

Background Information

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 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)

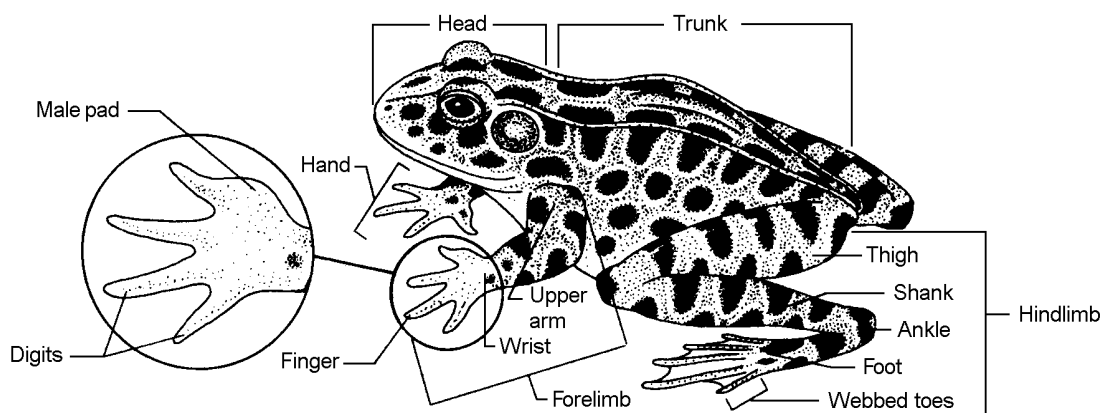
Preserved frog
Dissecting scissors
Hand lens or dissecting microscope

Dissecting tray
Forceps
Eye dropper

Dissecting pins
Probe

Procedure**Part A External Anatomy**

1. Place the preserved frog in your dissecting tray. Obtain all the dissecting equipment and place it at your work area.
2. Observe the frog. Feel the smooth and pliable skin. Note the coloration on all parts of the body.
3. The division of a frog's body includes the head, trunk, and limbs or legs as shown in Figure 1. All frogs lack necks and tails. Examine the front and hind limbs of the frog. Find the **digits**, which are finger like projections on the forelimbs and hind limbs. Locate the **hind limbs**, which are the longer and more muscular limbs of the frog. A hind limb consists of a thigh, shank, ankle, foot, and webbed toes. Locate the **forelimbs**, which are shorter than the hind limbs. A forelimb consists of an upper arm, wrist, hand, and fingers. On the male frog, find the male pad located on the innermost finger of the forelimb. The male pad is a dark swelling or enlargement used by a male to grasp a female during mating.

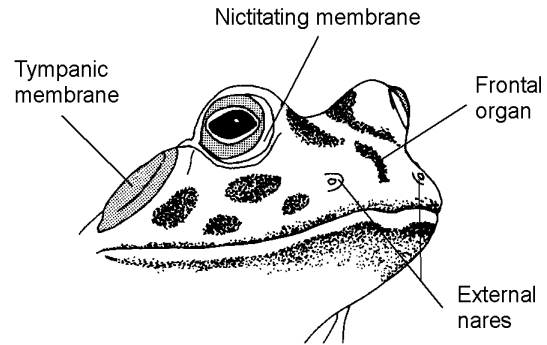
Figure 1

4. Examine the frog's head. Notice the size of the frog's eyes and how the eyes protrude. Find the nonmovable upper and lower eyelids. Locate the **nictitating membrane** that is a transparent covering that sweeps upward over the eyes. Identify the **tympanic membrane** or the eardrum located on each side of the head. Observe the **frontal organ** or brow spot found between and anterior to the two eyes. The frontal organ is the remaining indication of a third or middle eye. Note the **external nares** or nostrils that are the openings on the anterior and dorsal part of the skull.

5. Pry open the mouth. Use the scissors to cut the corners of the mouth where the **maxilla** (upper jaw) and **mandible** (lower jaw) join together. Examine the frog's mouth. Locate the **tongue**, which is a muscular, sticky flap on a living frog. The frog flicks out the tongue from the floor of the mouth to catch flying insects. Pull out the tongue. See Figure 3.

6. Feel the **maxillary teeth** that are found along the rim of the upper jaw or maxilla. Find the **vomerrine teeth** attached to the skull bones of the roof of the mouth. Notice that only the upper jaw has small teeth. Locate the **internal nares** or nostrils found in the roof of the mouth.

Figure 2



7. Locate the **glottis**, which is a slit-like opening on the swollen voice box found on the floor of the mouth. Air passes through the glottis going to and from the lungs.

Find the **esophagus** at the rear of the mouth. The wide opening of the esophagus allows the frog to swallow food whole. The esophagus is the first tube of the alimentary canal leading to the stomach.

Notice each **eustachian tube opening** found lateral to the esophagus near the hinge of the upper jaw. The eustachian tube openings lead to each ear and ensure equal air pressure on both sides of the tympanic membrane.

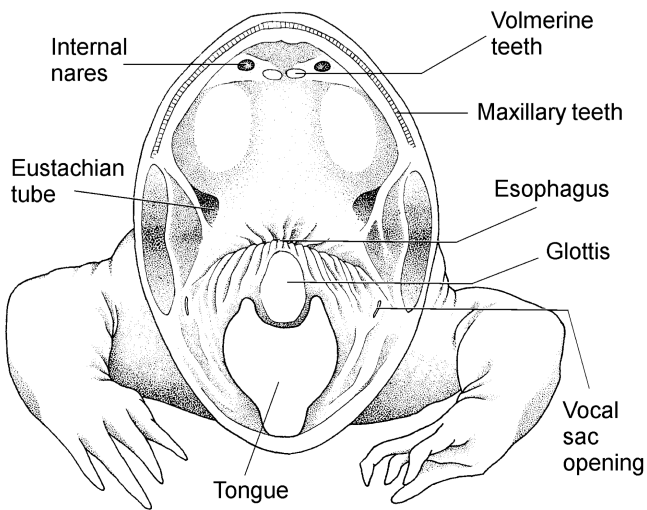


Figure 3

Part B Internal Anatomy

1. Place the frog in the dissection tray ventral side up and pin down the four limbs. Use the forceps and scissors to lift a piece of skin where the hind legs meet the body. Insert the scissors and cut just the skin along the midline to the level of the lower jaw as shown in Figure 4. Clip the skin at a right angle to the incision as shown. Now sever the layers of muscle that have been exposed. Make this incision a little to the right of center to avoid cutting a major vein. The large blood vessel lying under the muscle layer is the abdominal vein that originates in the liver.

(NOTE: Always lift the parts to be cut so as to avoid damaging underlying tissues and organs.) In the chest region you will have to cut through the breastbone. Again make right angle cuts from each end of the long incision as shown in Figure 4. Fold open and pin down flaps of the skin and body wall. Make additional cuts in the breastbone to expose the organs in the upper body.

- The sex of the frog is readily noticed once the internal organs are exposed. If there is a mass of black and yellow **eggs** in the transparent **ovaries**, the frog is a female. If the ovaries obscure the view of the other organs, the ovaries may be cut out of the body and removed.
- Circulatory System** - Find the **heart** in the center of the chest cavity. Notice that the heart lies in a thin sac called the **pericardium**. Remove the pericardium to observe the three- chambered heart. The two, dark-walled chambers, called **atria**, receive blood. The right atrium receives deoxygenated blood from the veins of the frog's body. The left atrium receives oxygenated blood from the lungs. Each atrium empties into the **ventricle** which is the lighter- colored, thick-walled part of the heart. The large vessel forming a y-shape at the anterior end of the ventricle is the **conus arteriosus**. Blood is pumped out of the conus arteriosus through a system of arteries that you see around the heart.
- Respiratory System** - 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. Insert a dropper into the glottis and pump air into the lungs. Observe what happens. Refer to Figure 5.

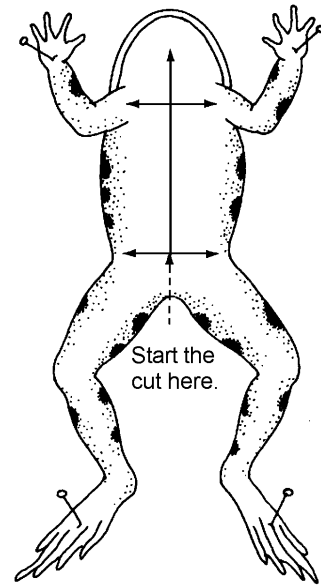
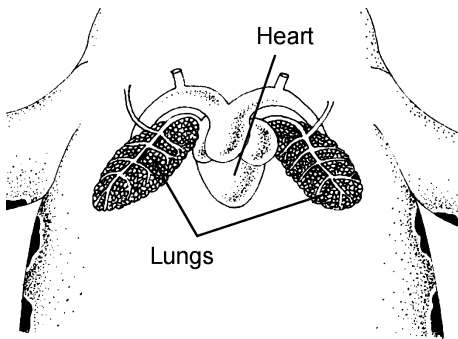


Figure 4

Figure 5



- Digestive System** - See Figure 6. Find the dark brown **liver**, composed of three to five lobes. Between the right lobe and the one next to it, is the transparent **gall bladder**, usually filled with green bile that it stores. Locate the **bile duct** that brings bile from the gall bladder to the first part of the small intestine, or **duodenum**.

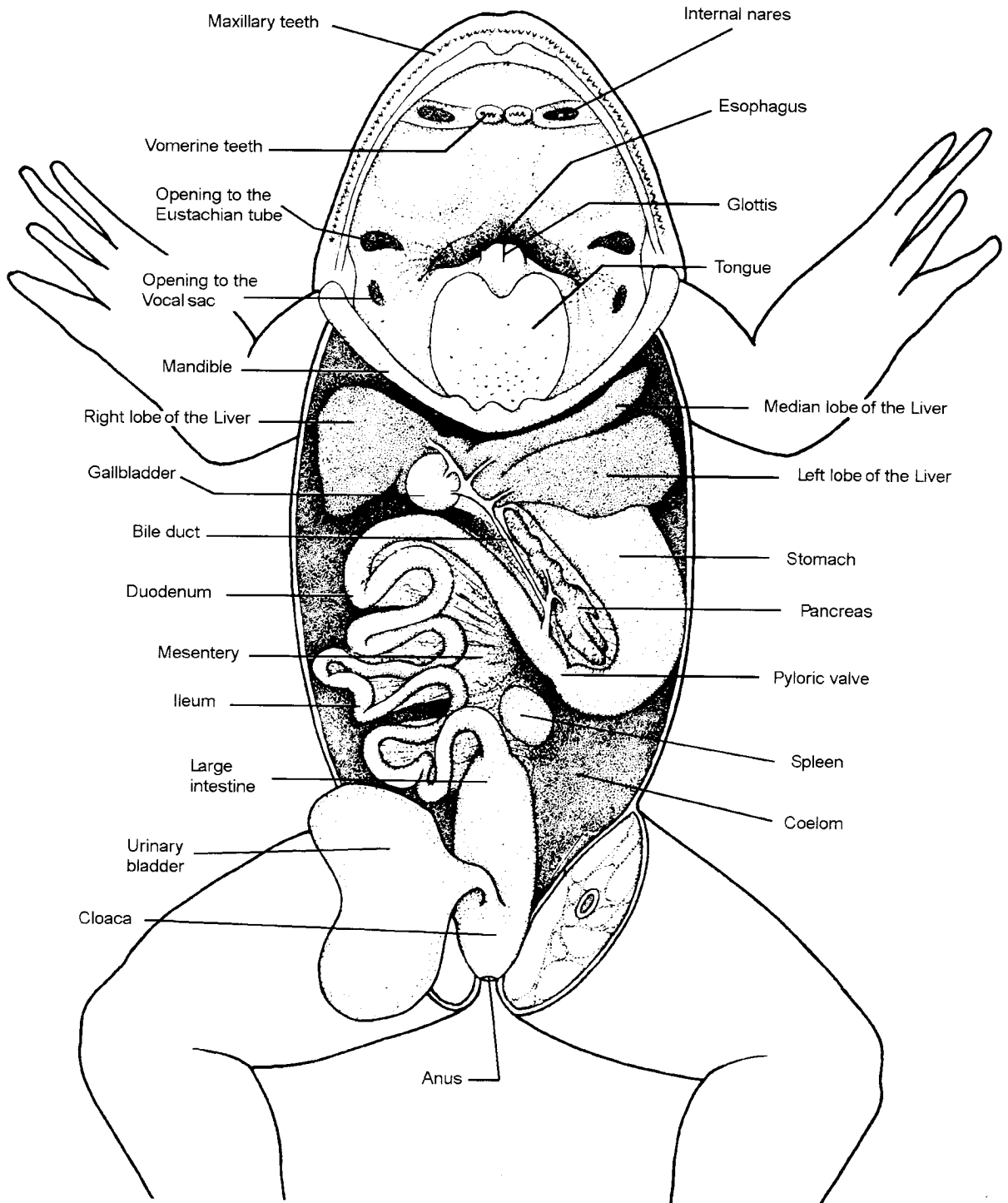
The **duodenum** and **stomach** form a loop that is held in place by sheets of membranous connecting tissue called **mesentery**.

In the mesentery, between the stomach and duodenum lies the **pancreas**, a glandular organ that produces digestive enzymes. The pancreas empties its enzymes through a duct that leads into the small intestine.

The dark, spherical **spleen**, which is a circulatory and lymphatic system organ, lies in the mesentery posterior to the stomach. One of the spleen's functions is to store blood.

The small intestine proceeds posteriorly to the coiled **ileum** that widens into the **large intestine**. Where the **urinary bladder** and reproductive ducts empty into the intestine, the section is called the **cloaca**. The wastes in the cloaca empty out at the **anus**.

Figure 6 – Internal View of the Frog



6. **Excretory System** - Push the intestines aside to see the two dark, oblong **kidneys** lying on the dorsal wall of the body cavity. Find the **ureter**, which is a tube leading out of each kidney. The ureters carry the urinary wastes from the kidney to the urinary bladder. The chemical waste is called urine and is stored in the urinary bladder that empties into the cloaca.

The **adrenal gland**, which is part of the endocrine system, can be seen as a yellow stripe on each kidney. **Fat bodies**, whose purpose is to store fat to be used during hibernation or when food is scarce, attach to the anterior end of each kidney. Usually fat bodies are bright yellow, finger-like projections.

7. **Reproductive System** - In male frogs each yellowish, oval-shaped **testis** is attached by tubes to the kidney. During mating the sperm mixes with and follows the exit route of the urine. The males of many frog species have vestigial oviducts attached to the cloaca called Müllerian tubes. In female frogs the two ovaries appear as **egg sacs**. Eggs released from the ovaries enter a long, coiled oviduct at the anterior opening. Eggs pass down the cream-colored oviduct and are held in an ovisac, or uterus, before entering the cloaca. From the cloaca the eggs pass from the body to be fertilized outside the frog's body.

Complete the following dissection of the frog's nervous system if time allows.

8. **Nervous System** - The **lens** of the eye in a living frog is crystalline and transparent. The lens does not change shape to focus as it does in the human eye. Frogs are nearsighted on land and farsighted under water.

With the scissors, carefully dissect the eyeball. Remove the spherical lens. Place the lens on your palm and hold it up to the light. Note that it gathers light, even in its preserved condition. With the tips of two dissecting needles, tease apart the lens to see its structure.

Place the frog dorsal side up and remove the skin from the **skull** with scissors or a scalpel. With a scalpel, shave or whittle the bone of the skull between the eyes. Use very shallow strokes, peeling off the bone in layers or shavings. When the bone becomes thin, peel it off very carefully using forceps. Be sure not to dig the points of the forceps into the brain tissue. See Figure 7.

The two hemispheres of the **cerebrum** control voluntary motion and conscious activities of the frog. Identify the rounded cerebral hemispheres between the eyes.

The **olfactory lobes** are centers for sensing odors. Nerves lead to these lobes from the nostrils. Continue to shave bone toward the anterior of the frog's head. Expose the olfactory lobes.

The **optic lobes** control the activities of the eyes. Continue to shave bone, working posteriorly from the cerebral hemispheres. Locate the optic lobes, relatively large, hollow, rounded masses of midbrain tissue.

The **cerebellum** coordinates the muscular activities and controls the balance of the frog. Posterior to the optic lobes, find the cerebellum, a very short section of the brain. The **medulla** is the control center in the brain for breathing, swallowing, digestion, and reflexes. Trace the cerebellum as it leads into the medulla. Then locate the **spinal cord** as it begins at the posterior base of the medulla. Dissect a **vertebra** or two in order to see the spinal cord encased within the vertebral column.

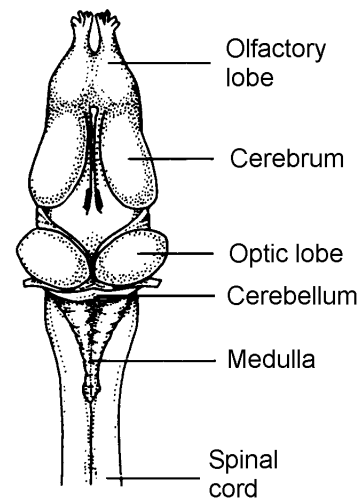


Figure 7

9. Clean up your work area and equipment. Return the cleaned dissecting equipment to the appropriate place.