Frog Anatomy Workbook

ACCOMPANIES 3D FROG ANATOMY APP BY BIOSPHERA
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Learning Objectives

- Explain how key anatomical features help frogs in their natural environments
- Describe the major body systems of frogs and their major organs
- Explain the function of each major organ
- Explain how major body systems in frogs work together to create whole, functioning organisms
Introducing the Frog!

Frogs are **amphibians**, so they spend time in both water and on land. Keep this in mind when we are looking at the inner workings of the frog!

In this lab, we will be taking a look at different body systems in the frog:

Musculoskeletal  
Respiratory  
Circulatory  
Urinary  
Endocrine  
Nervous and Sensory
Getting To Know 3D Frog Anatomy

BY BIOSPHERA

The app is available for iPads, Android tablets, and desktop: biosphera.com

Lets get comfortable with the app!

Take a few minutes to explore the app. Press buttons, move the model around, and touch/hold the organs... see what happens!
ADJUST FOR DARK OR LIGHT SCREEN
CHOOSE A MALE OR FEMALE FROG
USE THESE BUTTONS TO MOVE YOUR FROG UP, DOWN, LEFT OR RIGHT
USE THESE BUTTONS TO ROTATE YOUR FROG IN DIFFERENT DIRECTIONS
Each grey body system button displays small dots to indicate the number of layers you can click through. Try starting with the skin layer and you’ll notice that the number of dots goes down as the skin layers are removed. You can do this for each body system. Use this function to focus on one body system at a time.
Notice how the **skin** button now only has one set of dots, instead of two.
One More Thing!

When you see a “system button” noted in this workbook like this:

:: Skeleton
:: Respiratory

Make sure your app has the same buttons and layers showing.
Digestive System: External Anatomy

TURN OFF ALL OTHER BODY SYSTEMS AND FOCUS ON THESE:

- Skeleton
- Digestive

Rotate your frog and zoom in so that the head is visible.
Hover your pointer over the teeth to show the labels.
Can you label the image?
Teeth

Frogs’ teeth are **not used for chewing**! Instead, their special **vomerine teeth** (shown as ‘premaxillary teeth” on the frog anatomy app) are used to hold prey in place before swallowing. The vomerine teeth are notably pointy and appear in pairs of tiny clusters at the top front of the mouth.
Rotate your frog so you are looking at the ventral view (put your frog on their back), zoom in as needed.

After mechanical and chemical digestion in the mouth, the chewed food (called a bolus) is swallowed.

The bolus then enters the esophagus. Muscle contractions called peristalsis push food along towards the stomach.
**Stomach**

**Location:** dorsal and posterior to the liver

**Structure:** muscular organ

**Function:** muscular organ that continues the chemical and mechanical digestion that started in the mouth
The food travels to the **small intestines** from the **stomach** through the **pyloric sphincter**.

Find the small intestine on your frog.

Can you label it on the image?
Small Intestine

**Location:** slender coiled tube, starting at the stomach, and connects to the large intestine

**Structure:** consists of duodenum, jejunum, and ileum, supported and wrapped by a membrane of mesentery

**Function:** receives food from stomach and completes digestion started earlier—most food absorption and chemical digestion occurs here
Intestinal Villi

What lines the internal surface of the small intestine and what is its function?

Villi: Increase absorptive surface of the small intestine; higher surface area means more area for absorption

* You won’t see villi on the 3D Frog Anatomy app, but they are there!
The large intestine runs between the small intestine and the cloaca.

Rotate your frog as needed to explore the large intestine and cloaca.

The cloaca is the one exit hole for liquid waste, solid waste, sperm and eggs!
Large Intestine

**Structure:** consists of descending colon and rectum

Muscular contractions in large intestine initiate defecation

**Function:** storage of undigested materials that have passed through the small intestine

Reabsorbs water from food
Liver

**Location:** ventral and anterior to the **stomach**

**Structure:** dark red/brown wedge-shaped organ with **three** lobes

**Function:** multipurpose organ

*Produces bile, removes toxins, stores carbs, regulates blood sugar levels*
Pancreas

**Location:** dorsal to stomach, wrapped in the duodenum

**Structure:** flattened gland found in between stomach and small intestine

**Function:** produces two major secretions (1) digestive enzymes—responsible for breakdown of fats, carbs, and proteins; (2) insulin—a hormone which allows cells to absorb glucose
Finally, let us locate the **spleen**. It is a bean-shaped, red organ found on the right side of the frog’s body.

It’s **not part** of the digestive system, however it is nestled in with the digestive organs.

The spleen removes old blood cells and breaks them down.
With your group, trace the path of food through the digestive system. Name all the different structures the food passes through from the moment a frog takes a bite, to the moment it poops! Choose one person to explain it to the class.
MUSCULOSKELETAL SYSTEM
TURN OFF ALL OTHER BODY SYSTEMS AND FOCUS ON THE SKELETON:

Bones

Use your 3D Frog Anatomy app to label all the bones on this frog skeleton
TURN OFF ALL OTHER BODY SYSTEMS AND FOCUS ON THE SKELETON:

Muscles

Use your 3D Frog Anatomy app to label the muscles on the image. Feel free to peel back deeper layers and explore deeper muscles in the app!
With your group write down the names of three major muscles and three major bones in the musculoskeletal system of the frog.
RESPIRATORY SYSTEM
Types of Respiration in Frogs

Gills: respiration during tadpole stage, then disappear as they mature

Skin or Cutaneous

Bucco-pharyngeal: respiration through the mouth

Pulmonary: respiration through lungs
Cutaneous Respiration

What makes it possible for frogs to “breathe” through their skin?

Many blood capillaries, thin skin with no structures to block diffusion of oxygen, and secretion of mucus to always keep skin moist. Respiration takes place through the skin, which occurs in water and during periods of low metabolism/demand for oxygen. Skin absorbs oxygen dissolved in water through blood capillaries and can’t occur if skin is dry.
Bucco-pharyngeal Respiration

Respiration occurs through lining of the mouth. The lining is very moist and capillary rich. Why is this needed?

Locate the pterygoid and sternohyoid muscles.

What is the function of these muscles?

They aid in the up and down movement of the buccal cavity during respiration.
Bucco-pharyngeal Respiration

1. Floor of the mouth lowers on inhale

2. Air enters buccal cavity through external nares

3. Gas exchange occurs

4. Floor of buccal cavity raises on exhale

5. Air escapes through external nares
Pulmonary Respiration

LUNGS

Location: chest cavity

Structure: large, spongy expandable organ

Function: the site of gas exchange between the respiratory and circulatory systems

Locate the larynx and lungs
Can you label them on the image?
Pulmonary Respiration

In most mammals, the diaphragm pushes and pulls on the lungs to help inhale and exhale. **How do you think frogs do this?**

Frogs have **no diaphragm**.

They use the same mechanism in **bucco-pharyngeal respiration** that brings in and expels air to and from the **buccal cavity**.
<table>
<thead>
<tr>
<th>Trachea</th>
<th>Glottis opens and air travels down the <strong>trachea</strong> (a small nodule in frogs rather than a long tube)—air moves into each lung through the divided branches of the <strong>bronchial tube</strong></th>
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<tr>
<td>Bronchial tube</td>
<td>within the lungs, it branches further into <strong>bronchioles</strong></td>
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<tr>
<td>Bronchioles</td>
<td>tiny thin walled sacs are on the end of the bronchioles, called <strong>alveoli</strong></td>
</tr>
<tr>
<td>Alveoli</td>
<td>site of <strong>oxygen exchange</strong></td>
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Most animals breath using **negative pressure** breathing. Gases move from **high** pressure areas to **low** pressure areas. How is this different in animals like **frogs**?

**FUN FACT!** Frogs don’t have a diaphragm so they create a negative pressure gradients using their mouth and throat sack.
REVIEW BREAK

With your group, trace the path of air from the moment it is breathed in through the nose or mouth, to the moment it is exhaled (focus just on pulmonary breathing). Choose one person to explain it to the class.
CIRCULATORY SYSTEM
Heart

**Location:** center of the chest, nestled between the two lungs

**Structure:** strong muscular organ with three chambers (two atria, one ventricle)

**Function:** pumps blood to lungs and the rest of the body through strong rhythmic contractions

Locate the frog’s heart.

Locate the aorta (red) and the vena cava (blue).

Can you label them on the image?
Do arteries always carry oxygenated blood and the veins deoxygenated blood?

No, there are two exceptions, but arteries always carry blood away from the heart, and veins always carry blood towards the heart.

The pulmonary artery and pulmonary vein are the exceptions. Can you locate them and label them on the image?
For this more detailed view of the heart, we’re using screenshots from the Emantras Virtual Frog Dissection.

Heart

- **RIGHT ATRIUM**
- **LEFT ATRIUM**
- **TRUNCUS ARTERIOSUS**
- **VENTRICLE**

- **RIGHT ATRIUM**
- **SINOUS VENOSUS**
- **VENTRICLE**
The caudal, inferior and superior vena cava vessels carry **deoxygenated** blood to the right **atrium**.

Blood is then pumped from the right atrium to the **ventricle**.

Blood is pumped from the right ventricle out to the **pulmonary arteries**, which carry the blood to the lungs to receive oxygen.

The left ventricle pumps oxygenated blood out to the body via the aorta.

Blood is then pumped from the left atrium to the ventricle.

**Pulmonary veins** carry oxygenated blood back to the heart and into the **left atrium**.
With your group, trace the path of blood as it flows through the heart, to the lungs, and back again. Choose one person to explain it to the class.
URINARY SYSTEM

SEE ENDOCRINE SYSTEM FOR DETAILS OF REPRODUCTIVE ORGANS
Kidneys

Location: high in abdominal cavity, one on each side of the spine

Structure: bean-shaped, surrounded by tough fibrous tissue

Function: removes nitrogenous wastes (eg. urea/urine) from the blood and maintains osmolality (salt balance) in blood

Locate the kidneys found embedded in the fat in the dorsal body wall.

Find the other endocrine organ called the adrenal glands on the surface of each kidney.

Can you label them on the image?
Locate the ureter and urinary bladder.

The urinary bladder empties into the cloaca.

Can you label them on the image?

Note: the ureter is labeled as the archinephric duct in the Frog Anatomy app.
Ureter

**Location:** a vessel running between the kidneys and the urinary bladder

**Structure:** thin tube

**Function:** carries excretory products produced by the kidneys
Urinary Bladder

Location: connected to the ureter and urethra

Structure: sac-like structure

Function: stores urine produced by kidneys and releases it into the cloaca
With your group, trace the path of urine from the kidneys to the outside of the body. Choose one person to explain it to the class.
ENDOCRINE SYSTEM
Pancreas

**Location:** near stomach in abdominal cavity

**Function:** produces insulin (which reduces blood sugar) and glucagon (which increases blood sugar)
Adrenal Glands

**Location:** anterior end of kidneys

**Function:** produce **adrenaline** and **corticosterone** (the stress hormone—called cortisol in humans)
Testes

**Location:** in the abdominal cavity of male frogs

**Function:** produce testosterone—male sex hormone, and produce sperm
Ovaries

**Location:** in the abdominal cavity of female frogs

**Function:** produce estrogen and progesterone—female sex hormones, and produce eggs
Pituitary and Hypothalamus

**PITUITARY**

*Location:* the underside of the frog brain

*Function:* 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.

**HYPOTHALAMUS**

*Location:* the underside of the frog brain

*Function:* 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.
With your group, draw an outline of a frog’s body, and then add in the major endocrine glands. Choose one person to explain these to the class.
NERVOUS SYSTEM
Central Nervous System

**BRAIN**

**Location:** in the skull

**Structure:** about the size of a small peanut, smooth surface, packed with neurons

**Function:** the frog’s central information processor

Locate the **brain** and **spinal cord**.

Can you label them on the image? Use the app to label more features of the nervous system!
Nerves

Nerves are bundles of neurons (like the one pictured to the right) that transmit electrical “nerve impulses”. Nerve impulses are part of a special information system in the body. For example, when you touch something warm with your hand, the nerves in your hand transmit the information about temperature to your brain, which then translates that into your feeling of “warmth” in your hand.
With your group, draw an outline of a frog’s body, and then add in the major endocrine glands. Choose one person to explain these to the class.
Identify Some Key Similarities and Differences Between Frogs and Humans
Extra Study Questions:

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

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

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

4. How do hormones interact with other body systems?

5. How do the nervous and musculoskeletal systems interact with each other?