Dissection: The Frog

Objectives

- To learn some of anatomical structures of the frog.
- To be able to make contrasts and comparisons of structures between different animal phyla as additional organisms are observed.
- To deduce the adaptive significance of differences in the structures of animal phyla as additional organisms are studied.

Introduction

The frog will be used to illustrate the basic anatomical features of Class Amphibia. Amphibians are transitional organisms, living at least part of their life in the water and part of their life on land. Likewise, the features you will see in the frog's anatomy represent a mixture of characteristics, some being adaptations to an aquatic habit while others being adaptations to terrestrial life. To begin this exercise, go to the Dissections section of the BiologyOne DVD. Select The Frog from the menu.

In the dissection exercises, you will be asked to examine the organisms and learn something of their individual anatomy. Equally important is a comparison of the anatomical structures of between organisms, noting how they are similar, how they differ, and how their differences may be adaptive to the different life styles of these organisms.

Activity 23k.1
External Anatomy

From the introductory screen, click on the forward arrow in the lower right to begin your observations of the frog's anatomy. If you could gently rub your fingers across the skin of the frog, you would be able to note its smooth texture and how thin it is. In frogs the skin has a rich supply of blood vessels near its surface. These allow the moist skin to serve as a site of gas exchange between the frog and the environment. This type of gas exchange is called cutaneous respiration. In addition to oxygen, water also moves easily across the skin of frogs. Typically, frogs are able to acquire all the water they need by osmosis across the skin. However, if the frog finds itself in a dry environment, the loss of water across its skin can quickly lead to life threatening dehydration.

Carefully observe the shape of the frog's body. Describe its shape. How could the shape of the frog be advantageous in its habitat? Note the relative size and shape of the frog relative to the other organisms you've examined.

The frog has two paired appendages. The front legs are comparable to our own arms having an upper portion, an elbow, lower portion, wrist, and hand with digits. How many digits does the frog have on its forelegs? Likewise, the hind legs are similar to our legs having a thigh, knee, shank, ankle, and a foot with digits. How many digits are on the foot of a frog? How would you explain any difference in the number of digits between the forelimb and hind limb?

Note the points of attachment of the forelimb and hind limb of the frog in relation to the body's mass. Do their positions appear to be effective for the frog's mobility? What role do you think each limb plays in supporting the body and when the frog moves? Note the angle at which the limbs exit the body of the frog. Do you think the angle of the limbs could be adaptive to aid the support of the frog's body on land?

Note the position of the eyes on the body of the frog. If each eye is able to gather images within a 160 degree arc, how much of the frog's surroundings can it see without moving its head/body? Does this have a selective advantage?

In front of each eye is an opening leading to a nasal cavity. These are called the external nares, used to help detect odors. Behind each eye is the tympanic membrane used to detect sound. Are these features adaptations to an aquatic or terrestrial habit?

Examine the mouth of the frog by carefully cutting back from the angle of the jaw on each side. Extend these cuts back nearly to the frog's shoulder. Pull the lower jaw back so that both the upper and lower portions of the inner mouth are visible. To complete this dissection click on the forward arrow in the lower right.

Note the relatively large, muscular tongue attached to the floor of the mouth. The tongue is attached near the front of the mouth. This allows the tongue to be flipped forward and help capture food. As the tongue is extended from the mouth it rubs against glands in the mouth's roof that secrete a sticky substance.

If you could rub your fingers over the upper jaw, you would feel teeth along the margin. These are the maxillary teeth. There are also hard structures located on the palate. These are called the vomerine teeth and are used to help hold prey in the mouth. Inside the oral cavity you will also find openings to the nasal cavity, the internal nares, and openings that lead to the space behind the tympanic membrane, the Eustachian tubes.

Activity 23k.2
Internal Anatomy

To observe the internal organs of the frog, lay the frog on its back. Click on the forward arrow in the lower right to view the ventral side of the frog. Part of the skin has been removed here, which allows you to see some of the musculature of the frog. The frog has a well-developed muscular system with over 200 individual muscles. In many respects, this muscular system closely resembles the muscular system seen in humans. The muscular system of the frog will not be studied in this exercise.

To begin your dissection, make a longitudinal cut just to the left of the mid-ventral line. This cut should extend from the pectoral to the pelvis girdles. Lateral cuts should then be made at the two ends of the longitudinal incision so that the skin and underlying muscle can be pulled back to the left and right sides. Pinning these flaps of tissue back will expose the organs of the abdominal cavity. To better view the anterior organs as well as the heart, extend the longitudinal cut forward to the base of the mouth. Use a pair of scissors to cut through the bones of the pectoral girdle so that you can see the organs more easily. To complete this dissection, click on the forward arrow in the lower right.

The major organs of the frog can now be seen. Some of the most prominent of these are the liver and intestines. In some frogs you may find large, yellow-orange fat bodies that must be removed to clearly view the organs. Review the major organs of the frog so that you could identify them later.

To better view some of the other organs, remove part of the liver. Complete this dissection by clicking on the forward arrow in the lower right. This allows you to better view the frog's stomach and heart. Completely remove the liver by clicking on the forward arrow in the lower right.

With the liver removed, if you still couldn't readily identify the stomach, a blunt probe could be passed through the esophagus. The probe will then enter the stomach that you should be able to see and feel. Food leaves the stomach through the pyloric sphincter and enters the small intestine. The small intestine is composed of two parts. The first part nearest the stomach is the duodenum. This part is relatively straight. It is specialized to receive the food from the stomach as well as bile and digestive enzymes from the liver and pancreas. The lower portion of the small intestine is the ileum. It's somewhat smaller in diameter than the duodenum and is highly twisted. If you were to stretch out the small intestine to its full length by gently teasing away the connective tissues holding it in position, you'd find the small intestine is several times longer than the length of the body. How does this compare to the relative length of the intestine to body length in the other organisms you've studied?

After the small intestine, undigested food enters the large intestine or colon. Water and ions are recovered from the digestive tract at this point. The lower portion of the colon constricts as it passes through the pelvic girdle. The feces are then expelled from the body through the anus. To see the large intestine, cut away the small intestine and a portion of the stomach. Complete this dissection by clicking on the forward arrow in the lower right. With part of the internal structure of the stomach exposed, you can also see its internal folding and thick muscular wall. Fat bodies often surround the intestines, click on the forward arrow to remove these to view the large intestine.

Click on the forward arrow in the lower right to better view the heart and lungs. Note that the lungs are relatively small. Some of this is due to shrinkage when the animal is preserved but also the lungs are not as large because much of the respiratory function occurs across the skin rather than via internal lungs. Another feature to note is the lack of ribs and a muscular diaphragm. What does this tell you about how the lungs exchange air?

The frog has a closed circulatory system composed of a heart for pumping blood, arteries which carry blood away from the heart, capillaries where gas and nutrient exchange occur, and veins which return the blood to the heart.

As you examine the frog's heart you should be able to identify two sections. The lower section is the single ventricle that is responsible for pumping blood out to the lungs and body of the frog. The upper section is divided into two chambers, the left and right atria (referring to the frog's left and right). The right atria receives blood from the body while the left atria receives blood from the lungs.

When the blood returns from the frog's body to the heart it first collects in a large vein next to the right atrium called the sinus venosus. From here the blood enters the right atrium. When the atrium contracts, the blood is forced through a valve into the ventricle. Ventricular contraction then pushes the blood into the conus arteriosus which quickly divides into left and right branches, the truncus arteriosus. These arteries deliver blood to both the lungs of the frog and its body. The blood that goes to capillary beds in the frog's body collects in veins and is returned to the sinus venosus. The blood that goes to the capillary beds in the frog's lungs collects in pulmonary veins and enters the left atrium of the heart. When the left atrium contracts it forces the blood inside it into the same ventricle receiving blood from the right atrium. What are the advantages to this circulatory pattern? What are its disadvantages?

After studying the internal features of the frog, label the illustration located in the Results Section

Lab Exercise **23k** Name _____

Results Section

Activity 23k.2
Internal Anatomy