

Amphibian Anatomy

Topic

Amphibian anatomy shows how structure and function are related.

Introduction

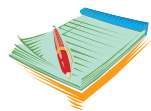
Frogs and humans do not look much alike, but they have a lot in common. Like humans, frogs are *vertebrates*, animals with backbones. They have an internal bony skeleton very similar to the skeleton of a human. In addition, a frog's body is organized very much like that of a human. The adult frog can be studied as a good example of vertebrate organization.

Frogs are amphibians and humans are mammals, so the two species show some significant differences. Mammals are warm-blooded organisms whose bodies are covered in hair. All mammals nourish their offspring with milk produced in mammary glands. Frogs are cold-blooded, so their body temperatures are close to the temperature of the environment. For that reason, frogs are more active in warm weather than in cold weather. In addition, frogs, like all amphibians, lead a double life; they spend their youth in water and their adulthood on land. Through the process of metamorphosis, young frogs undergo a complete change in form to become adults. In this experiment, you will examine the internal and external structures of a frog.



Time Required

90 minutes



Materials

- safety goggles
- lab coat or apron
- latex gloves

- ◊ preserved frog
- ◊ dissecting probe
- ◊ dissecting pan with wax
- ◊ dissecting pins
- ◊ dissecting scissors
- ◊ forceps
- ◊ paper towels
- ◊ plastic bag for disposal
- ◊ science notebook

Safety Note Please review and follow the safety guidelines.

Procedure A: External Anatomy

1. Line the dissecting pan with paper towels to aid in the disposal of the frog at the end of the experiment.
2. Rinse a frog with water to remove as much of the preserving fluid as possible. Place the frog in the dissecting pan.
3. Run your finger along the surface of the skin. Notice that the skin is smooth. Frogs have the ability to absorb oxygen through their smooth, moist skin. During the winter months when frogs are inactive, they rely on oxygen absorbed through the skin to stay alive.
4. Notice the differences between the front and hind feet and limbs. While observing the front feet, look for a thick pad below the thumbs. If one is there, your frog is most likely a male. This pad is used to hold the female during mating. Notice that only the hind feet are webbed.
5. Look carefully at the an eye of the frog, and you will see an extra transparent lid called the *nictating membrane*. On the side of the head and below each eye is a *tympanic membrane*, which functions as an ear drum. The membrane vibrates in response to sound or vibrations in the ground. Near the mouth are two openings called the *external nares*, which are outer nose openings.

6. To examine the internal structures in the mouth, use the scissors to cut the jaw at each hinge joint. It may be necessary to insert your thumb between the jaws to open the mouth wide.
7. Run your finger along the edges of the mouth, and note a row of ridges called *maxillary teeth*. In the roof of the mouth, you will feel two sharp mounds called *vomerine teeth*. Near these teeth are openings that connect to the external nares these are the *internal nares*.
8. In the back of the mouth are two openings. The larger opening is the top of the *esophagus*, which is the tube that leads to the stomach. The smaller opening is the *glottis*, which leads to the lungs.
9. The largest structure in the mouth is the *tongue*. Note that it is attached at the front of the mouth. In a live frog, the tongue is sticky and can be extended several inches to aid in capturing prey.
10. After locating these structures, sketch them in your science notebook.

Procedure B: Internal Anatomy

1. Place the frog on its back in the pan so the ventral side is facing up. Pin the back limbs to the wax in the pan.
2. Use the forceps to raise the skin just above the anal opening. Insert the pointed blade of the scissors and make an incision through the raised skin. Cut the skin along the center of the body until you reach the base of the head. Cut laterally from this incision to each of the limbs. The final incision should look like the letter “I.”
3. Repeat this procedure to cut through the muscle of the body wall. Make sure to raise the scissors so that you will not cut through any internal organs. When you get to the forelimbs, cut through the *sternum*, the bone that connects the ribs and protects the heart and lungs. Continue the cut until you reach the base of the lower jaw. Again, cut across to each limb, then pin the flaps back to expose the internal organs.
4. If your frog is a female, a large mass of black and white eggs may fill most of the abdomen. In order to see the internal organs, this egg mass will need to be removed. You should be able to remove most of the mass with your fingers, making cuts where necessary.

In both males and females, you may see orange or yellow finger-like structures. These are *fat bodies*. Fat bodies store food for times of inactivity. Carefully cut where necessary to remove the fat bodies.

5. In the center of the body cavity is the largest organ of the body, the *liver*. The liver is reddish-brown with three lobes, two large and one small. The liver produces bile, stores food, and helps to break down toxic waste materials.

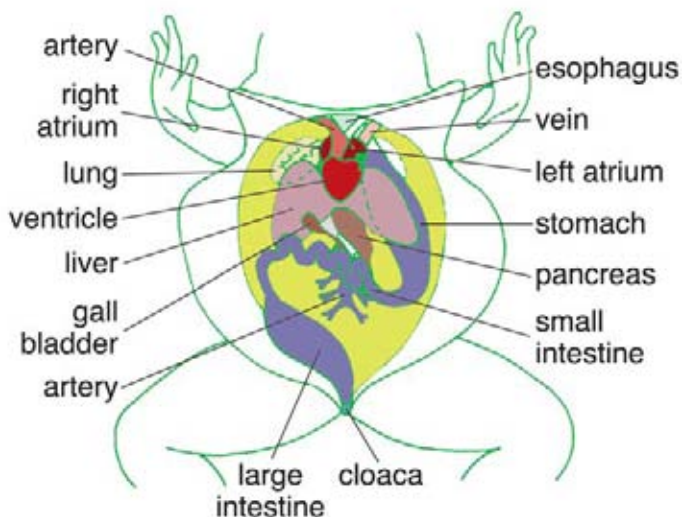


Figure 1

6. Carefully lift the liver to expose the *gall bladder*, a green sac that stores the bile. Use the scissors to remove both the liver and gall bladder to expose the rest of the digestive system.
7. Compare the internal structure of the frog to Figure 1. Locate the *stomach*. It is a white, oval structure on the right side of the body cavity. At the top of the stomach is the *esophagus*, the tube through which food passes. Lying just above the stomach is the thin, ribbon-like *pancreas*, which releases enzymes into the *small intestine*. The small intestine is the thin tube leading away from the stomach. Most digestion and nutrient absorption takes place here. Follow the loops of the small intestine to a short, wide tube, the *large intestine*. This organ, which processes digestive system wastes, leads to the *cloaca*, a large sac that passes the wastes out of the body.
8. Use your scissors to remove the organs of the digestive system by

cutting just above the stomach and at the end below the cloaca. Cut open the stomach to examine its contents.

9. Before continuing, sketch these structures in your science notebook.
10. The triangular organ in the middle of the upper body is the three-chambered *heart*. The amphibian heart has two upper chambers called *atria* and the lower chamber is the *ventricle*. You can distinguish the chambers of the heart by their different colors. The left atrium sends blood to the lungs through veins to pick up oxygen. The blood returns to the right atrium and then is pumped into the ventricle. The ventricle contracts and pumps blood out to the body through the arteries.
11. Before continuing, sketch these structures in your science notebook.
12. Located on either side of the heart are the *lungs*. The lungs may look like purplish raisins. Frogs do not have a *diaphragm*, the large muscle that helps mammals pull air into their lungs. Instead, frogs expand the skin under the jaw and air enters the mouth through the nares. This tissue then contracts and forces the air into the lungs through the glottis.
13. Before continuing, sketch these structures in your science notebook.
14. The *kidneys* are long, dark organs embedded in the back of the frog on each side of the spinal column. They filter liquid wastes from the blood. The *urinary bladder* is a two-lobed pouch attached to the cloaca. Urine is stored in the bladder and exits through the cloaca.
15. Before continuing, sketch these structures in your science notebook.
16. If your frog is a female, the egg producing *ovaries* appear as thin-walled gray folds of tissue attached to the long, dark kidneys (see Figure 2). If you removed an egg mass from your female the ovaries were removed at this time. The coiled white tube on each side of the kidneys is the oviduct. Eggs pass through the oviduct on their way out of the body through the cloaca.

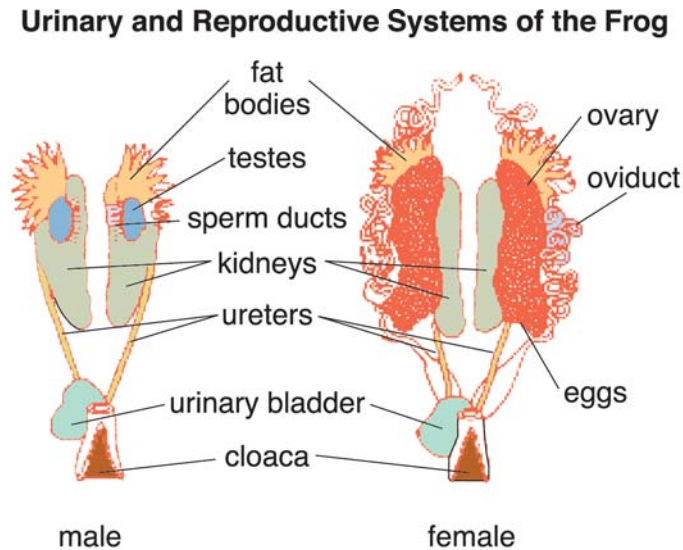


Figure 2

17. In a male frog, the two yellow, bean-shaped *testes* are located next to the kidneys. Sperm reaches the cloaca through the *Wolffian duct*.
18. Before continuing, sketch these structures in your science notebook
19. When you have completed your dissection, wrap the frog and all removed organs in the paper towel and place it into the plastic bag. Dispose of the bag as instructed by your teacher.

Analysis

1. What do you think is the purpose of the nictating membrane on the frog's eyes?
2. Why do you think the back limbs are more muscular than the front?
3. In what situation would the position of the external nares be an advantage in breathing?
4. List two glands that aid the process of digestion.
5. Based upon the contents of your frog's stomach, is the frog a carnivore or herbivore?

6. How does the position of the frog's tongue help it to catch its prey?
7. To what three systems is the cloaca attached?
8. How does the length of the small intestine relate to its function in absorbing nutrients?



What's Going On?

By examining the internal structures of the frog, you can learn a lot about human anatomy. Adult frogs have body structures that are similar in size, shape, and function to those of humans. The frog has a three-chambered heart located in the upper chest that is similar to the four-chambered version found in mammals. Other similarities include the placement of the lungs, digestive system, kidneys, liver, brain, and sense organs. One major difference in amphibians and humans is the arrangement of the reproductive organs and the existence of the cloaca. Despite the differences, frog dissection is one of the most valuable ways to become acquainted with a human's internal anatomy.

Want to Know More?

See Our Findings.

OUR FINDINGS

AMPHIBIAN ANATOMY

Suggestion for class discussion: Have students brainstorm a list of ways that frogs and humans are anatomically similar.

Analysis

1. The nictating membrane covers the eye underwater to allow the frog to see while protecting its vision.
2. Back limbs are used for swimming in water and jumping on land.
3. While the frog is underwater. It only needs to expose the tip of the head.
4. gall bladder and pancreas
5. Carnivore. The frog's stomach most likely held insects, crayfish, or fish parts.
6. The tongue is attached at the front of the mouth instead of the back. This enables the frog to hold live organisms in its mouth without suffocating.
7. reproductive, digestive, and urinary systems
8. The longer the intestine, the more nutrients it can absorb.

SAFETY PRECAUTIONS

Review Before Starting Any Experiment

Each experiment includes special safety precautions that are relevant to that particular project. These do not include all the basic safety precautions that are necessary whenever you are working on a scientific experiment. For this reason, it is absolutely necessary that you read and remain mindful of the General Safety Precautions that follow. Experimental science can be dangerous, and good laboratory procedure always includes following basic safety rules. Things can happen very quickly while you are performing an experiment. Materials can spill, break, or even catch fire. There will be no time after the fact to protect yourself. Always prepare for unexpected dangers by following the basic safety guidelines during the entire experiment, whether or not something seems dangerous to you at a given moment.

We have been quite sparing in prescribing safety precautions for the individual experiments. For one reason, we want you to take very seriously every safety precaution that is printed in this book. If you see it written here, you can be sure that it is here because it is absolutely critical.

Read the safety precautions here and at the beginning of each experiment before performing each lab activity. It is difficult to remember a long set of general rules. By rereading these general precautions every time you set up an experiment, you will be reminding yourself that lab safety is critically important. In addition, use your good judgment and pay close attention when performing potentially dangerous procedures. Just because the book does not say “Be careful with hot liquids” or “Don’t cut yourself with a knife” does not mean that you can be careless when boiling water or using a knife to punch holes in plastic bottles. Notes in the text are special precautions to which you must pay special attention.

GENERAL SAFETY PRECAUTIONS

Accidents caused by carelessness, haste, insufficient knowledge, or taking an unnecessary risk can be avoided by practicing safety procedures and being alert while conducting experiments. Be sure to

check the individual experiments in this book for additional safety regulations and adult supervision requirements. If you will be working in a lab, do not work alone. When you are working off-site, keep in groups with a minimum of three students per groups, and follow school rules and state legal requirements for the number of supervisors required. Ask an adult supervisor with basic training in first aid to carry a small first-aid kit. Make sure everyone knows where this person will be during the experiment.

PREPARING

- Clear all surfaces before beginning experiments.
- Read the instructions before you start.
- Know the hazards of the experiments and anticipate dangers.

PROTECTING YOURSELF

- Follow the directions step by step.
- Do only one experiment at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure there is adequate ventilation.
- Do not horseplay.
- Keep floor and workspace neat, clean, and dry.
- Clean up spills immediately.
- If glassware breaks, do not clean it up; ask for teacher assistance.
- Tie back long hair.
- Never eat, drink, or smoke in the laboratory or workspace.
- Do not eat or drink any substances tested unless expressly permitted to do so by a knowledgeable adult.

USING EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives or other sharp-pointed instruments with care.

- Pull plugs, not cords, when removing electrical plugs.
- Clean glassware before and after use.
- Check glassware for scratches, cracks, and sharp edges.
- Clean up broken glassware immediately.
- Do not use reflected sunlight to illuminate your microscope.
- Do not touch metal conductors.
- Use alcohol-filled thermometers, not mercury-filled thermometers.

USING CHEMICALS

- Never taste or inhale chemicals.
- Label all bottles and apparatus containing chemicals.
- Read labels carefully.
- Avoid chemical contact with skin and eyes (wear safety glasses, lab apron, and gloves).
- Do not touch chemical solutions.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly.

HEATING SUBSTANCES

- Wear safety glasses, apron, and gloves when boiling water.
- Keep your face away from test tubes and beakers.
- Use test tubes, beakers, and other glassware made of Pyrex™ glass.
- Never leave apparatus unattended.
- Use safety tongs and heat-resistant gloves.
- If your laboratory does not have heat-proof workbenches, put your Bunsen burner on a heat-proof mat before lighting it.
- Take care when lighting your Bunsen burner; light it with the airhole closed, and use a Bunsen burner lighter in preference to wooden matches.

- Turn off hot plates, Bunsen burners, and gas when you are done.
- Keep flammable substances away from flames and other sources of heat.
- Have a fire extinguisher on hand.

FINISHING UP

- Thoroughly clean your work area and any glassware used.
- Wash your hands.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Do not dispose of materials in the sink unless instructed to do so.
- Clean up all residues and put them in proper containers for disposal.
- Dispose of all chemicals according to all local, state, and federal laws.

BE SAFETY CONSCIOUS AT ALL TIMES!