecting tray and tools. Wash your hands with soap and water.

## Frog Lab Observations

*Record your information on a separate sheet of paper and incorporate it into your lab report.*



1. Describe how the eyes of a frog close.
2. a. How many times do the nostrils open and close in one minute?  
b. How many times does the throat move up and down in one minute?
3. Describe the movements of the sides of the frog's body during breathing.
4. Describe how a frog jumps.
5. a. Are the hind legs or forelegs more important in jumping?  
b. Are the hind legs or forelegs more important in landing?
6. Is the skin of the frog smooth or rough? Moist or dry?
7. When is the frog difficult to hold?
8. Describe the position of a frog when it floats.
9. What parts of the body remain above the surface when the frog floats?
10. How does the frog use its legs while swimming?
11. Describe the color of the dorsal and ventral surfaces of the frog.
12. How many digits are on each of the frog's hands?
13. How many digits are on each of the frog's feet?
14. Is your frog male or female? How can you tell?

15. Where is the nictitating membrane attached?
16. Where is the tongue attached to the mouth?
17. How many lobes does the liver contain?
18. What is the shape of the stomach?
19. Describe the mesentery that holds the intestines.
20. Describe the general shape, or plan, of the frog's digestive system.
21. Describe the inside wall of the stomach.
22. Describe the contents of the frog's stomach.
23. What happens when air is pumped into the lungs with the eyedropper?
24. Compare the walls of the two atria and the ventricle.
25. Describe the movement of the leg muscles as the leg is bent and straightened.

### Analysis and Conclusions

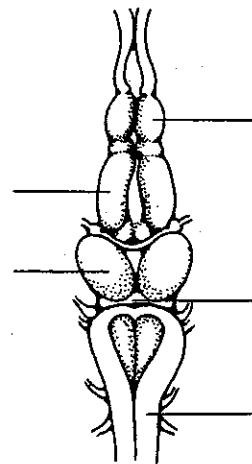
1. How does the number of times the nostrils open and close in one minute compare with the number of times the throat moves up and down in one minute?
2. How are the feet of a frog adapted for swimming?
3. How is the coloration of the frog an adaptation to its habitat?
4. How is the location of the nares an adaptation to living in water?
5. The tip of the tongue in a live frog is sticky. What would be the advantage of this?
6. How does the length of the small intestine relate to its function in absorbing digested food?
7. Explain why in a frog's heart the ventricle has a thicker wall than the atrium.

### Critical Thinking

1. Frogs are insect eaters. How is the frog's tongue designed for the type of food it eats?
2. List three adaptations that permit the frog to live on land successfully.
3. List three adaptations that permit the frog to live in water successfully.
4. The frog's sense organs are located on top of the head. How does this help the frog when it is in the water?

### Going Further

Carefully remove the brain and spinal cord of your preserved frog. To do this, remove the skin from the dorsal surface of the frog. Using a probe and a dissecting needle, carefully chip away the bone of the cranial cavity and the vertebral column. **Note:** *To remove the brain and spinal cord in one piece, work slowly and carefully.* Using reference materials, identify the parts of the brain. Sketch and label the parts of the brain.

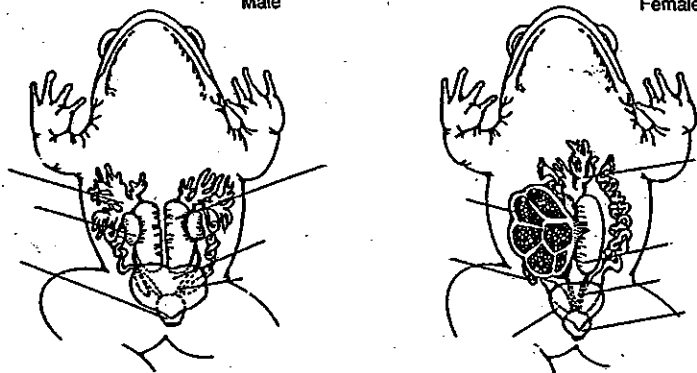


Frog Brain

Urogenital System of the Frog

Male

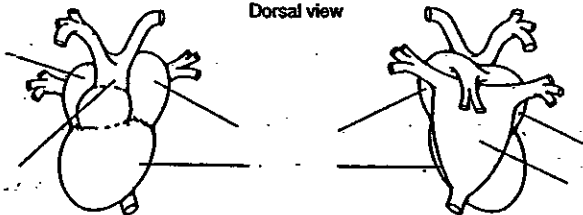
Female



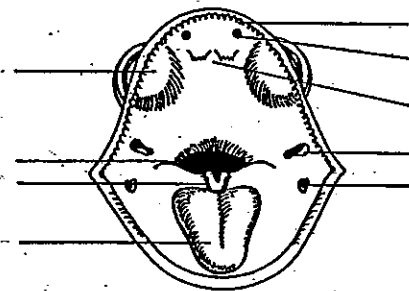
The Frog Heart

Ventral view

Dorsal view



Mouthparts of the Frog



Digestive System and Other Parts of the Frog

