SynFrog Lab Lesson Plan
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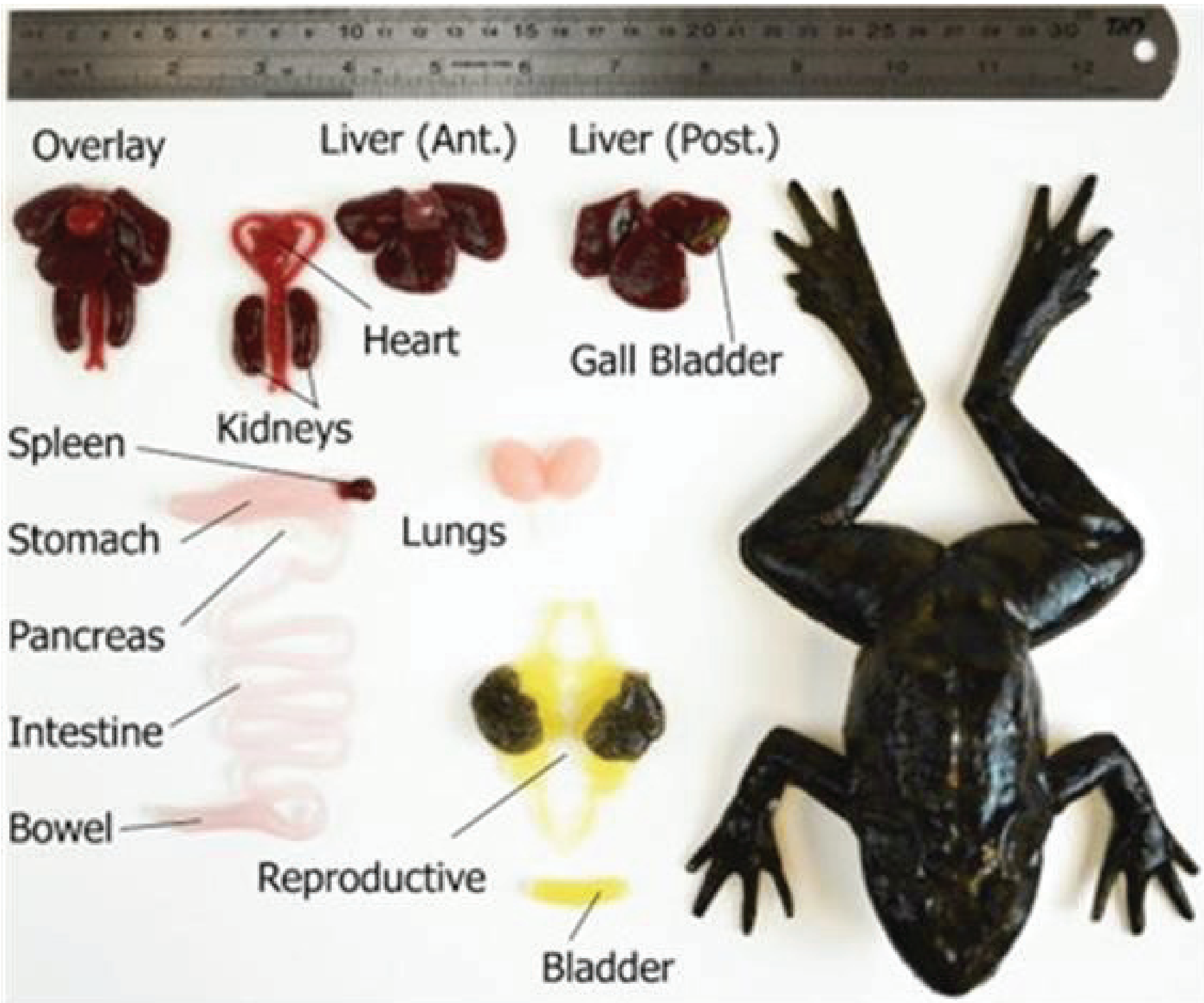
PETA's Humane Science Education Division

SynFrog Lab Lesson Plan
Teacher Guide



Summary and Expected Outcomes

Introduction to comparative anatomy between amphibians and humans. Students will compare frog and human anatomy while identifying and describing organs inside a simulated cadaver frog. An optional warm-up lab, in which students talk through the ethics of using real animals for this procedure, is included for discussing the topic of dissection.

NGSS Alignment

MS-LS4-2: Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

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Duration

50 to 80 minutes

Group Size

Four students per group

Background Knowledge Required

Organ systems (digestive, respiratory, and circulatory) and their function

Materials

- Scalpel and blades
- Gloves
- Dissection pins
- Dissection tray
- Dissection scissors
- Tweezers
- SynFrog
- SynFrog student lab worksheet (included below)
- Pre-lab warm-up reading, optional (included below)
- Pencil
- Aprons, optional
- Spray bottle with water

Safety

Review safety guidelines and precautions for using dissection tools in a lab setting.

Prepping the SynFrog

- Over the sink, cut open the plastic package and pour the shipping fluid down the drain.
- Wear gloves to protect the tissue from microorganisms on your hands.
- Take the product out of the packaging and wash it with hand soap and water. Rinse thoroughly.
- While wearing gloves, place the SynFrog on a clean dissection tray.
- Place all listed materials at each dissection station.

Warm-Up Exercises (Optional)

- Have students read and discuss the dissection factsheet warm-up reading (10 to 15 minutes).
- Have students watch this video to learn how to dissect the SynFrog and gain knowledge of the various internal organs (11 minutes).

Lab

- Have students read the dissection “fun facts” at the top of the SynFrog lab worksheet and provide definitions for the listed vocabulary words. This can also be a prelab homework prompt if class time is too short (15 minutes).
- Have students dissect the SynFrog and locate each part: bladder, heart, reproductive organs, bowel, intestine, pancreas, stomach, spleen, lungs, kidneys, overlay, anterior liver, and posterior liver. Routinely spray the SynFrog with the water-filled spray bottle every 20 minutes to keep the model from drying out (15 minutes).
- Have students use the diagrams provided on the lab guide to compare the SynFrog’s anatomical structure with that of humans, then have a class discussion about their findings (15 minutes).
- Have students fill out the lab worksheet comparing amphibian anatomy with human anatomy (20 minutes).

Cleanup

If choosing to reuse the same organs

- Remove any metal (such as surgical staples), which can rust. Sutures and nonmetal implants are safe to leave in the tissue.
- Have students put the organs back into the SynFrog in the appropriate order (or you can do this yourself).
- Wash the tissue gently with hand soap and water. Rinse thoroughly.
- Place the tissue in a sealable plastic container or zip-lock bag.
- Add a drop of hand soap and fill with enough water to cover. If storing in a zip-lock bag, exclude as much air as possible.
- Store at room temperature away from direct light or in a refrigerator.

If choosing to use an “organ replacement puck” (a new set of organs)

- Remove any metal (such as surgical staples), which can rust. Sutures and nonmetal implants are safe to leave in the tissue.
- Used soft tissue (synthetic organ tissue) is safe to dispose of with other nonrecyclable material.
- Place the replacement puck of new tissue inside the frog’s abdomen.
- Wrap the new, synthetic skin over the frog’s abdomen and button it on the backside of the frog.
- Wash the tissue gently with hand soap and water. Rinse thoroughly.
- Place the tissue in a sealable plastic container or zip-lock bag.
- Add a drop of hand soap and fill with enough water to cover. If storing in a zip-lock bag, exclude as much air as possible.
- Store at room temperature away from direct light or in a refrigerator.

Animal-Free Dissection Lab
Warm-Up Reading

Name ______________________________ **Date** ____________________

Key Vocabulary	
Nonprofit organization	A group that uses the money it receives to further a social cause
Animal dissection	Cutting open a dead animal or animal organ in order to view the internal anatomy (excluding humans who have donated their bodies to science)
Animal-free dissection	Using software or a model of an animal or organ in order to study anatomy without harming real animals

About TeachKind Science

Thank you for participating in our humane dissection pilot program! TeachKind Science offers animal-free dissection materials to teachers so that modern animal anatomy methods and lessons can be accessible to all, providing students with a comfortable learning atmosphere while also protecting animals and the environment.

Please review this document carefully before beginning the animal-free dissection activity.

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Studies on Efficacy

- A systematic review of 20 published studies from 2005 to 2020 in the journal *The American Biology Teacher* compared the educational value of animal dissection with that of non-animal teaching methods. In 95% of the studies, students at all educational levels who used animal-free methods performed at least as well on course evaluations as those using animal dissection—and, in many cases, performed even better.
- Modern science curricula and standards don't require or refer to the use of animal dissection. The College Board (AP Biology), the International Baccalaureate® program, and the Next Generation Science Standards make no mention of animal dissection.
- U.S. and Canadian medical schools no longer use animal dissection to teach students, and no U.S. medical schools expect or require incoming students to have participated in animal dissection.

Supplemental Background: Dissection Facts

Did you know?

- In the U.S., approximately 10 million animals are used for dissection each year.
- Animals used for dissection do not die of natural causes. They are obtained from fur farms, animal shelters, slaughterhouses, and the natural world, and it has been documented that some of them are also stolen or abandoned companion animals.
- Each year, millions of frogs are captured in their natural habitats to be used for dissection, and the U.S. Department of the Interior has even stated that the decline in the amphibian population has been caused in part by this practice.
- Animals used for dissection are preserved in harmful chemicals such as formaldehyde, which is classified as a human carcinogen by Occupational Safety and Health Administration standards. Other chemicals used for preserving animals have limited to no data available on their carcinogenic effects, chronic toxicity, or acute toxicity.
- In a 2015 study, medical students and instructors exposed to formaldehyde in a laboratory setting were found to have decreased pulmonary function.
- In 2017, undergraduate students exposed to formaldehyde in anatomy classes were shown to have genetic mutations in certain cells and this effect was shown to have increased over time.

Student Activity

Directions: Read the passage below, then answer the questions that follow it.

> One landmark study investigated the conditions of the capture and housing of frogs bound for dissection (Gibbs, Nace, & Emmons, 1971). The researchers found that the frogs, which were taken from a network extending thousands of miles throughout North America, were captured and stored in large sacks, up to 100 frogs per sack, for a week or more until they were transported to a supply company. … Upon arrival at the supply company, the frogs were placed in large tubs of water, where they were kept for weeks to months, with no food, until a request came in for their shipment. When a request came, the frogs were sorted—at a rate of 25 frogs per minute per sorter—on the basis of size (small, medium, or large), while badly damaged, "broken," and dead frogs were discarded. Gibbs et al. … describe high mortality rates at each stage of the process, as frogs would perish from being crushed during capture, from overheating, from exposure to unsanitary holding tanks, and from starvation. Today, frogs that are bound for dissection are killed prior to shipment. This is done by dropping them in a solution of alcohol and water; on average, it takes 15–20 minutes for a frog to die this way (Balcombe, 2000). A second, undercover investigation into the treatment of animals bound for dissection was conducted by employees of the organization People for the Ethical Treatment of Animals, who were hired to work for the Carolina Biological Supply Company and WARD's biological supply company for over a year. … In total, it is noted that the investigators documented 181 violations of the American Animal Welfare Act and 99 violations of Carolina anti-cruelty statutes during their investigation.

Oakley, J. (2014). Under the Knife: Animal Dissection as a Contested School Science Activity. *Journal for Activist Science and Technology Education, 1*(2). Retrieved from https://jps.library.utoronto.ca/index.php/jaste/article/view/21182.

Response Questions

After you've read TeachKind Science's factsheet, discuss it with your lab partner and group.

Discussion Prompts

1. What facts stood out to you?

2. What does "responsible science" mean to you? What role does ethics play in science?

3. How do you feel about animal dissection vs. animal-free dissection?

4. Have you ever dissected an animal? What are your memories and thoughts from that experience?

5. Do you think schools should switch to animal-free dissection? Why or why not?

ANSWER KEY:
SynFrog Dissection Lab

Here are some fun facts about frogs:

1. A group of frogs is called an *army*.
2. Females remember exactly where they laid their clutches of eggs.
3. Frogs have been hopping around on Earth for at least 200 million years and were contemporaries of the dinosaurs.
4. There are more than 6,000 species of frog worldwide.
5. They have superior night vision.
6. While they're excellent **bioindicators**, frogs are also able to withstand extreme environmental stress using a process known as **estivation**.
7. Madagascar's *climbing mantilla* and Ecuador's *little devil frog* are nurturing and attentive when raising their young. Both lay just a few eggs in pools of water that collect on leaves. Then they stay with their offspring and feed the growing tadpoles until they're big enough to venture off on their own.
8. Frogs—like many other amphibians—can exchange oxygen and carbon dioxide through their skin via a process called **cutaneous respiration**.

Define the following terms from the video:

Amphibian An ectothermic, four-limbed vertebrate that can live in various ecosystems and whose eggs are fertilized outside the body

Metamorphosis A biological process in which an organism experiences a distinct physical transformation during the life cycle, such as a caterpillar's transformation into a butterfly or a tadpole's transformation into an adult frog

Ectothermic Having a body temperature that is determined by environmental or external sources, such as sunlight

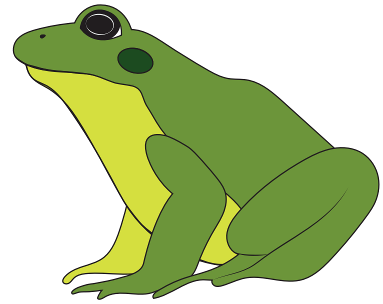
Cutaneous respiration Breathing, or transferring a gas or air, through the skin

Bioindicator A species whose health status within an ecosystem reflects the ecosystem's overall health

Estivation The process of becoming dormant during warm temperatures, including a slowing of the metabolic rate, similar to hibernation but in the summer

Comparative Anatomy

Frogs are classified as **amphibians**, which means that they spend a portion of their lives in the water and a portion of their lives on land. ("Amphi" means "both," and "bios" means "life.") Frogs start out as fertilized eggs in the water, develop into aquatic tadpoles, then finally become either aquatic or terrestrial adults. They undergo **metamorphosis**, completely transforming their bodies from one form to another. They are **ectothermic**, which means that their body temperature depends on the temperature of their external environment.



Body System	Mammals vs. Amphibians
Digestive	While mammals drink water through their mouths, amphibians absorb water through their skin. Mammals have a longer small intestine, which is made up of three parts: the *duodenum*, the *jejunum*, and the *ilium*. Amphibians' small intestine doesn't include the jejunum, which is responsible for chemical digestion and absorption; instead, absorption occurs in the ilium. While mammals excrete through the rectum and urinate separately through the urethra, amphibians both excrete and urinate through the *cloaca*. Unlike mammals, they also lack an appendix for protecting gut flora.
Respiratory	Both mammals and amphibians have lungs for breathing, but amphibians also use their skin to absorb oxygen from the environment and excrete carbon dioxide. Mammals have a diaphragm to help expand the rib cage, but amphibians lack this adaptation.
Circulatory	While mammals' hearts have four chambers (two ventricles and two atria) to help circulate blood, amphibians' hearts have only three (one ventricle and two atria). Both have circulatory systems that pump oxygenated blood throughout the body, but amphibians have an extra circuit that allows them to take in oxygen through both the lungs and the skin.
Nervous	Both mammals and amphibians have a central nervous system that includes a brain, a spinal cord, and nerves. Most sensory organs in both mammals and amphibians are located on the head, but there are many key differences. For example, unlike amphibians, mammals can change the focus of their eyes, but amphibians have excellent night vision and can see color in the dark, unlike humans. Both have nostrils to aid in perceiving odors, but amphibians' olfactory organ can also detect chemicals in the water. Mammals' ears have external parts that help in receiving sound waves, while amphibians have a *tympanum*, which is a thin membrane that covers the ear and transmits sound waves for both hearing and balance.
Skeletal	Both mammals and amphibians are vertebrates, but amphibians lack several skeletal structures that mammals have, such as a pelvis, a tailbone, and ribs. Mammals have 24 bones in their spinal column, while amphibians only have nine. While mammals have both a tibia and a fibula in their lower legs, not all amphibians share this build. For example, frogs specifically have a single shinbone called the *tibiofibula*, which is an adaptation for leaping.

Student Guide

Objective

Compare frog and human anatomy while identifying and describing organs inside a simulated cadaver frog.

Materials

- Scalpel and blades
- Gloves
- Dissection pins
- Dissection tray
- Dissection scissors
- Tweezers
- SynFrog
- SynFrog worksheet
- Pencil
- Aprons, optional

Safety

Be sure to follow all safety procedures provided by your teacher.

Procedure

- Read the dissection facts at the top of the SynFrog lab worksheet and provide definitions for the listed vocabulary words (15 minutes).
- Gather all the necessary materials listed above for your dissection station (5 minutes).
- Dissect the SynFrog by creating an I-shaped incision vertically down the model's torso and pinning the skin to the tray (5 minutes).
- Locate the following parts inside the SynFrog: bladder, heart, reproductive organs, bowel, intestine, pancreas, stomach, spleen, lungs, kidneys, overlay, anterior liver, and posterior liver. Spray your SynFrog lightly with water every 20 minutes to keep it moist (15 minutes).
- Use the diagrams below to compare the SynFrog's anatomical structure with that of humans, and have a class discussion about your findings (15 minutes).
- Fill out the rest of the lab worksheet comparing amphibian anatomy with human anatomy (20 minutes).

Cleanup

If choosing to reuse the same organs

- Remove any metal (such as surgical staples), which can rust. Sutures and nonmetal implants are safe to leave in the tissue.
- Put the organs back in the SynFrog in the appropriate order.
- Wash the tissue gently with hand soap and water. Rinse thoroughly.
- Place the tissue inside a sealable plastic container or zip-lock bag.
- Add a drop of hand soap and fill with enough water to cover. If storing in a zip-lock bag, exclude as much air as possible.
- Store at room temperature away from direct light or in a refrigerator.

If choosing to use an "organ replacement puck" (a new set of organs)

- Remove any metal (such as surgical staples), which can rust. Sutures and nonmetal implants are safe to leave in the tissue.
- Used soft tissue (synthetic organ tissue) is safe to dispose of with other nonrecyclable material.
- Place the replacement puck of new tissue inside the frog's abdomen.
- Wrap the new, synthetic skin over the frog's abdomen and button it on the backside of the frog.
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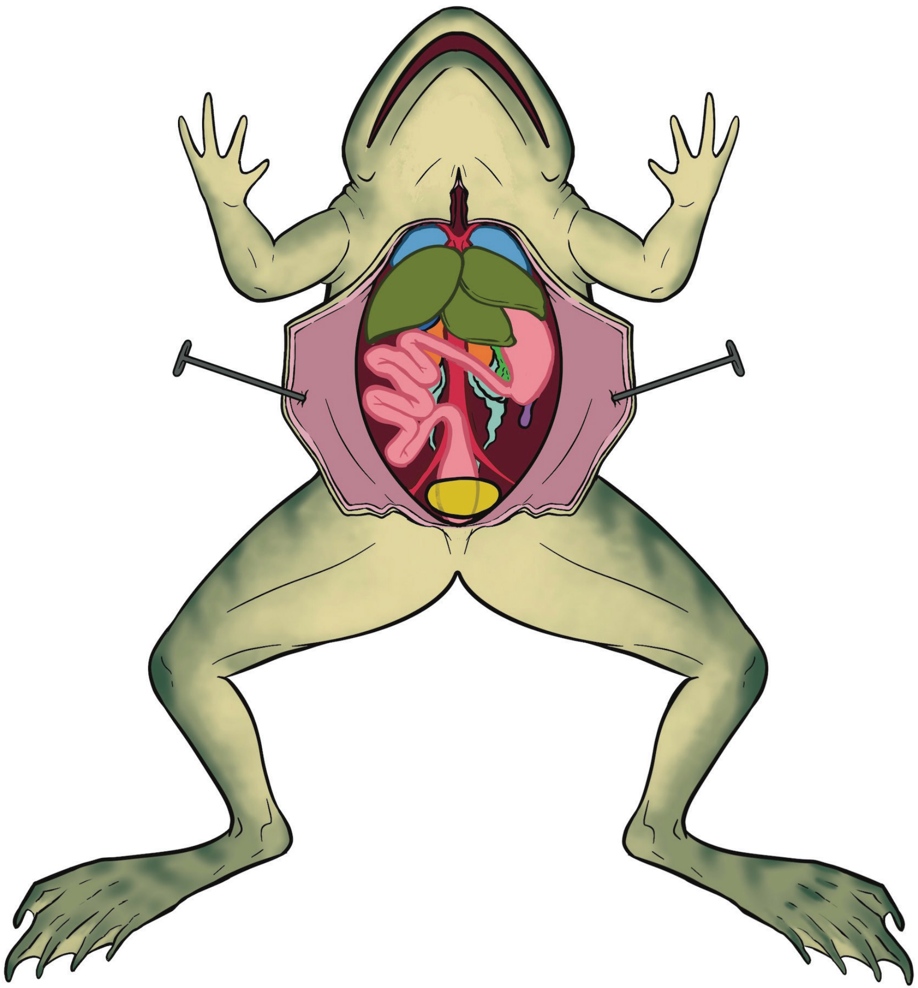
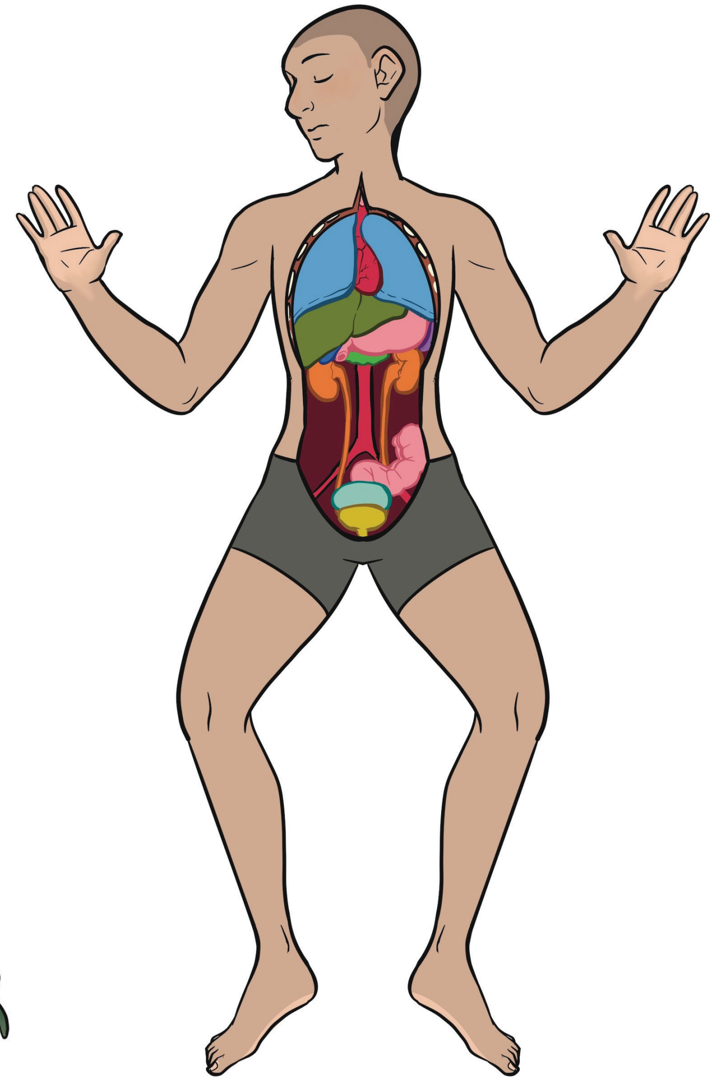
Frog Anatomy vs. Human Anatomy





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Name ______________________________ Date ______________________

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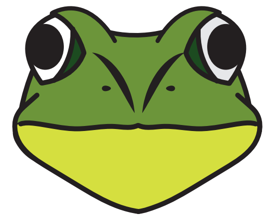

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8. Frogs—like many other amphibians—can exchange oxygen and carbon dioxide through their skin via a process called **cutaneous respiration**.

Define the following terms from the video:

Amphibian ______________________________

Metamorphosis ______________________________

Ectothermic ______________________________

Cutaneous respiration ______________________________

Bioindicator ______________________________

Estivation ______________________________

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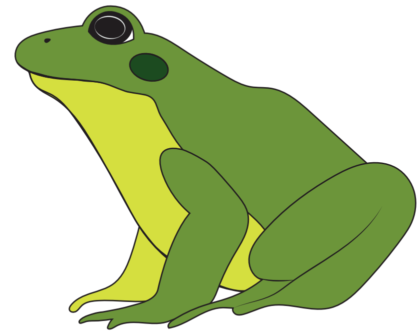
Name ______________________________ Date ______________________

Comparative Anatomy



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Using the video of the SynFrog dissection, compare the following body systems found in amphibians (such as frogs) and in mammals (such as humans).

Body System	Amphibians	Mammals
Digestive		
Respiratory		
Circulatory		
Nervous		
Skeletal		