# Frog Anatomy Body Systems Lesson Plan

GRADES K-6

Animal Welfare Institute

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*AWI wishes to thank Elisabeth Ormandy for granting us permission to use and share these lesson plans in the hopes that more classrooms can replace once-living specimens with alternatives. This content was generated outside of AWI and we do not warrant the accuracy or timeliness of any information contained in this version. Please refer to your school district's requirements to ensure alignment with the relevant standards.*

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# Curriculum Alignment

This lesson plan can be used to create classes for Grades K–6 based on the BC Science Curriculum. Specific Big Ideas covered in this lesson plan include:

**Kindergarten**

Animals have observable features

**Grade 1**

Living things have observable features and behaviours that help them survive in their environment

**Grade 2**

Living things have life cycles adapted to their environment

**Grade 4**

All living things sense and respond to their environment

**Grade 5**

Multicellular organisms have organ systems that help them to survive and interact with their environment

**Grade 6**

Multicellular organisms rely on internal systems to survive, reproduce, and interact with their environment

We have recommended specific anatomy apps and virtual dissection tools to use to get the most out of the lesson plans. You'll find links to those on page 9.

# Learning Objectives

This lesson plan for summary of frog adaptations, lifecycle, and body systems can be condensed into a summary class or used to delve into each body system over multiple classes. It can be adapted for Grades K–6 depending on the level of detail covered.

By the end of the lesson students should be able to:

**Kindergarten–Grade 1**

- Explain how key anatomical features help frogs in their natural environments

**Grade 2**

- Describe the major stages of frog development from fertilized egg to grown adult

**Grades 5–6**

- Identify the major organ systems of frogs and their major components
- Explain the function of each major organ Explain how the major organ systems in frogs work together to create whole functioning organisms
- Identify key similarities and differences between frogs and humans

# All About Frogs!

*Use these notes to inform your class content, no matter what grade you're teaching!*

Frogs are part of the same kingdom as humans, Kingdom Animalia. Frogs are amphibians, the "cold-blooded", vertebrate cousins of humans—their blood isn't actually cold though, it is always the same as the ambient temperature (as opposed to humans, who are "warm-blooded" and whose blood remains at a constant 36.5–37.5 degrees Celsius). Frogs have smooth, moist skin, lay jelly-like eggs, and leave the water to spend their adult life on land. Many amphibians go through a process known as metamorphosis, a physical change in their bodies as they grow from a tadpole to an adult.

Frogs can overwinter by burying themselves underground and by using an internal form of "antifreeze" that keeps them from turning into frog-sicles. Frogs are great indicators of ecosystem health. If you ever find a wild frog with more than four limbs, chances are you may have pollutants in your watershed system. Why would this be important? Well, frogs have many of the same organ systems as humans. Studying them in their natural habitat helps us to understand how pollutants in our waterways may also affect human health.

## EXTERNAL ANATOMY

At the front of the frog's head you'll find two small slits. Frogs have a set of internal and external **nares** (nostrils) through which the frog breathes. Directly behind the nares are two eyes covered by a transparent membrane, which acts like a third eyelid to protect the frog's eyes while it swims and eats. Frogs do not have ears like humans. Instead, their eardrum, or **tympanic membrane**, resides externally on either side of the head, toward the junction of the head and body, and receives sound input from the environment. Frogs have smooth, moist skin and secrete a mucus (from mucus glands below the skin surface), which allows them to stay moist. The moisture facilitates diffusion of oxygen across the skin surface, allowing the frog to "breathe." At the posterior end of the body is the **cloaca**—the common exit for the digestive, urinary and reproductive systems. The fore and hind limbs of frogs vary in size and shape. Female frogs lays eggs in the water while the male releases his sperm to fertilize the eggs externally. The hind limbs are very muscular, allowing frogs to jump great distances. Webbed hind feet assist in assist in propelling them through water while swimming.

## INTERNAL ANATOMY

To capture prey, a frog shoots out a long, muscular, sticky **tongue**, which is connected at the front of the mouth (unlike ours, which is attached at the back of our mouth). The tongue retrieves the prey and brings it into the mouth for consumption. Frogs may also use their lower jaw to capture food. Frogs have two types of cone teeth: the maxillary teeth (found around the edge of the upper jaw) and the **vomerine teeth** (found on the roof of the mouth) to grasp prey. The **esophagus** carries food from the mouth to the stomach using muscle contractions called **peristalsis**. As it does in humans, the **stomach** mechanically and chemically breaks food down and provides a storage area for the food until it is ready to move to the small intestine. It's in the **small intestine** that most of the chemical digestion and absorption of nutrients takes place, with the help of organs such as the **pancreas** (which releases digestive enzymes into the small intestine), the **liver** (which makes bile and filters the blood of toxins) and the **gallbladder** (which stores the bile, and releases it into the small intestine via the bile duct).

The **spleen** hangs out with the digestive organs but is not technically a digestive organ—it is part of the lymphatic/immune system and recycles worn out blood cells. As nutrients are absorbed from the digestive system, extra nutrients get stored in the **fat bodies**. Fat bodies help to insulate the body from the cold and are also used to provide nutrition during mating and hibernation.

Two dark, elongated **kidneys** on the inner dorsal surface work with the digestive and circulatory systems to filter and remove liquid waste from the frog's blood stream. Any collected fluid will be stored in the **urinary bladder** until it is ready to be released through the **cloaca**. Any undigested remains of food are stored in the rectum until they are ready to be expelled from the body through the **cloaca**, the common exit for food and water waste, as well as sperm and eggs.

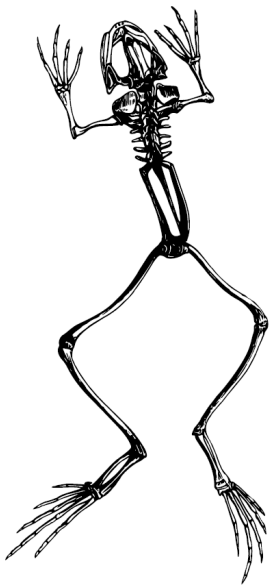
Frogs have two small **lungs** that flank either side of the heart near the dorsal surface in their adult form. The lungs are responsible for the exchange of oxygen and carbon dioxide in the blood.

The amphibian circulatory system is less complex than the human system. The frog **heart** consists of three chambers: two **atria** that receive blood and one **ventricle** that pumps blood. At the anterior region of the ventricle, the conus arteriosus carries blood away from the heart. Within the **conus arteriosus** is a valve that directs oxygenated and deoxygenated blood to the appropriate vessels. The

conus arteriosus splits into two smaller arteries, the left and right truncus arteriosus. Each **truncus arteriosus** carries blood to its respective side and further branches into three smaller aortic arches, which carry blood to specific regions of the body. The common carotid arteries deliver oxygenated blood to the head region, the **pulmocutaneous arteries** deliver deoxygenated blood to the lungs and skin, and the **systemic arteries** turn caudally, or toward the tail, to deliver more oxygenated blood to the arms via the **subclavian arteries** and to the rest of the body.

Males have a special pad located on their thumbs called a **nuptial pad**, which they use during mating to grasp the female. Internally, the distinction is much easier to make. Males have two **testes** located at the end of spermatic canals. The testes produce **sperm** and store it until it is ready to be released through the spermatic canals during reproduction. Females have two large **ovaries**, which produce hundreds of **eggs**. The eggs are moved through two long **oviducts** to be released for fertilization by the male during their mating hug. On their journey along the oviducts, the eggs are coated in a thick protective jelly.

Even though a frog's nervous system is more primitive compared to a human's, frogs exhibit many sophisticated behaviors. Like all vertebrates, they have an anteriorly located **brain** that controls all life functions such as hunting, hibernating or mating. The brain is comprised of three main regions: the **forebrain**, the **midbrain**, and the **hindbrain**. The forebrain is further subdivided into the **telencephalon** and the **diencephalon**. The anterior telencephalon bears two **cerebral hemispheres** and two **olfactory lobes**. Cerebral hemispheres function in higher order thoughts, such as intelligence and memory, as well as control voluntary and involuntary movements. The olfactory lobes receive chemical inputs to be interpreted by the brain as smell. The midbrain contains the **optic lobes**, which perceive visual stimuli such as dark, light intensity and color. The hindbrain consists of the **cerebellum** and the **medulla oblongata**. The cerebellum is the structure that provides balance and coordination, while the medulla regulates automatic body functions such as digestion and respiration. The medulla continues out of the skull and becomes the **spinal cord**. The spinal cord leaves the frog's skull and is housed inside the bony spine, which is comprised of ten **vertebrae**.



# Recommended software and other education tools

3D Frog Anatomy app by Biosphera
(also available via Google Play and as a desktop install)

Paper frog dissections and worksheets by Mel and Gerdy
(These are great fun! We highly recommend trying to get these to your students even if you're teaching online.)

Froggipedia app for frog life cycle
(only available for iPads)

Emantras virtual frog dissection app
(supplemental; also available via Google Play)

Uncover a Frog book
(supplemental)

4D Vision Frog Anatomy model
(supplemental)

# Recommended hardware/workbooks

This inventory is for regular in-person classes. For responsible physical distancing use one tablet per student. If teaching online, screen share your own tablet or desktop with the Biosphera 3D Frog Anatomy app installed, and use electronic versions of the Frog Anatomy Workbook.

**Six (or more) tablets**

**Six (or more) constructed frog paper dissections** (3 male, 3 female) with blank legends printed out (the legends are part of the frog paper dissection bundle from Getting Nerdy with Mel and Gerdy, linked below) and the relevant numbers highlighted to focus students on the body systems/organs you want to cover. If teaching online, we recommend trying to get paper frogs to your students somehow, whether you arrange for them to pick them up at the school, mail them, or have them print them at home. Their homework can be to cut out their frog and stick it together before class (assembly instructions are included in the bundle from Mel and Gerdy)

**Six (or more) printed copies of the Frog Anatomy Workbook** (accompanies the 3D Frog Anatomy app; contact us if you don't already have access as part of your subscription with us)

## IF TEACHING PHYSICALLY-DISTANCED CLASSES

Use one tablet and one constructed paper frog dissection for each student. Give half the students a female paper frog and the other half a male paper frog. Proceed as per directions above.

## IF TEACHING ONLINE

You can either mail the students the paper frog dissections, or ask them to print them at home or pick them up from the school if you want to include those in your lesson plan. If using the paper dissections, it's fun homework to ask the students to build their frog ahead of time by cutting it out and sticking it together before class—full assembly instructions are given as part of the Mel and Gerdy frog dissection bundle.

Guide the students through a demonstration of each body system by screen sharing your own tablet or desktop with the 3D Frog Anatomy app by Biosphera installed.

Take 10–15 minutes per body system.

Pause for a Kahoot quiz check-in at the end of each body system to see what information the students learned.

Students can follow along using an online version of our Frog Anatomy Workbook.

# Kindergarten–Grade 1 Lesson Plan

TOPIC: Living things have observable features and behaviors that help them survive in their environment.

CONTENT: Features and behaviors of frogs that help them succeed in their semi-aquatic habitat.

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|---|---|
| **Goals** | Students will be able to:<br>• Describe what type of animals frogs are<br>• Describe their natural habitat<br>• Identify that observable features and behaviors of frogs that help them survive in their environment |
| **Objectives** | After this lesson students will state four or more major features or behaviors of frogs that help them succeed in their natural habitats |
| **Materials** | Froggipedia app<br>Frog Features worksheet (see page 14) |
| **Introduction** | Using the Froggipedia app, the teacher will introduce the topic of frogs, where they live, and some important vocabulary students will need to learn. |
| **Development** | Questions to support inquiry-based learning:<br>• How do the different features of frogs help them with their basic needs?<br>• How do frogs use those features to respond to stimuli in the environment?<br>• How do frogs adapt when their basic needs are not being met?<br>• How do frogs depend on their environment? |
| **Practice** | Students will work independently or in pairs to circle features on their frog diagram. Students will then hear from others in their class, and add to their own diagram. |

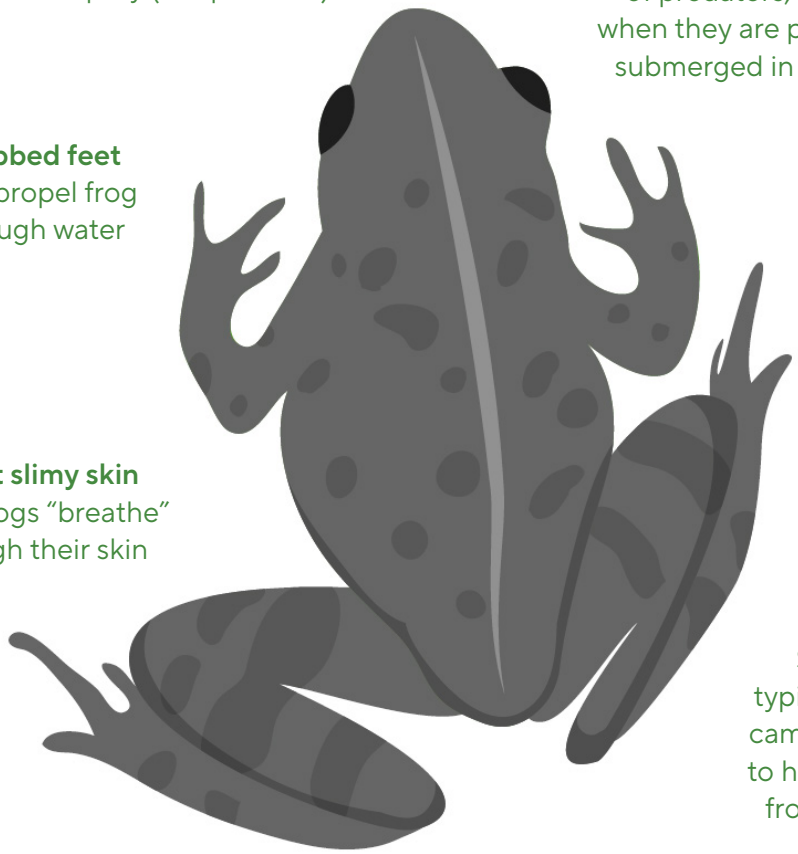
# Frog Features

Ask students to draw a circle around three different features of frogs that they think help them survive in their environments. Follow up with a class discussion. Ask them *why* they chose to circle the features they did and ask them to add ideas from other students to their own diagram.

**Long sticky tongue** helps them catch prey (not pictured)

**Large bulging eyes** helps frogs stay vigilant of predators, even when they are partially submerged in water

**Webbed feet** help propel frog through water



**Moist slimy skin** helps frogs "breathe" through their skin

**Skin color** typically helps to camouflage frogs to help them hide from predators

**Strong, muscular back legs** help with (a) hopping to catch food (flies), (b) hopping to avoid predators, and (c) swimming

# Frog Features

# Grade 2 Lesson Plan

TOPIC: Living things have life cycles adapted to their environment.

CONTENT: The lifecycle of frogs and how that helps them succeed in their semi- aquatic habitat.

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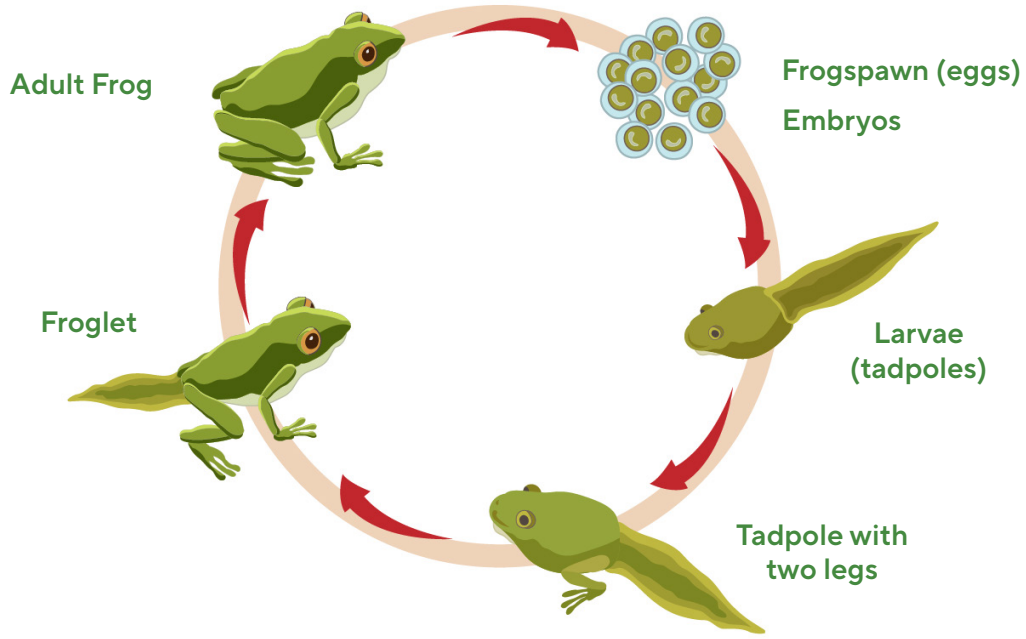
|---|---|
| **Goals** | Students will be able to:<br>• Describe the major stages of the frog life cycle<br>• Explain how frog life cycle is different from other species<br>• Explain how the frog life cycle helps frogs succeed in their habitat |
| **Objectives** | After this lesson students will state the major stages of frog development from egg to full adult |
| **Materials** | Froggipedia app<br>Frog Life Cycle Worksheet (see page 17) |
| **Introduction** | Using the Froggipedia app, the teacher will introduce the topic of the frog life cycle by demonstrating the growth of a single frog egg into a tadpole, then a froglet, then an adult frog. |
| **Development** | Questions to support inquiry-based learning:<br>• Why are life cycles important?<br>• How are the life cycles of frogs and other animals similar/ different?<br>• How do frog offspring compare to their parents? |
| **Practice** | Students will work independently or in pairs to label their frog life cycle worksheet. They will then stay in pairs to discuss how this life cycle is helpful for frogs, and to identify other species who give birth to live young. |

# Frog Life Cycle Teaching Notes




Frogs are **amphibians**, which means that they can live in water or on land. They go through several stages of life before they become adult frogs, and during those stages they live only in water.

STAGE 1: A frog begins life as a **fertilized egg**. A female frog lays a lot of eggs at once in a pond. The eggs float on water in a jelly mass or cluster. Fertilized eggs develop into **embryos**. The embryos will soon hatch into larvae, called **tadpoles**.

STAGE 2: When the tadpole hatches, it looks more like a fish than a frog. It doesn't have any legs. It has **gills** that allow it to breathe underwater. The tadpole swims, eats plants and algae from the water, and grows for several weeks. During this time, the tadpole starts to develop **lungs** so it will be able to breathe out of the water when it becomes a frog. The tadpole also starts to grow two hind legs. Now it can leap around instead of only swimming. Although the tadpole is starting to look a little more like a frog, it still has a long tail.

STAGE 3: The tadpole grows two front legs and its long tail becomes shorter and shorter. The tadpole uses the nutrients stored in its tail as food, so until its tail is completely gone, it doesn't need anything else to eat. Then just a little stub of its tail is left, and the tadpole is a **young frog**. It hops right out of the water and onto dry land for the first time! The frog is still very small. It is called a **froglet**.

STAGE 4: The frog's tail will eventually disappear completely and it will start to eat insects instead of plants from the water. The young frog will grow for about 2–4 years to become an adult. The adult frogs then lay their eggs and more tadpoles hatch and the cycle begins again.

# Frog Life Cycle Student Activities

**Activity 1**

Cut out images of the various stages of frog development and ask the students to work in pairs or small groups to put them in the right order.

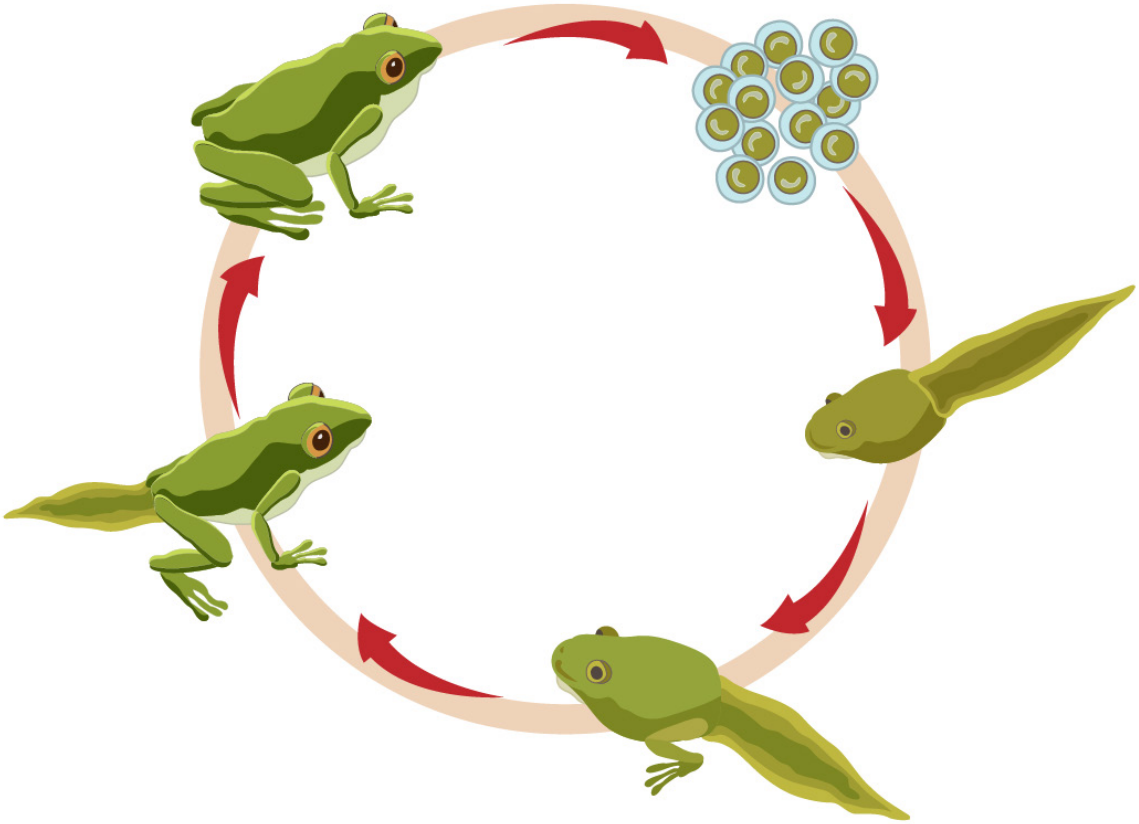
**Activity 2**

Give each student a picture of the frog lifecycle, along with paper labels, for each stage in the lifecycle. Ask the students to put the labels in the right places on their lifecycle picture. (We've provided a blank lifecycle picture on the next page for you to use).

**Activity 3**

If you are able to go on a nature walk with your students to find frogspawn (eggs) in the spring, it can be a great place-based learning opportunity!

# Frog Life Cycle Activity Sheet



Adult Frog

Froglet

Larvae (tadpoles)

Embryos

Frogspawn (eggs)

Tadpole with two legs

# Grade 5–6 Unit Plan: Frog Body Systems

TOPIC: Multicellular organisms have organ systems that help them to survive and interact with their environment.

CONTENT: The different organ systems of frogs and how they help frogs thrive in their semi-aquatic habitat.

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|---|---|
| **Goals** | Students will be able to:<br>• Identify the body systems of frogs and their major components Explain the function of each major organ<br>• Explain how the body systems in frogs work together to create a whole functioning organism<br>• Identify key similarities and differences between frogs and humans |
| **Objectives** | After this unit students will state the major frog body systems and the major organs of each system. They will also identify the major differences and similarities between frogs and humans. |
| **Materials** | 3D Frog Anatomy app by Biosphera<br>Frog Anatomy Workbook<br>Paper frog dissection by Getting Nerdy with Mel and Gerdy<br>Various anatomy worksheets (found within this document) |
| **Introduction** | Using the 3D Frog Anatomy app and the paper frog dissections, the teacher will introduce the various body systems. |
| **Development** | Questions to support inquiry-based learning:<br>• How do body systems interact with one another?<br>• How do a frog's body systems interact with the environment to meet their basic needs?<br>• How are internal systems necessary for survival?<br>• What do body systems require for survival? |
| **Practice** | Going one body system at a time (one system per lesson), students will work independently or in pairs to fill out the legend of their paper frog dissection by using the 3D Frog Anatomy app to help them identify the different organs. |

# Grade 5–6 Unit Plan Overview

| BODY SYSTEM LESSON | MAJOR COMPONENTS |
|---|---|
| **Digestive** | esophagus, stomach, pancreas, liver, gallbladder, (spleen), small intestine, large intestine, cloaca |
| **Musculoskeletal** | bones, tendons, ligaments, muscles, fascia |
| **Respiratory** | trachea, bronchial tube, bronchioles, alveoli, lungs, skin |
| **Circulatory** | heart, arteries, veins, capillaries |
| **Urogenital (Excretory and Reproductive)** | kidneys, ureter, bladder, ovaries and oviducts (female), testes (male), cloaca, fat bodies |
| **Endocrine (Hormonal)** | adrenals, hypothalamus, ovaries, pancreas, pituitary, testes, thyroid |
| **Nervous and Sensory** | brain, spinal cord, nerves, neurons / eyes, internal ears, sensory papillae, taste buds, nasal epithelium |

# Grade 5–6 Unit Plan Approach

## IF TEACHING REGULAR IN-PERSON CLASSES:

- Split students into 6 groups.
- Give each group one constructed paper frog dissection model to refer to and a blank legend with highlighted numbers to indicate which sections to fill out (you'll need to prepare these ahead of time—the legends are part of the frog paper dissection bundle from Getting Nerdy with Mel and Gerdy, linked on page 9). The legend corresponds to the paper dissection and the apps will be used to help identify tissues and organs so that students can fill in the blanks. Give three of the groups a female paper frog and the other three groups a male paper frog.
- Give all groups one (or more) tablet(s) with the 3D Frog Anatomy app loaded and ready to use (linked on page 9).
- For each body system, give the students time explore the apps and do self-directed learning to learn about the organs. Ask them to fill in the blanks of their paper dissection legends using the app to help them.
- Every 15-minutes or so, have a 5-minute check-in to make sure the students are sticking to the learning objectives and filling their legends out correctly.
- The Froggipedia app, Emantras virtual frog dissection app, Uncover a Frog book, and 4D Vision Frog Anatomy model can be used as supplemental materials if you wish. All are linked on page 9. Close each lesson with a focused discussion to recap what was learned, to discuss how the major body systems work together, and to make sure you've covered all your learning objectives.

## IF TEACHING PHYSICALLY DISTANCED CLASSES:

- Proceed as above but with one tablet and one paper frog per student.

## IF TEACHING ONLINE:

- Screen share your own desktop or tablet to guide students through each organ system (one per lesson).
- We recommend using Kahoot quizzes to create learning games and to keep students engaged. Ask students to fill out their paper frog legends as you go along (if doing this you'll need to arrange for students to have access to paper frogs ahead of teaching this unit—you can either mail them, arrange for them to be picked up at the school, or ask students to print out their frogs at home).

# Detailed Grade 5–6 Lesson Plans and Teaching Notes

## INTRODUCTION TO TOPIC

Have a conversation about why you're choosing to use non-animal teaching methods rather than real animal specimens, and how this aligns with a culture of respect for animals.

Introduce the software and other materials you'll be using to teach frog anatomy.

Give the students a roadmap of topics that will be covered in the body systems unit: digestive, musculoskeletal, respiratory, circulatory, urogenital, endocrine, and nervous and sensory systems, as well as species differences, adaption to habitat and function, etc.

## OPENING QUESTIONS TO CLASS:

1. What type of animals are frogs?
*Amphibians*

2. Where do frogs live?
*They are semi-aquatic so they live on both land and water, typically in freshwater ponds or rivers*

3. Can anyone think of anything special about frogs that helps them adapt to their habitat?
*Camouflage, they can 'breathe' with their skin, strong back legs for jumping, long sticky tongues for catching flies, etc.*

Encourage students to bear these answers in mind as they go through the frog anatomy lessons.

## LESSON PLAN 1: DIGESTIVE SYSTEM

Topic: Multicellular organisms have organ systems that help them to survive and interact with their environment

Content: The frog digestive system

| | |
|---|---|
| **Goals** | Students will be able to:<br>• Identify the major organs of the frog digestive system Explain the function of each major organ<br>• Explain how the major organs work together<br>• Identify key similarities and differences between the digestive systems of frogs and humans |
| **Objectives** | After this lesson students will state the organ in the frog digestive system and explain the function of each organ. They will also identify the major differences and similarities between the digestive systems of frogs and humans. |
| **Materials** | 3D Frog Anatomy app by Biosphera<br>Frog Anatomy Workbook (to accompany 3D Frog Anatomy app)<br>Paper frog dissection by Getting Nerdy with Mel and Gerdy |
| **Introduction** | Using the 3D Frog Anatomy app and the paper frog dissections, the teacher will introduce the digestive system. |
| **Development** | The teacher will ask students to explain how the various organs in the frog digestive system work together to help digest food. The teacher will also ask the students how they think frog and human digestive systems are similar and different. |
| **Practice** | Going one digestive organ at a time students will work independently or in pairs to fill out the legend of their paper frog dissection by using the 3D Frog Anatomy app to help them identify the different digestive organs. |

## DIGESTIVE SYSTEM

| | |
|---|---|
| **Mouth** | Digestion begins in the mouth. The tongue pulls food in. The teeth are used to pin down prey before swallowing (not for chewing). |
| **Esophagus** | After swallowing food moves through the esophagus. Wave-like muscular contractions along the esophagus, called peristalsis, move the food along and into the stomach. |
| **Stomach** | The stomach uses mechanical and chemical digestion to break down food further. Three layers of muscle contract in different directions to break down food mechanically. Gastric acid (hydrochloric acid) and protein-digesting enzymes are released into the stomach for chemical digestion. |
| **Small Intestine** | Food then passes into the small intestine—in the upper portion of the small intestine digestion continues via secretion of pancreatic digestive enzymes from the pancreas, and bile from the gallbladder. In the lower portion of the small intestine, nutrient absorption occurs via intestinal villi, which line the inner surface of the intestine. Nutrients pass across the villi wall to surrounding capillaries and into the bloodstream. |
| **Pancreas** | Both a digestive and endocrine organ. In its digestive function it releases digestive enzymes into the small intestine that break down carbohydrates and proteins. In its endocrine function it produces insulin, glucagon and glycogen, which together work to regulate blood sugar levels. |
| **Liver** | Has three lobes. Produces bile, which contains enzymes that break down fats. Also the body's major waste filter—via the hepatic portal system blood is filtered through special functional cells called hepatocytes. |
| **Gallbladder** | Stores bile for release into the upper portion of the small intestine. |
| **Large Intestine** | Responsible for absorption of water. |
| **Cloaca** | The exit-hole for urine, feces, and sperm/eggs in frogs. |

### During check in:

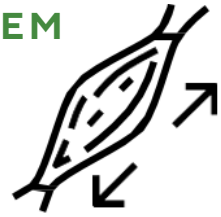
Highlight key differences between frogs and other species, especially humans:
*Vomerine teeth, cloaca, three liver lobes (humans have two).*

Highlight key similarities between frogs and other species, especially humans:
*Same major organs with same functions and cellular processes.*

### Development question:

- How does the digestive system work with the circulatory system to make sure nutrients absorbed during digestion are carried into the bloodstream?

## LESSON PLAN 2: MUSCULOSKELETAL SYSTEM



Topic: Multicellular organisms have organ systems that help them to survive and interact with their environment

Content: The frog musculoskeletal system

| | |
|---|---|
| **Goals** | Students will be able to:<br>• Identify the major organs and tissues of the frog musculoskeletal system<br>• Explain the function of each major organ/tissue Explain how the major organs/tissues work together Identify key similarities and differences between the musculoskeletal systems of frogs and humans |
| **Objectives** | After this lesson students will state the organs/tissues in the frog musculoskeletal system and explain the function of each. They will also identify the major differences and similarities between the musculoskeletal systems of frogs and humans. |
| **Materials** | 3D Frog Anatomy app by Biosphera<br>Frog Anatomy Workbook (to accompany 3D Frog Anatomy app)<br>Paper frog dissection by Getting Nerdy with Mel and Gerdy |
| **Introduction** | Using the 3D Frog Anatomy app and the paper frog dissections, the teacher will introduce the musculoskeletal system. |
| **Development** | The teacher will ask students to explain how the various organs in the frog musculoskeletal system work together to help with body stability and movement. The teacher will also ask the students how they think frog and human musculoskeletal systems are similar and different. |
| **Practice** | Going one organ/tissue at a time students will work independently or in pairs to fill out the legend of their paper frog dissection by using the 3D Frog Anatomy app to help them identify the different musculoskeletal organs/tissues. |

## MUSCULOSKELETAL SYSTEM

| | |
|---|---|
| **Bones** | The major functions of the bones are body support, facilitation of movement, protection of internal organs, and the production of red blood cells. |
| **Tendons** | A fibrous connective tissue, which attaches muscle to bone. |
| **Ligaments** | A fibrous connective tissue, which attaches bone to bone. |
| **Muscles** | Muscles allow a frog to move, vocalize and chew. They control heartbeat, breathing, and digestion. Other seemingly unrelated functions, including vision, also rely on the muscular system. There are three types of muscles: skeletal (consciously controlled), smooth (lines blood vessels and organs) and cardiac (located only in the heart). |
| **Fascia** | Connective tissue that surrounds muscles, groups of muscles, blood vessels, and nerves, binding some structures together, while permitting others to slide smoothly over each other. |

### During check in:

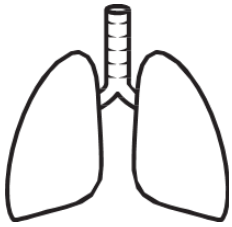
Highlight key differences between frogs and other species, especially humans:
*Bones—frogs only have one forearm bone (humans have two), frogs only have one lower-leg bone (humans have two), frogs have nine vertebrae (humans have 24), frogs have no ribs. Muscles—a frog's rear leg muscles are proportionally larger than a human's, frogs have no diaphragm.*

Highlight key similarities between frogs and other species, especially humans:
*Same major components (bones, muscles, tendons, ligaments, fascia) with same functions and cellular processes. Many of the same muscle groups.*

### Development question:

- How does the musculoskeletal system work with the nervous system to make sure there is coordination between muscles and nerves?
- How does the musculoskeletal system work with the circulatory system to make sure muscles get the oxygen they need to function effectively?

## LESSON PLAN 3: RESPIRATORY SYSTEM



Topic: Multicellular organisms have organ systems that help them to survive and interact with their environment

Content: The frog respiratory system

| | |
|---|---|
| **Goals** | Students will be able to:<br>• Identify the major organs and tissues of the frog respiratory system Explain the function of each major organ<br>• Explain how the major organs work together<br>• Identify key similarities and differences between the respiratory systems of frogs and humans |
| **Objectives** | After this lesson students will state the organs in the frog respiratory system and explain the function of each. They will also identify the major differences and similarities between the respiratory systems of frogs and humans. |
| **Materials** | 3D Frog Anatomy app by Biosphera<br>Frog Anatomy Workbook (to accompany 3D Frog Anatomy app)<br>Paper frog dissection by Getting Nerdy with Mel and Gerdy |
| **Introduction** | Using the 3D Frog Anatomy app and the paper frog dissections, the teacher will introduce the respiratory system. |
| **Development** | The teacher will ask students to explain how the various organs in the frog respiratory system work together with the circulatory system to result in effective respiration. The teacher will also ask the students how they think frog and human respiratory systems are similar and different. |
| **Practice** | Going one organ at a time students will work independently or in pairs to fill out the legend of their paper frog dissection by using the 3D Frog Anatomy app to help them identify the different respiratory organs. |

## RESPIRATORY SYSTEM

| | |
|---|---|
| **Trachea** | AKA 'windpipe'—a small nodule in frogs rather than a long tube. It moves into the lungs via the divided bronchial tube. |
| **Bronchial tube** | Appears within the lungs in frogs. Divides further into smaller branches called bronchioles. |
| **Bronchioles** | Small branched tubes that carry air to terminal air sacs called alveoli. |
| **Alveoli** | Air sacs that are located at the end of the bronchioles. Just one cell wall thick, the alveoli are surrounded by tiny blood vessels called capillaries. They are the site of gas exchange in the lungs (i.e. where oxygen passes into the bloodstream and carbon dioxide passes out). |
| **Lungs** | Major respiratory organs that expand and fill with air on an inhale, and deflate and empty of air on an exhale. |
| **Skin** | Frogs can 'breathe' through their skin! Except for on their hands and feet, frog skin does not contain keratin, so it is gas permeable. This means oxygen can pass into frogs' bloodstream via their skin, and carbon dioxide can pass out. |

### During check in:

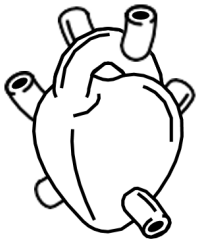
Highlight key similarities between frogs and other species, especially humans:
*Most of the same major organs (bronchial tube, bronchioles, alveoli = lungs). Bronchial tube is inside lungs in frogs, but is outside lungs in humans.*

Highlight key differences between frogs and other species, especially humans:
*1) A frog's trachea is a small nodule instead of a longer tube.*
*2) Frogs have no diaphragm so they use their mouth cavity to pull air into their lungs. This is called buccopharyngeal breathing.*
*3) Frogs can breathe with their skin—human skin has a substance called keratin, which makes it waxy, waterproof and not permeable for gases. Frogs only have keratin on their hands and feet, the rest of their skin has no keratin so it is gas permeable.*

### Development question:

- How do frogs' unique respiratory system (i.e. ability to breathe through skin) help them in their natural environment?
- How does the respiratory system work together with the circulatory system to make sure that oxygen reaches all the parts of the body, and that carbon dioxide is expelled?

## LESSON PLAN 4: CIRCULATORY SYSTEM



Topic: Multicellular organisms have organ systems that help them to survive and interact with their environment

Content: The frog circulatory system

| | |
|---|---|
| **Goals** | Students will be able to:<br>• Identify the major organs and tissues of the frog circulatory system Explain the function of each major organ<br>• Explain how the major organs work together<br>• Identify key similarities and differences between the circulatory systems of frogs and humans |
| **Objectives** | After this lesson students will state the organs in the frog circulatory system and explain the function of each. They will also identify the major differences and similarities between the circulatory systems of frogs and humans. |
| **Materials** | 3D Frog Anatomy app by Biosphera<br>Frog Anatomy Workbook (to accompany 3D Frog Anatomy app)<br>Paper frog dissection by Getting Nerdy with Mel and Gerdy |
| **Introduction** | Using the 3D Frog Anatomy app and the paper frog dissections, the teacher will introduce the circulatory system. |
| **Development** | The teacher will ask students to explain how the various organs in the frog circulatory system work together with other body systems to result in effective functioning. The teacher will also ask the students how they think frog and human circulatory systems are similar and different. |
| **Practice** | Going one organ at a time students will work independently or in pairs to fill out the legend of their paper frog dissection by using the 3D Frog Anatomy app to help them identify the different circulatory organs. |

## CIRCULATORY SYSTEM

| | |
|---|---|
| **Heart** | Frogs have three heart chambers (unlike humans, who have four). Frogs have two atriums and one ventricle.<br>• The right atrium receives deoxygenated blood from the blood vessels (veins) that drain the various organs of the body.<br>• The left atrium receives oxygenated blood from the lungs and skin (which also serves as a gas exchange organ in most amphibians).<br>• Both atria empty into the single ventricle. While this might appear to waste the opportunity to keep oxygenated and deoxygenated bloods separate, the ventricle is divided into narrow chambers that reduce the mixing of the two types of blood.<br>When the ventricle contracts,<br>• oxygenated blood from the left atrium is sent, relatively pure, into the carotid arteries taking blood to the head (and brain);<br>• deoxygenated blood from the right atrium is sent, relatively pure, to the pulmocutaneous arteries taking blood to the skin and lungs where fresh oxygen can be picked up. |
| **Sinus venosus** | A large cavity that contracts to drive blood into the right atrium. |
| **Veins** | Veins **always** carry blood towards the heart, and usually carry deoxygenated blood. The only vein that carries oxygenated blood is the pulmonary vein, which carries blood from the lungs towards the heart. Major vein = vena cava. |
| **Arteries** | Arteries **always** carry blood away from the heart, and usually carry oxygenated blood. The only vein that carries deoxygenated blood is the pulmonary artery that carries deoxygenated blood away from the heart to the lungs. Major artery = aorta |
| **Capillaries** | Capillaries are tiny blood vessels that are just one cell wall thick. This means that various substances like gases, nutrients, waste products, hormones, etc. can pass across the cell wall of capillaries. |

### During check in:

Highlight key similarities between frogs and other species, especially humans:
*Same major organs and vessels (heart, veins, arteries, capillaries)*

Highlight key differences between frogs and other species, especially humans:
*Frogs have three chambers in their heart, humans have four chambers. Frogs have three circuits for their circulation (unlike humans, who have two)—the systemic circuit, which pumps oxygenated blood throughout the body, the pulmonary circuit moves blood to the lungs to pick up oxygen, and the pulmocutaneous circuit, where deoxygenated blood is transported to the skin to pick up oxygen and undergo gas exchange..*

### Development question:

- Why might frogs only have three chambers in their heart?
- How does the circulatory system work together with the respiratory system to get oxygen into the body?
- How does the circulatory system work together with the digestive system to get nutrients into the bloodstream?

## LESSON PLAN 5: UROGENITAL SYSTEM (EXCRETORY AND REPRODUCTIVE)

Topic: Multicellular organisms have organ systems that help them to survive and interact with their environment

Content: The frog urogenital system

| | |
|---|---|
| **Goals** | Students will be able to:<br>• Identify the major organs and tissues of the frog urogenital system<br>• Explain the function of each major organ Explain how the major organs work together<br>• Identify key similarities and differences between the urogenital systems of frogs and humans |
| **Objectives** | After this lesson students will state the organs in the frog urogenital system and explain the function of each. They will also identify the major differences and similarities between the urogenital systems of frogs and humans. |
| **Materials** | 3D Frog Anatomy app by Biosphera<br>Frog Anatomy Workbook (to accompany 3D Frog Anatomy app)<br>Paper frog dissection by Getting Nerdy with Mel and Gerdy |
| **Introduction** | Using the 3D Frog Anatomy app and the paper frog dissections, the teacher will introduce the urogenital system. |
| **Development** | The teacher will ask students to explain how the various organs in the frog urogenital system work together with other body systems to result in effective functioning. The teacher will also ask the students how they think frog and human urogenital systems are similar and different. |
| **Practice** | Going one organ at a time students will work independently or in pairs to fill out the legend of their paper frog dissection by using the 3D Frog Anatomy app to help them identify the different urogenital organs. |

## UROGENITAL SYSTEM (EXCRETORY AND REPRODUCTIVE)

| | |
|---|---|
| **Kidneys** | Filters blood and produces urine. Functional unit—nephrons, which are responsible for blood filtration, reabsorption of water and other important substances, and secretion of urine. In frogs nephrons are shorter (they don't have a loop of Henle) because frogs are semi-aquatic and don't need to reabsorb water to the same degree that other animals and humans do. |
| **Ureters (labeled as archinephric duct in males)** | The tubes that connect the kidneys and bladder. The urine produced by the kidneys, travels along these tubes for storage in the bladder. In males this tube (also called the archinephric duct) also carries sperm from the testes to the cloaca. |
| **Bladder** | Stores urine. |
| **Cloaca** | The exit-hole for urine, feces, and sperm/eggs in frogs. |
| **Testes** | Pair of oval-shaped structures that produce sperm—sperm are released into the cloaca via the archinephric duct (see description above). |
| **Ovaries** | Paired structures that produce eggs. |
| **Oviducts** | Long coiled ducts that connect the ovaries and the cloaca. As eggs travel along the oviduct they are coated in a thick protective jelly. |
| **Fat bodies** | Large, yellow, finger-like structures that store fat (energy) for mating, hibernating, and metamorphosis. |

### During check in:

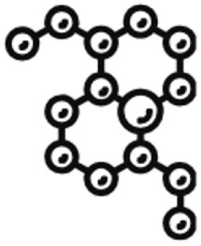
Highlight key similarities between frogs and other species, especially humans:
*Same major organs and functions.*

Highlight key differences between frogs and other species, especially humans:
*Frogs lay eggs, no penis in males, no discernible uterus in females—ask class why? How does this anatomical arrangement fit frogs' reproductive strategy? They are an r-selected species, which means they produce large numbers of offspring and only put a small investment of resources into each offspring (as opposed to k-selected species like humans, who invest a great deal of resources into raising very few offspring).*

### Development question:

- Looking at your paper frog dissections—Do you have a male frog or a female frog? How do you know? Compare your paper frog with another group that has a different sex.

## LESSON PLAN 6: ENDOCRINE (HORMONAL) SYSTEM



Topic: Multicellular organisms have organ systems that help them to survive and interact with their environment

Content: The frog endocrine system

| | |
|---|---|
| **Goals** | Students will be able to:<br>• Identify the major organs and tissues of the frog endocrine system<br>• Explain the function of each major organ Explain how the major organs work together<br>• Identify key similarities and differences between the endocrine systems of frogs and humans |
| **Objectives** | After this lesson students will state the organs in the frog endocrine system and explain the function of each. They will also identify the major differences and similarities between the endocrine systems of frogs and humans. |
| **Materials** | 3D Frog Anatomy app by Biosphera<br>Frog Anatomy Workbook (to accompany 3D Frog Anatomy app)<br>Paper frog dissection by Getting Nerdy with Mel and Gerdy |
| **Introduction** | Using the 3D Frog Anatomy app and the paper frog dissections, the teacher will introduce the endocrine system. |
| **Development** | The teacher will ask students to explain how the various organs in the frog endocrine system impact with other body systems. The teacher will also ask the students how they think frog and human endocrine systems are similar and different. |
| **Practice** | Going one organ at a time students will work independently or in pairs to fill out the legend of their paper frog dissection by using the 3D Frog Anatomy app to help them identify the different endocrine organs. |

## ENDOCRINE (HORMONAL) SYSTEM

| | |
|---|---|
| **Adrenals** | Produce adrenaline and cortisol (the stress hormone). |
| **Hypothalamus** | The hypothalamus produces a variety of hormones that are responsible for body temperature, hunger, moods and the release of hormones from other glands; and also controls thirst and sleep. |
| **Ovaries** | Produce estrogen and progesterone—female sex hormones. |
| **Pancreas** | Produces insulin (which reduces blood sugar) and glucagon (which increases blood sugar). |
| **Pituitary** | The pituitary gland controls the function of most other endocrine glands and is therefore sometimes called the master gland. It produces a wide variety of different hormones that influence other endocrine glands. |
| **Testes** | Produce testosterone—male sex hormone. |
| **Thyroid** | The thyroid gland produces hormones that regulate the body's metabolic rate controlling heart, muscle and digestive function, brain development and bone maintenance. |

### During check in:

Highlight key similarities between frogs and other species, especially humans:
*Same major endocrine glands and function.*

Highlight key differences between frogs and other species, especially humans:
*No major differences.*

### Development question:

- How does the endocrine system impact other body systems? Think about blood sugar regulation by the pancreas, adrenaline and cortisol release from the adrenal glands, etc.

## LESSON PLAN 7: NERVOUS AND SENSORY SYSTEM

Topic: Multicellular organisms have organ systems that help them to survive and interact with their environment

Content: The frog nervous and sensory system

| | |
|---|---|
| **Goals** | Students will be able to:<br>• Identify the major organs and tissues of the frog nervous and sensory system<br>• Explain the function of each major organ<br>• Explain how the major organs work together<br>• Identify key similarities and differences between the nervous and sensory systems of frogs and humans |
| **Objectives** | After this lesson students will state the organs in the frog nervous and sensory system and explain the function of each. They will also identify the major differences and similarities between the nervous and sensory systems of frogs and humans. |
| **Materials** | 3D Frog Anatomy app by Biosphera<br>Frog Anatomy Workbook (to accompany 3D Frog Anatomy app)<br>Paper frog dissection by Getting Nerdy with Mel and Gerdy |
| **Introduction** | Using the 3D Frog Anatomy app and the paper frog dissections, the teacher will introduce the nervous and sensory system. |
| **Development** | The teacher will ask students to explain how the various organs in the frog nervous and sensory system interact with other body systems, particularly the nervous system. The teacher will also ask the students how they think frog and human nervous and sensory systems are similar and different. |
| **Practice** | Going one organ at a time students will work independently or in pairs to fill out the legend of their paper frog dissection by using the 3D Frog Anatomy app to help them identify the different nervous and sensory organs. |

## NERVOUS AND SENSORY SYSTEM

| | |
|---|---|
| **Brain** | Part of the central nervous system (CNS), the brain is the primary organ that controls movement, muscular contraction, respiration, digestion, and interprets sensory input. |
| **Neurons** | The basic working unit of the brain. Transmits information to other nerve cells. |
| **Spinal cord** | The main pathway to and from the brain. Part of the CNS. |
| **Nerve** | Part of the peripheral nervous system (PNS)—specialized fibre bundles that transmit electrical impulses. Frogs have ten pairs of cranial nerves, which pass information from the outside directly to the brain and ten pairs of spinal nerves, which pass information from the extremities to the brain through the spinal cord. |
| **Eyes** | The eyes of most frogs are located on either side of the head near the top and project outwards as hemispherical bulges. They provide binocular vision over a field of 100° to the front and a total visual field of almost 360°. |
| **Ears** | Frogs do not have external ears; the eardrums (tympanic membranes) are directly exposed or may be covered by a layer of skin and are visible as a circular area just behind the eye. |
| **Taste buds** | Frogs have sensitive taste buds. They will occasionally spit out hastily grabbed prey if the taste is unpleasant. The taste buds are on the surface of the tongue and the inside of the mouth. |
| **Nasal epithelium** | Like humans, frogs use their two nostrils (nares) to sample odors in the air. They also have a second type of olfactory organ between the nostrils, called the Jacobson's organ. It is used to detect chemicals in the water. Because all of their olfactory organs are on the top of their head, frogs can sample air and water odors simultaneously by putting their nostrils just above the water's surface. |

### During check in:

Highlight key similarities between frogs and other species, especially humans:
*Same major nervous and sensory system components.*

Highlight key differences between frogs and other species, especially humans:
*Smaller brain. Fewer cranial and spinal nerves. No folded cerebral cortex. Internal ears. 360 degree vision.*

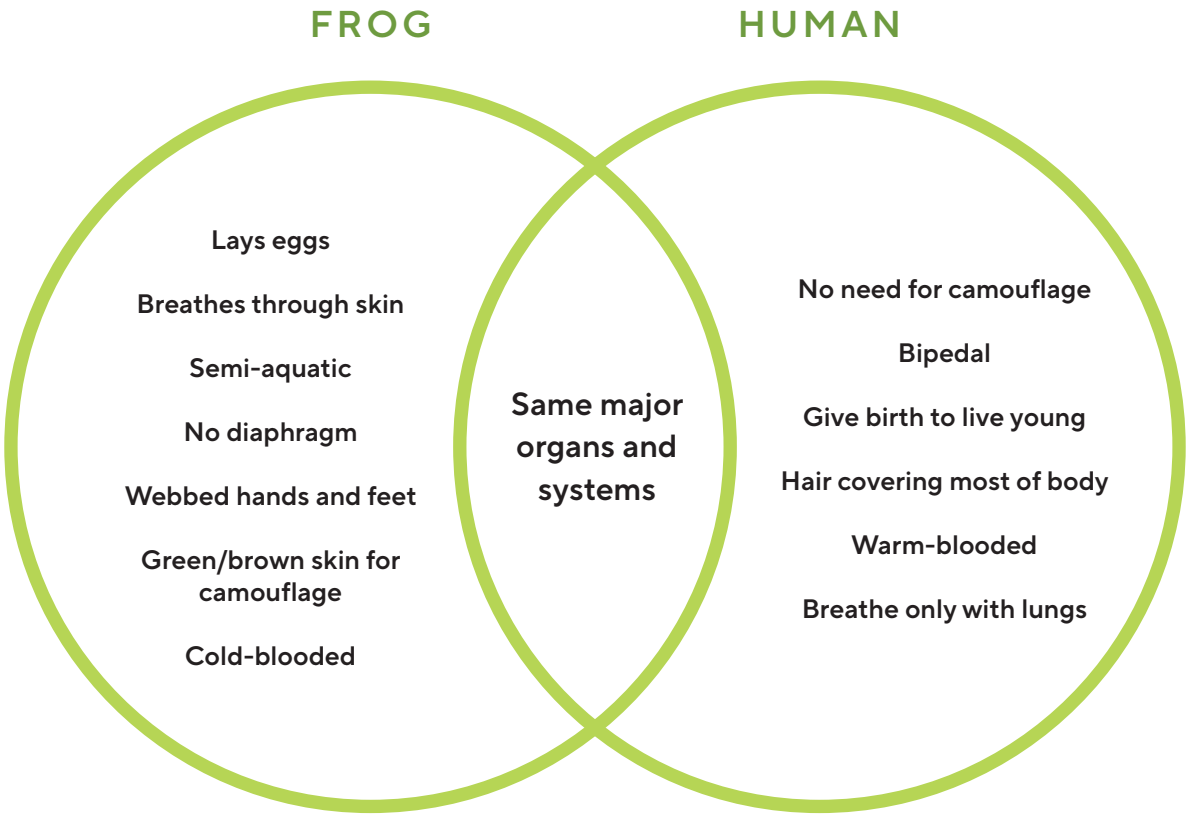
### Development question:

- How does the nervous and sensory system interact with other body systems? Think about the sense of smell and how saliva is produced in response to the smell of yummy food!

# Similarities and Differences Between Frogs and Humans

## ACTIVITY:

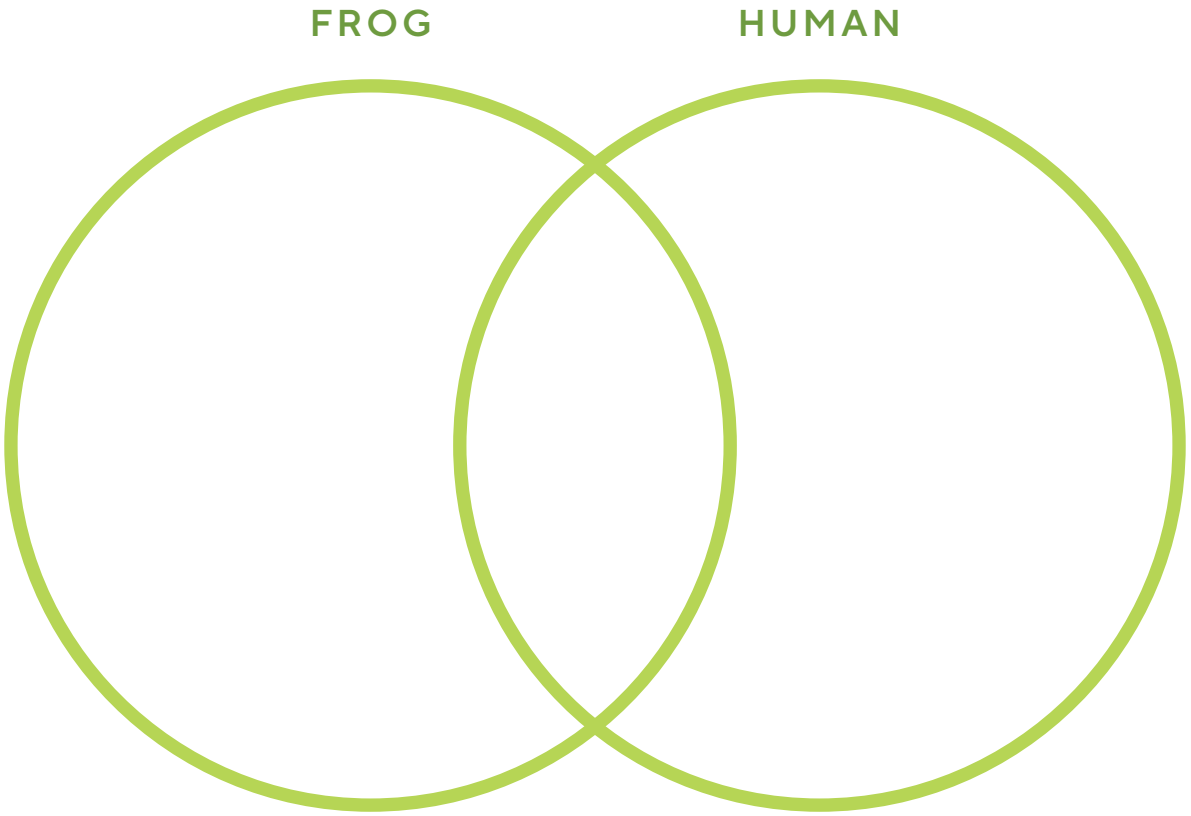
Ask the students to get into pairs, reflect on what they've learned about frog adaptations and organ systems, and fill out the Venn diagram below (some examples are given below but this is not a complete list—blank student copy is on next page).




## KEY DISCUSSION POINT AFTER THE ACTIVITY:

While there are some important differences between frogs and humans, because we are adapted to different natural habitats, there are also many similarities. We both have hearts, lungs, a digestive system, nerves, muscles, bones, blood vessels, etc. We are more alike than we are different once you look inside our bodies! It's important that we respect frogs and their protect their habitat.

# Similarities and Differences Between Frogs and Humans



# How Do Organ Systems Work Together?

Ask students how they think the major organ systems work together.

## SPECIFIC QUESTIONS CAN INCLUDE:

1. How does oxygen get into the bloodstream? How do the respiratory and circulatory systems connect with each other?

*Gas exchange in the alveoli of the lungs and through skin—links the respiratory and circulatory systems via the capillary network that surrounds the alveoli.*

2. How do nutrients from the frog's food get into the bloodstream? How do the digestive and circulatory systems connect with each other?

*Nutrient exchange between small intestine and bloodstream—links the digestive and circulatory systems via the capillary network that surrounds the villi in the small intestine.*

3. How are harmful substances filtered from the blood? How do the circulatory and urinary systems connect with each other?

*Hepatic portal system—links digestive and circulatory systems. Renal portal system—links urinary (excretory) and circulatory systems.*

# Example Evaluation Questions and Activities

## FROG ADAPTATIONS

**List three ways in which the anatomy of frogs helps them adapt to their natural environment.**

*Good examples:*

1. They have large, strong back leg muscles that help them both in their role as prey, so they can escape predators, and in their role as predators, so they can jump to catch insects (a key food source for them). These strong back legs, coupled with webbed hands and feet also facilitate their ability to be very strong swimmers.
2. They can breathe both through their skin and with their lungs, which helps them live in a semi-aquatic environment as amphibians.
3. They have webbing between their "fingers" and "toes," which allows them to be great swimmers.

## ORGAN SYSTEMS ACTIVITY

Give students both a male and female paper frog dissection and ask them to a) find the number labels that correspond to the major organs of each body system (you can be specific with this list; for example, ask them which of the numbered labels on the paper dissections correspond to heart, liver, kidneys etc.), and b) identify which paper frog is male and which is female.

## RESPIRATORY SYSTEM

**Which of the following are the types of respiration in frogs? (check all that apply)**

- ☑ Cutaneous (skin)
- ☑ Bucco-pharyngeal (mouth)
- ☑ Pulmonary
- ☐ Musculoskeletal
- ☐ All of the above

**What muscles are used in bucco-pharyngeal respiration? (check all that apply)**

*This content is covered in the Frog Anatomy Workbook.*

- ☑ Sternohyoid
- ☐ Glottis
- ☑ Pteroid
- ☐ Trachea

**What is the correct order of airflow for frogs when they inhale using pulmonary respiration?**

◯ Bronchial Tube > Trachea > Bronchioles < Alveoli
◯ Trachea > Bronchioles > Bronchial Tube > Alveoli
⊘ Trachea > Bronchial Tube > Bronchioles > Alveoli
◯ Bronchioles > Trachea > Bronchial Tube > Alveoli

## CIRCULATORY SYSTEM

**True or False: Pulmonary veins carry oxygenated blood from the Lungs to the Left Atrium**

True.

**Which of the following is correct?**

◯ Atrium contracts, sending oxygenated blood to the brain from the left ventricle. Blood flows through the pulmonary arteries to reach the head.
◯ Ventricle contracts, sending deoxygenated blood to the brain from the right ventricle. Blood flows through carotid arteries to reach the head.
◯ Ventricle contracts, sending deoxygenated blood to the lungs from the left atrium. Blood flows through the pulmonary arteries to reach the head.
⊘ Ventricle contracts, sending oxygenated blood to the brain from the left atrium. Blood flows through carotid arteries to reach the head.

**Of the pulmonocutaneous arteries, which send blood to the skin?**

◯ Pulmonary arteries ⊘ Cutaneous arteries

## DIGESTIVE SYSTEM

**Which of the following make up the alimentary canal?**

⊘ Mouth, Esophagus, Stomach, Small Intestine, Large Intestine, Cloaca.
◯ Gastric glands, Liver, Pancreas, Intestinal glands.

**Write a detailed summary of the major body parts and organs that a frog's food passes through, from the moment it enters the mouth to the moment it is pooped out of the cloaca.**

Mouth > esophagus > stomach (chemical and mechanical digestion) > pancreas (secretes pancreatic juices and enzymes to help with food breakdown) > small intestine (chemical digestion and food absorption via villi in SI walls) > liver (filters digestive products from blood) > large intestine (water and food absorption) > cloaca (point of excretion of undigested food)

**How many lobes does a frog's liver have?**

◯ 2 ⊘ 3 ◯ 4 ◯ 5

## UROGENITAL SYSTEM

**Which of these are correct? (check all that apply)**

- ☑ Kidney: filters blood and produces urine
- ☐ Cloaca: stores urine
- ☐ Urinary bladder: expels urine, faeces, sperm and eggs
- ☑ Urinary bladder: stores urine

**What is the name of the duct in *male* frogs that transports urine from the kidneys to the bladder *and* sperm from the testes to the cloaca?**

Ureter/urogenital duct/Wolffian duct

**Give a detailed summary of the lifecycle of a frog from a freshly fertilized egg, to a full-grown adult.**

Egg > tadpole > external gills appear > tail grows > hind legs appear > lives from food stored in tail > front legs appear > tail becomes shorter > young frog > adult frog

## HOW DO THE BODY SYSTEMS CONNECT?

**How do the respiratory system and circulatory system connect and work together in a fully functioning frog?**

Gas exchange between lungs and bloodstream across the walls of alveoli and capillaries.

**How do the digestive system and circulatory system connect and work together in a fully functioning frog?**

Via the liver and hepatic portal system:

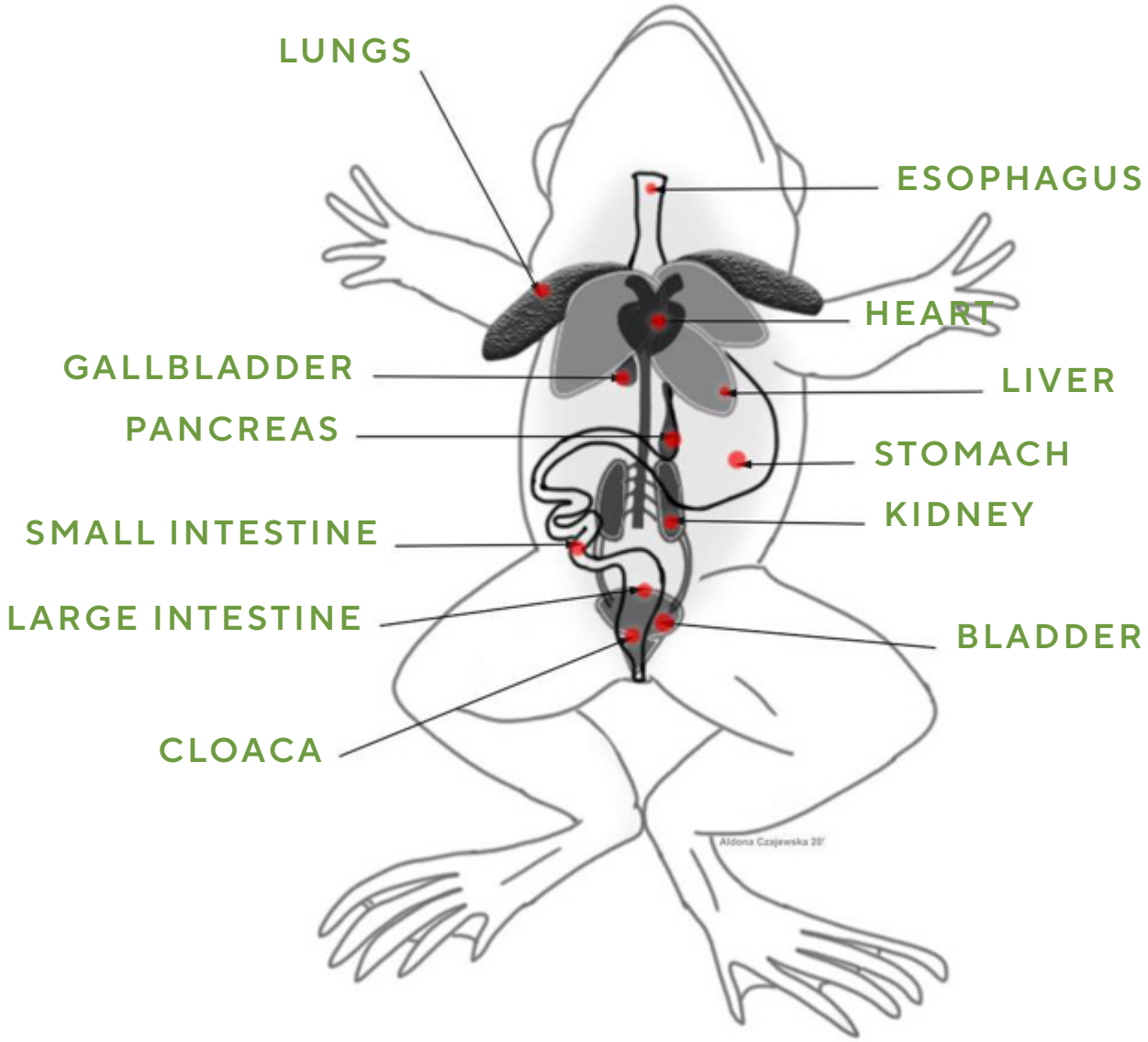
1. Small intestine absorbs products of digestion
2. Nutrient molecules travel in hepatic portal vein to liver
3. Liver monitors blood content
4. Blood enters general circulation by way of hepatic vein

**How do the urogenital system and circulatory system connect and work together in a fully functioning frog?**

Via the kidneys and the renal portal system:

1. Nutrient and waste molecules in the bloodstream travel in the renal portal vein to the kidneys.
2. Kidneys filter out harmful substances like urea and carbon dioxide, which are passed outside as urine.

# Frog Anatomy Quiz



# Frog Anatomy Quiz