Frog Anatomy Workbook

ACCOMPANIES 3D FROG ANATOMY APP BY BIOSPHERA

Animal Welfare Institute

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.

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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

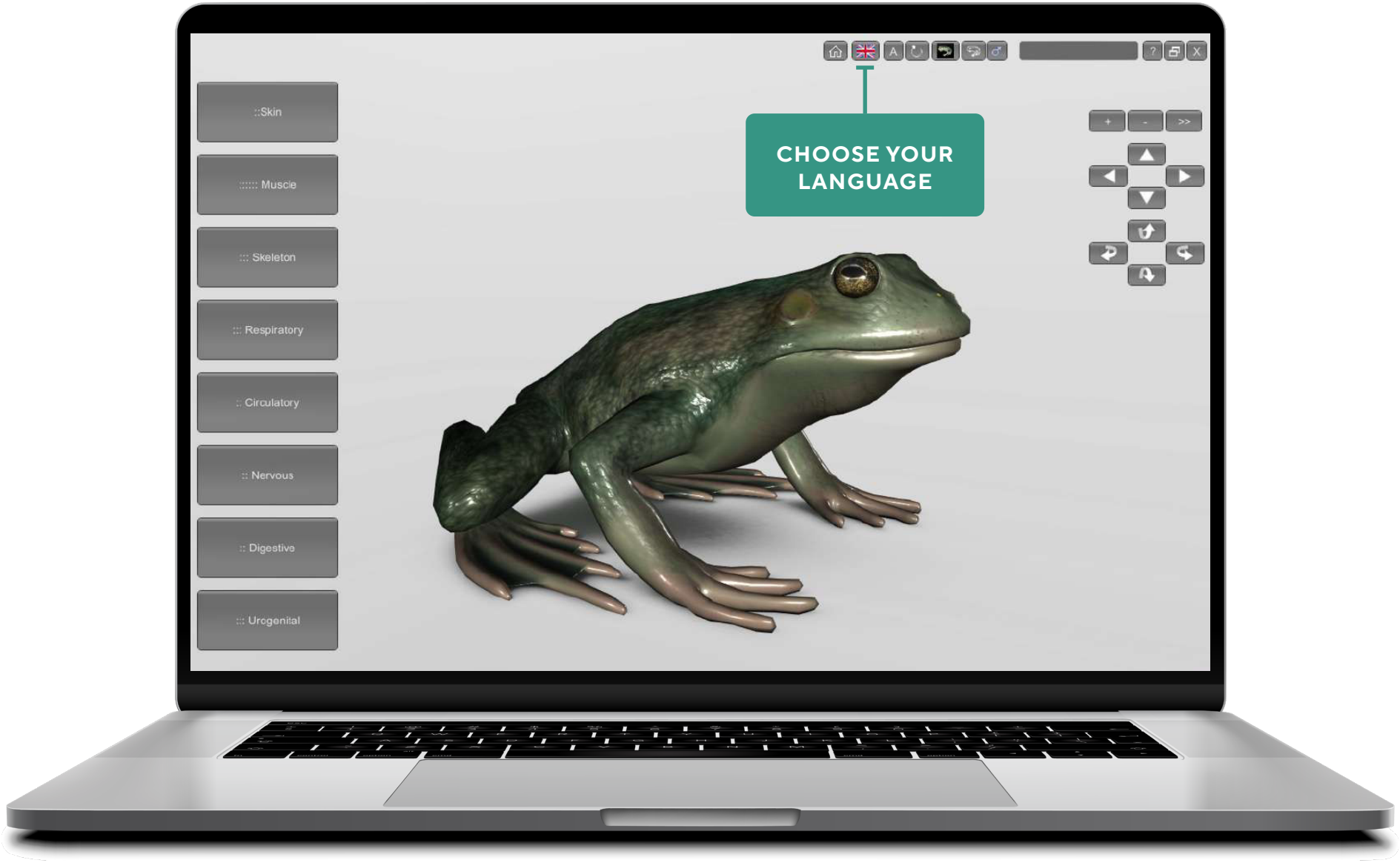
Getting To Know 3D Frog Anatomy

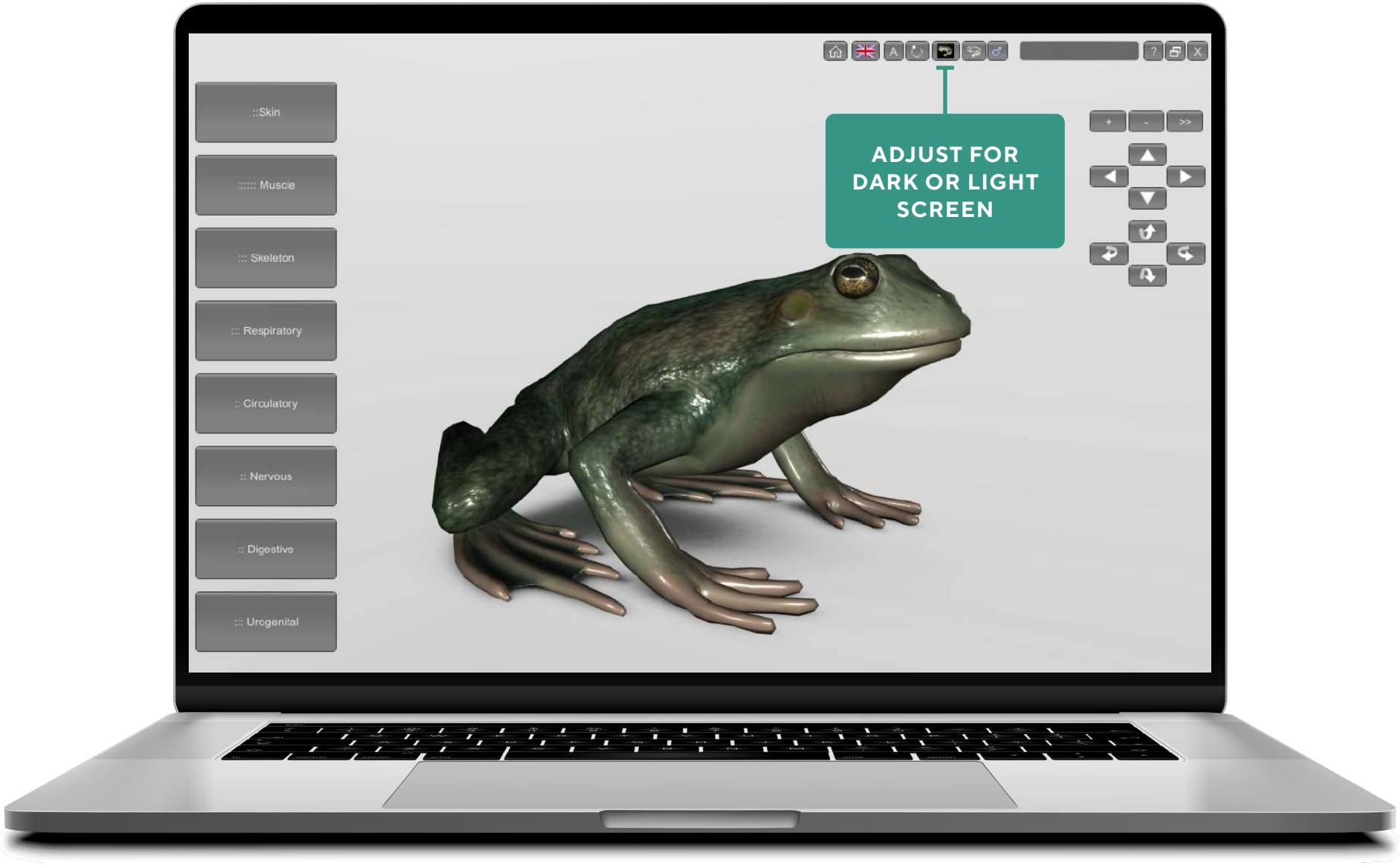
BY BIOSPHERA

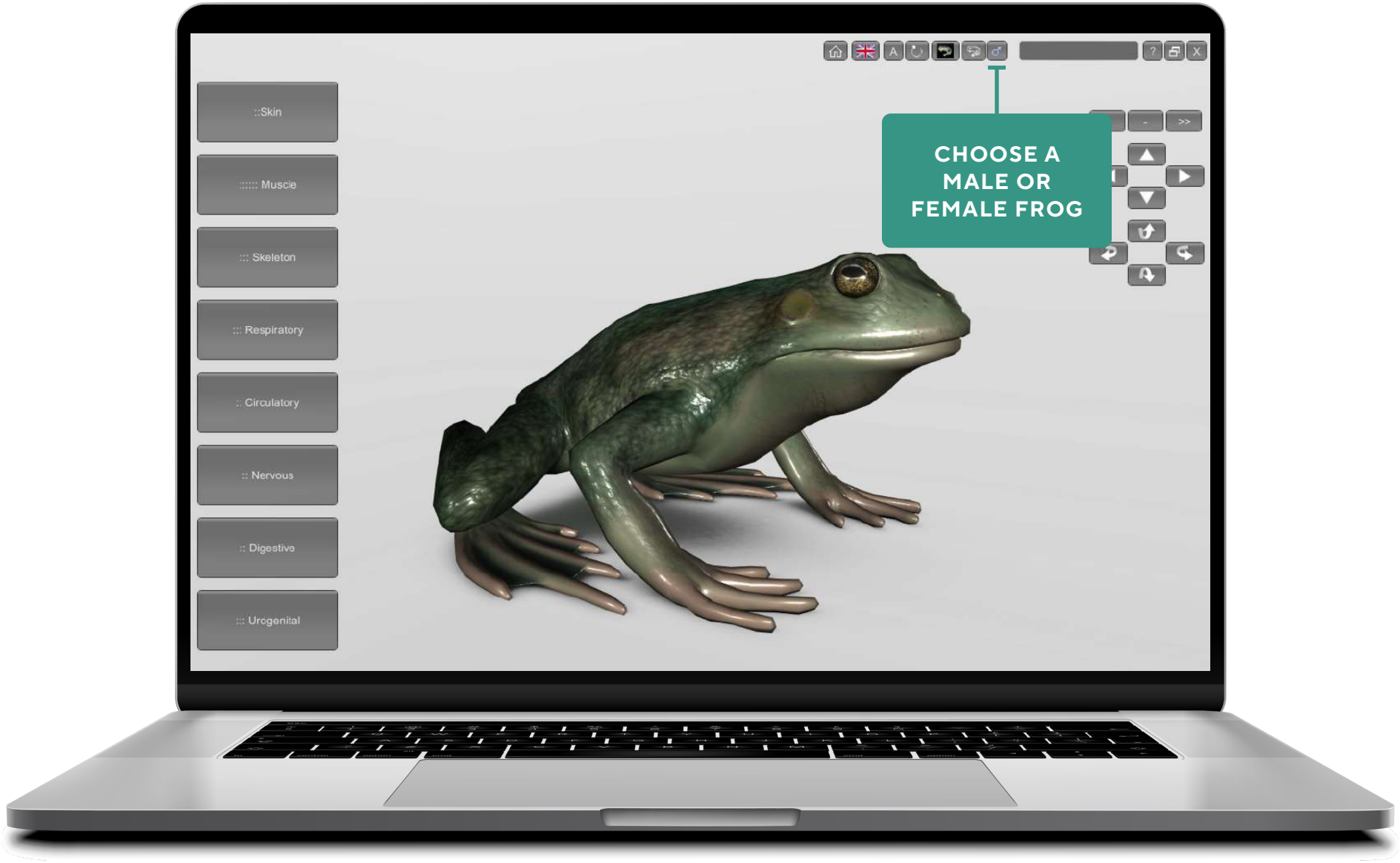
The app is available for iPads, Android tablets, and desktop: **biosphera.com**

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!


::Skin
::::: Muscle
::: Skeleton
::: Respiratory
:: Circulatory
:: Nervous
:: Digestive
::: Urogenital
CHOOSE YOUR LANGUAGE


::Skin
::::: Muscle
::: Skeleton
::: Respiratory
:: Circulatory
:: Nervous
:: Digestive
::: Urogenital
ADJUST FOR DARK OR LIGHT SCREEN


::Skin
::::: Muscle
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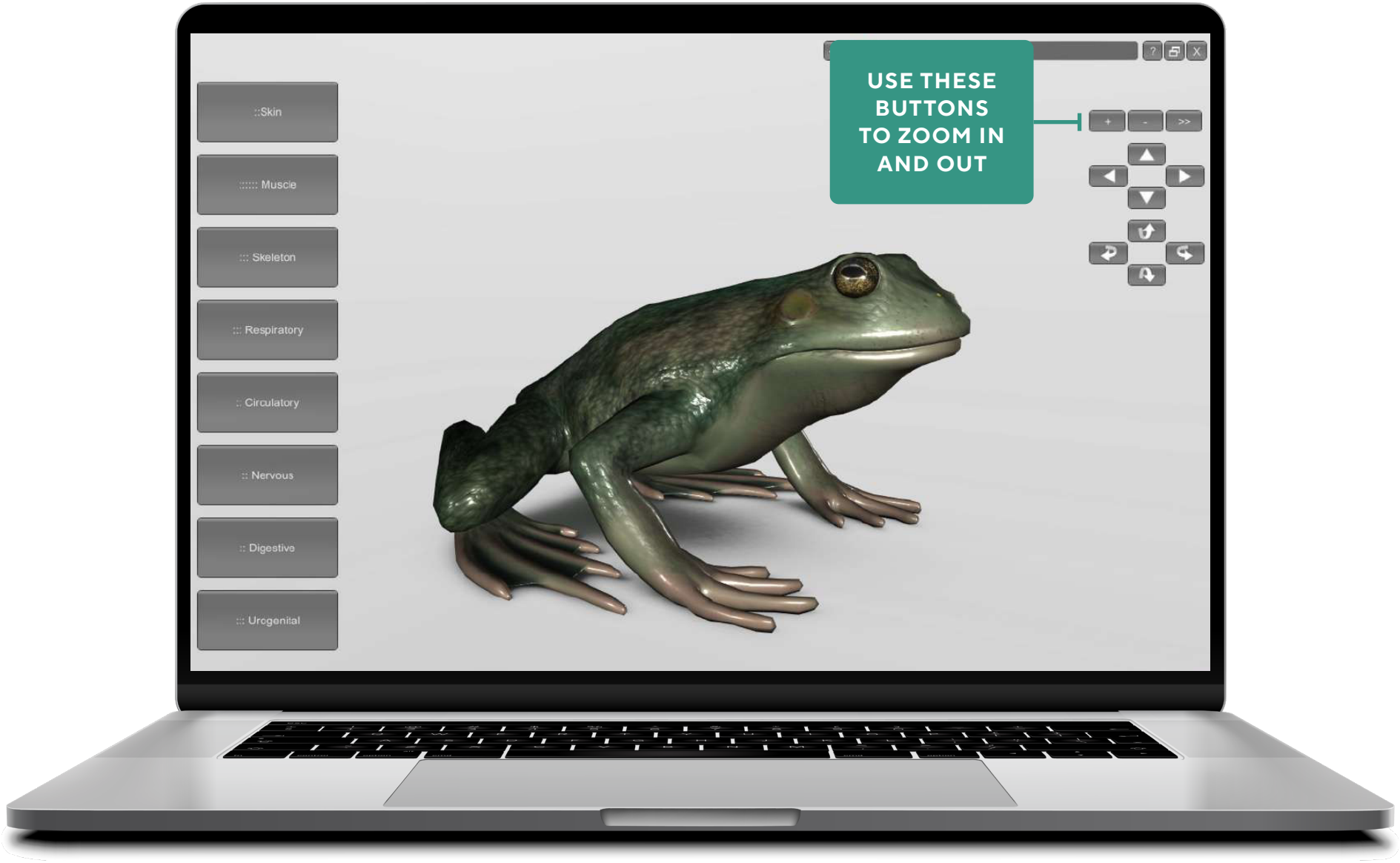
::: Respiratory
:: Circulatory
:: Nervous
:: Digestive
::: Urogenital
CHOOSE A MALE OR FEMALE FROG


::Skin
::::: Muscle
::: Skeleton
::: Respiratory
:: Circulatory
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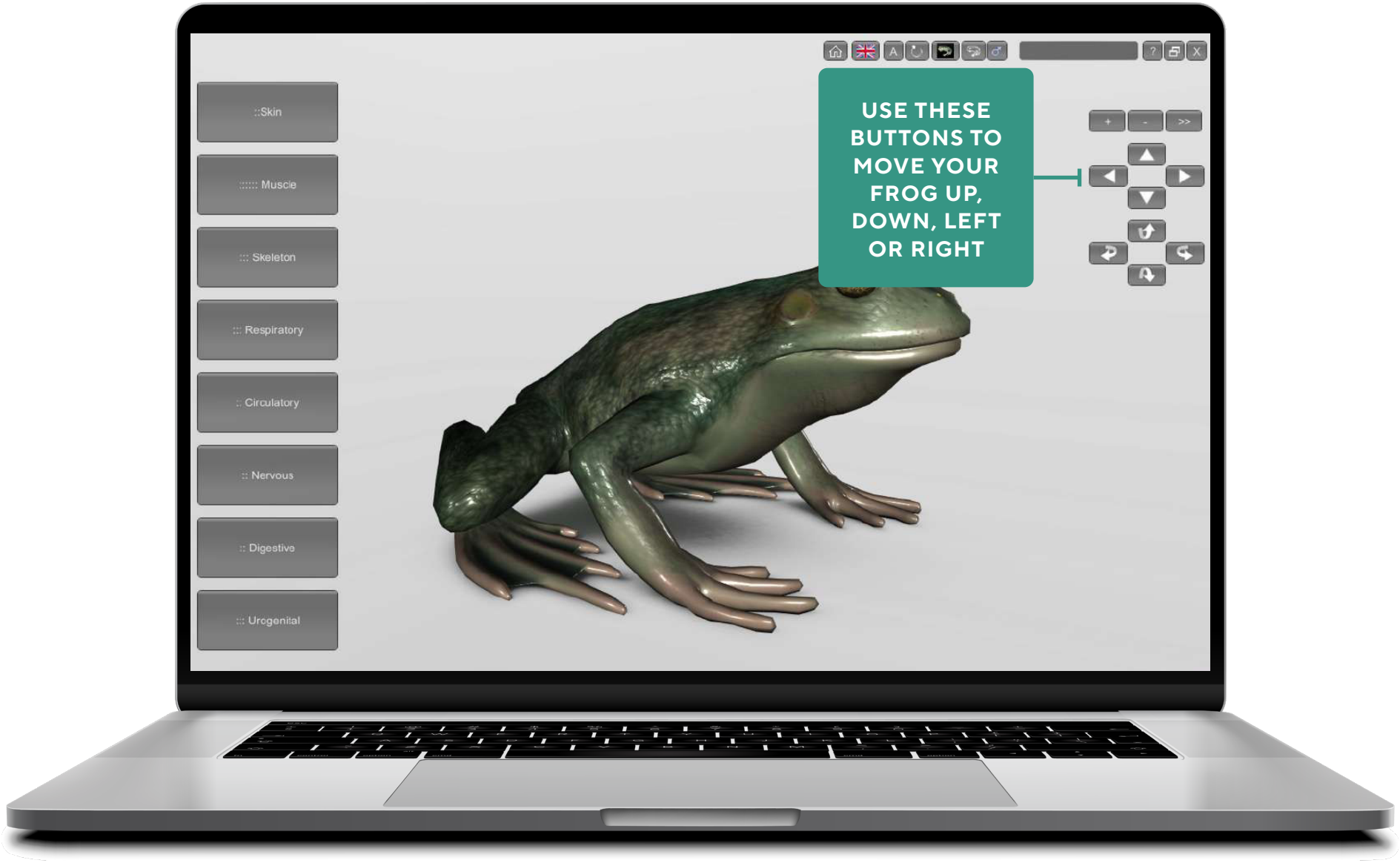
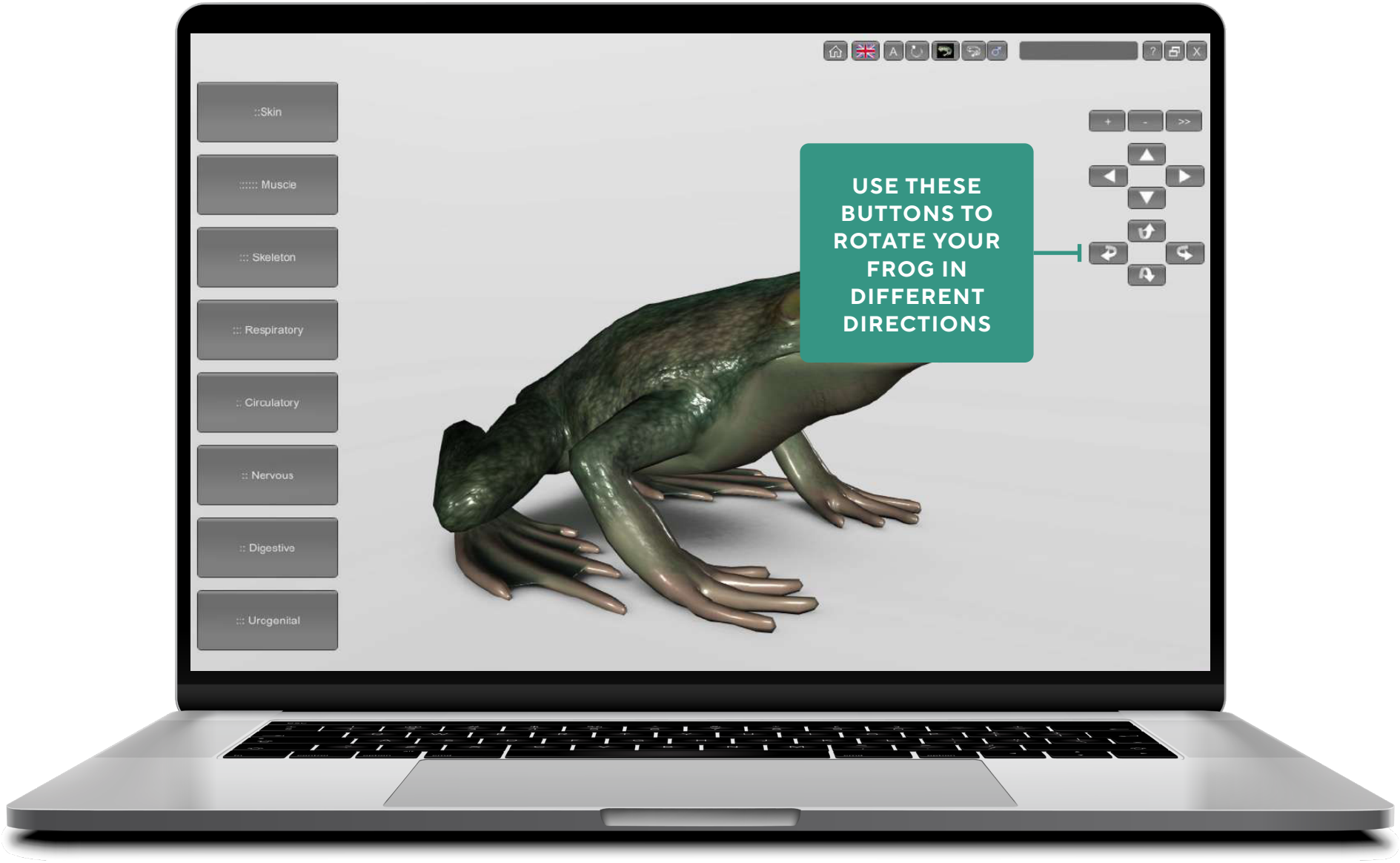
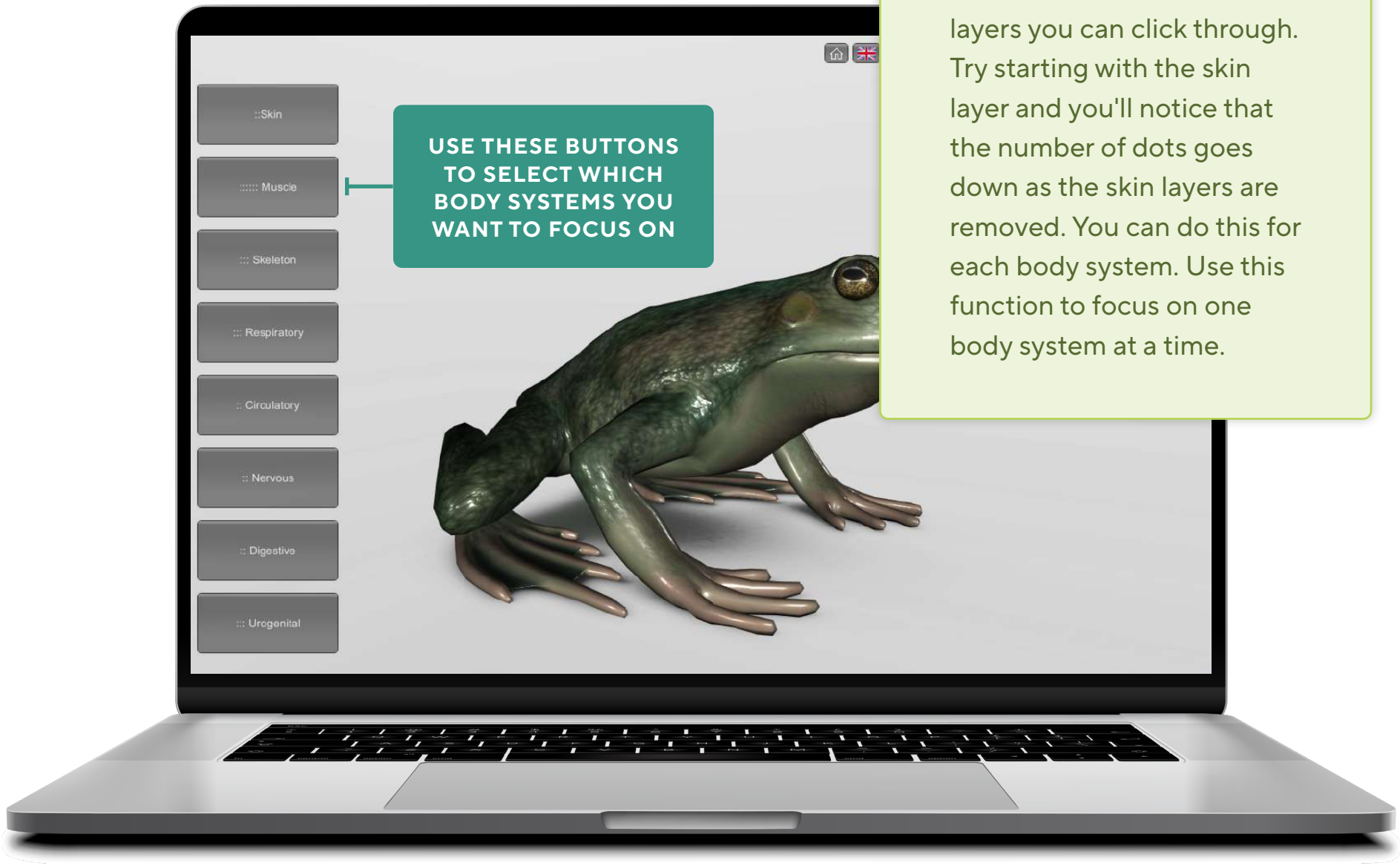
:: Digestive
::: Urogenital
USE THESE BUTTONS TO ZOOM IN AND OUT

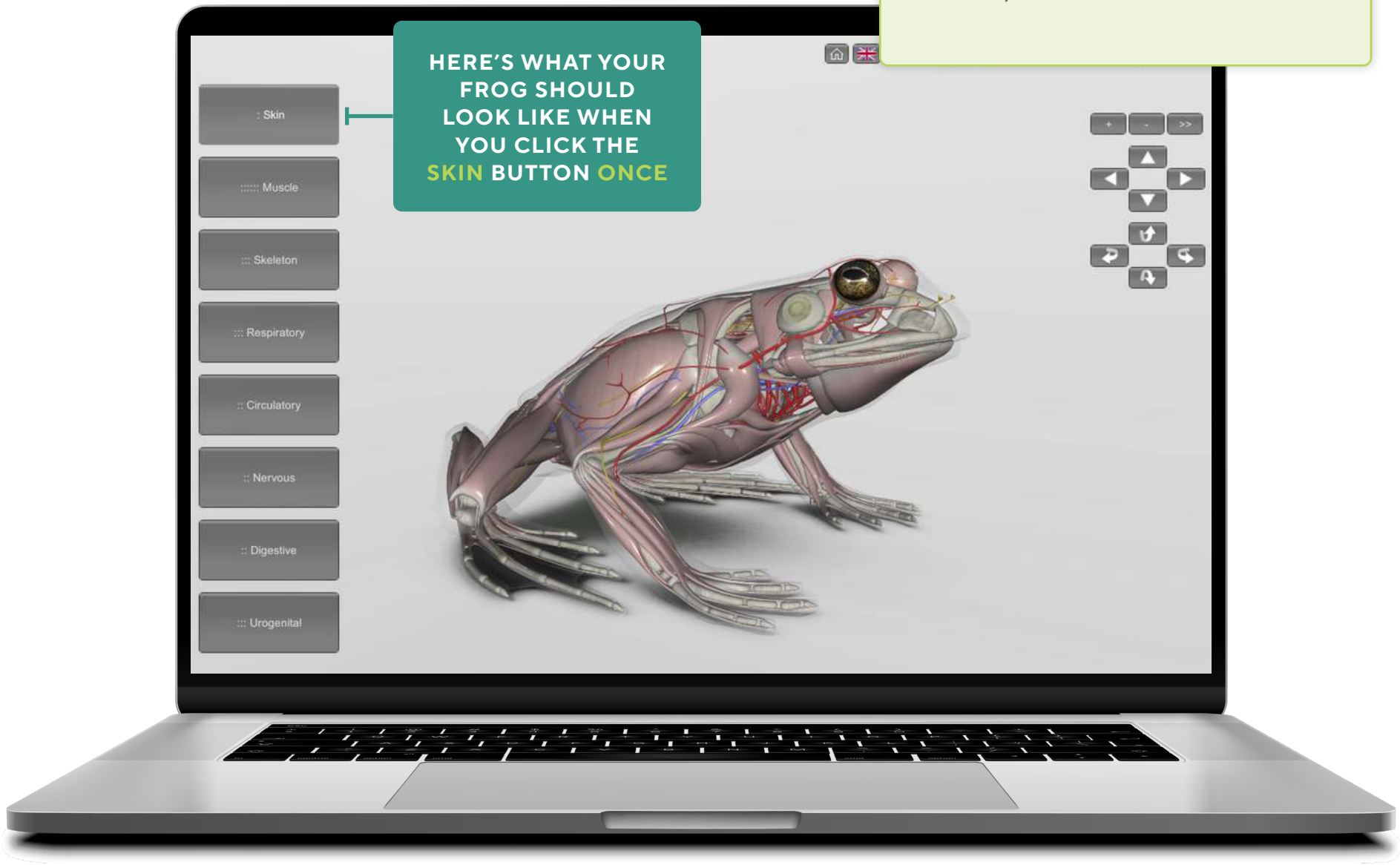

::Skin
::::: Muscle
::: Skeleton
::: Respiratory
:: Circulatory
:: Nervous
:: Digestive
::: Urogenital
USE THESE BUTTONS TO MOVE YOUR FROG UP, DOWN, LEFT OR RIGHT


::Skin
::::: Muscle
::: Skeleton
::: Respiratory
:: Circulatory
:: Nervous
:: Digestive
::: Urogenital
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!

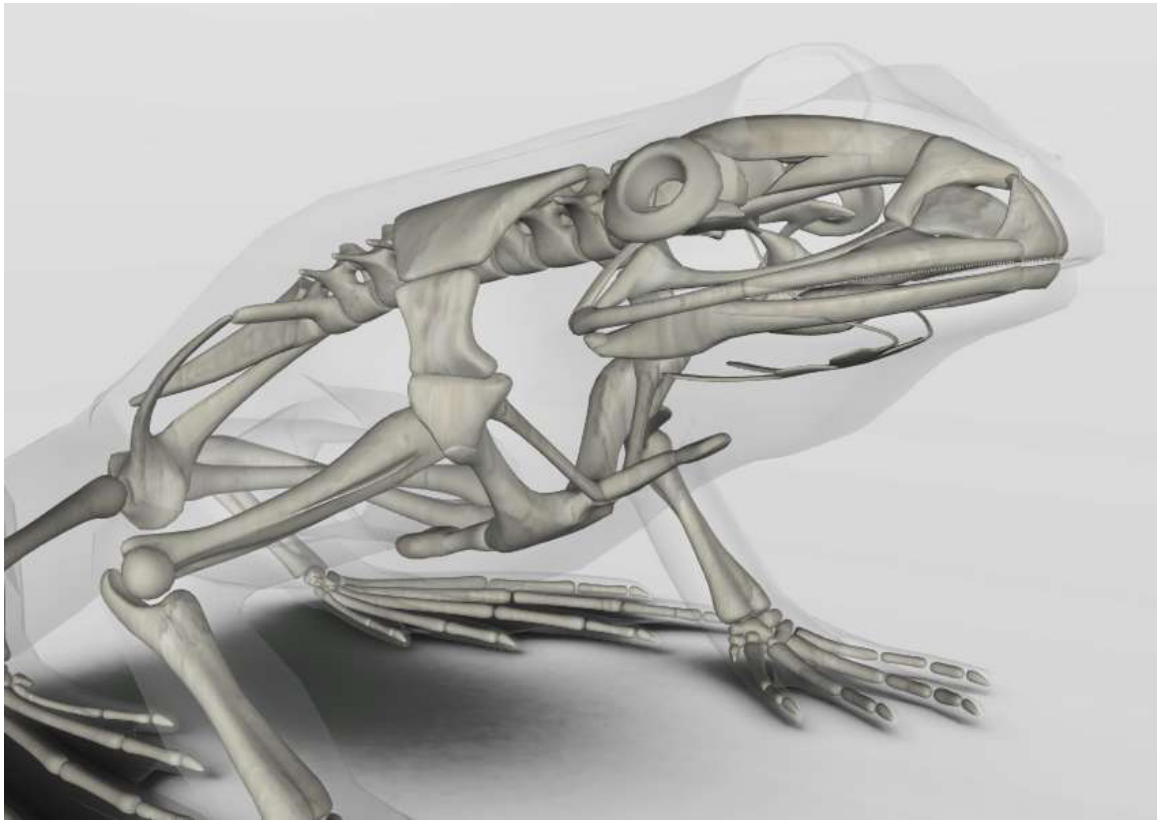
When you see a "system button" noted in this workbook like this:

Make sure your app has the same buttons and layers showing.

DIGESTIVE SYSTEM

TURN OFF ALL OTHER BODY SYSTEMS AND FOCUS ON THESE: : Skeleton :: Digestive

Digestive System: External Anatomy



Rotate your frog and zoom in so that the head is visible.

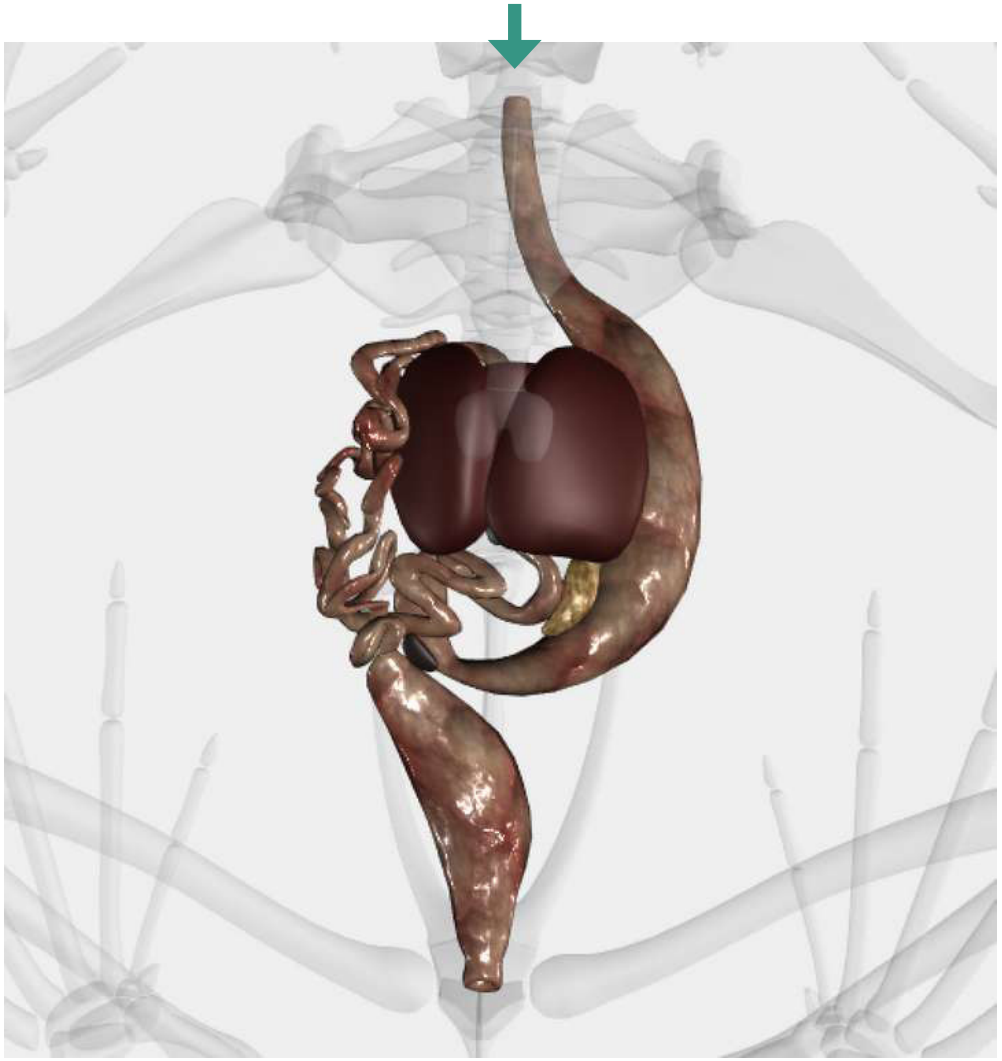
Hover your pointer over the **teeth** to show the labels.

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.

Food travels down esophagus towards stomach.

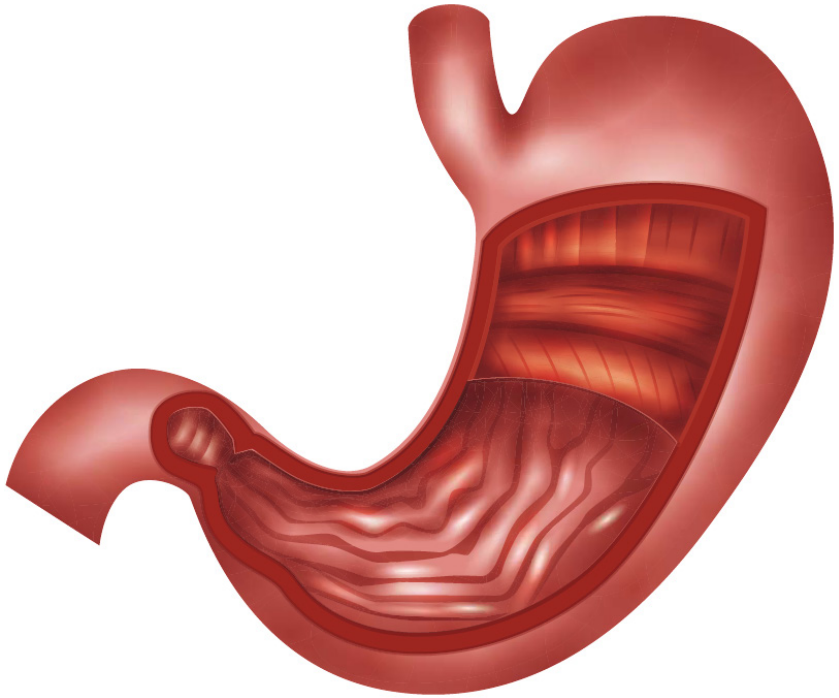


Rotate your frog so you are looking at the **ventral** view (put your frog on their back), zoom in as needed.

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

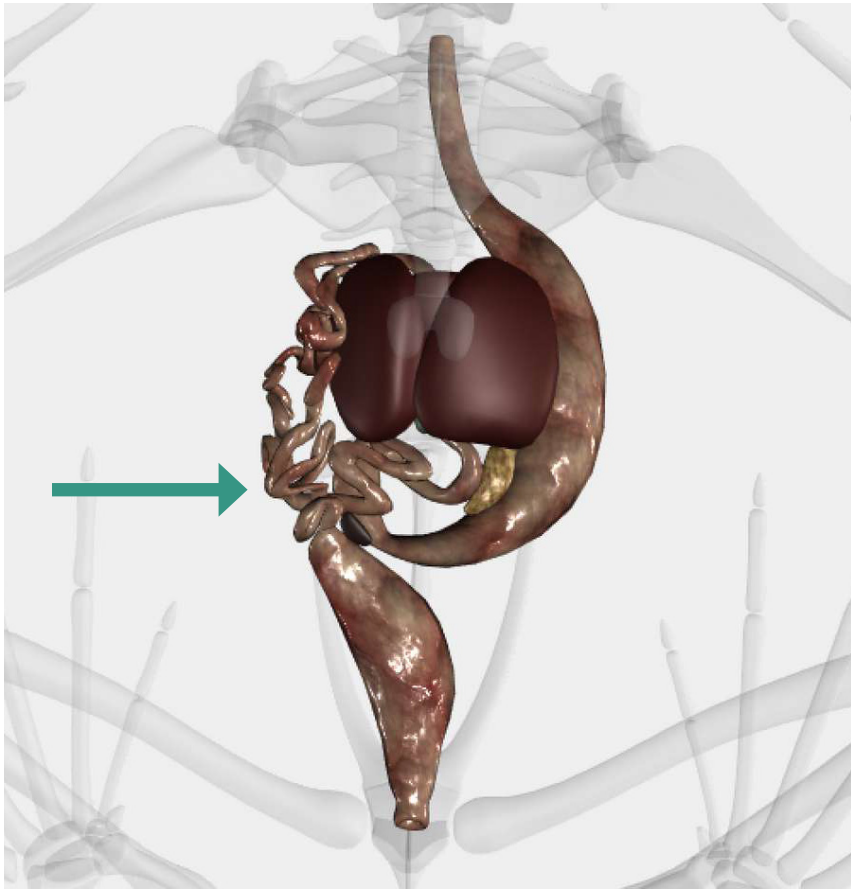
Function: muscular organ that continues the chemical and mechanical digestion that started in the mouth

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

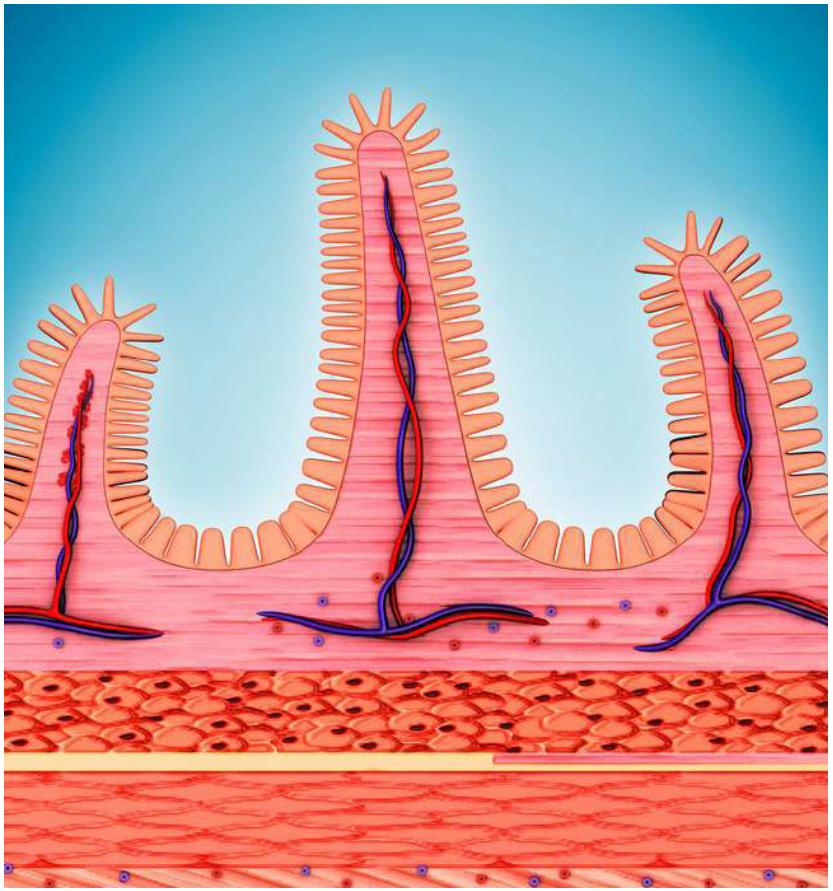


Location: slender coiled tube, starting at the **stomach**, and connects to the **large intestine**

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

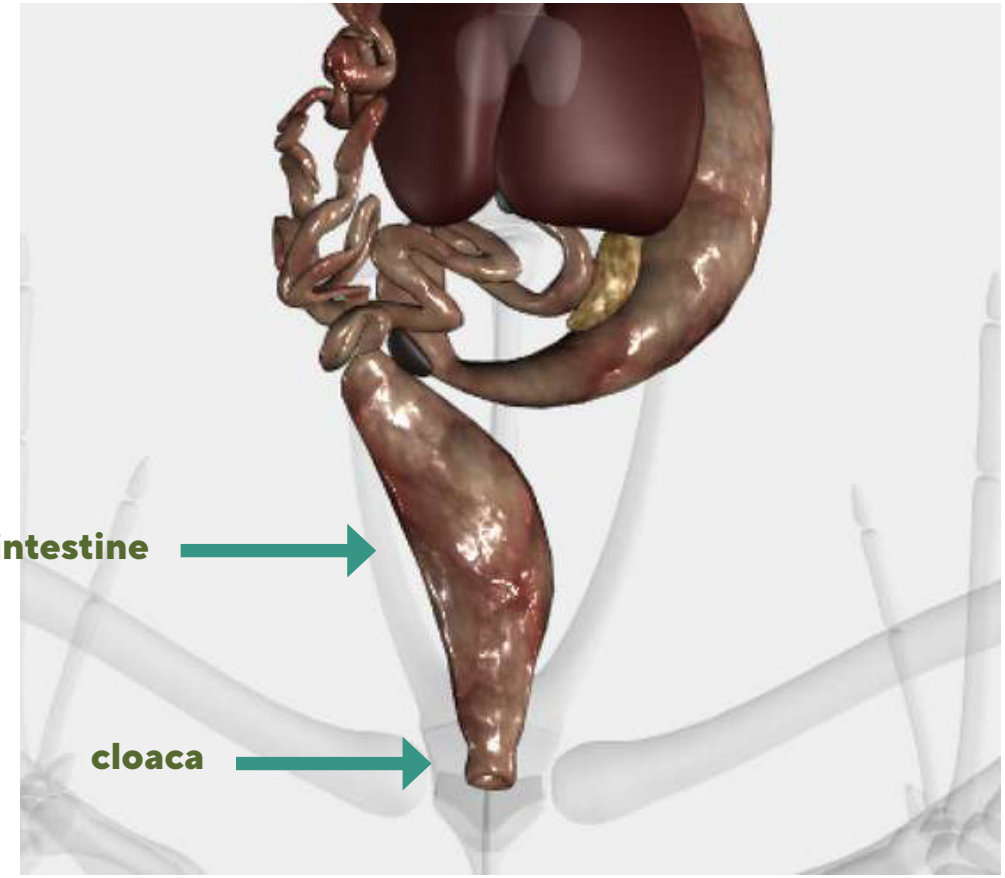


What lines the internal surface of the small intestine and what is its function?

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!*

Large Intestine and Cloaca

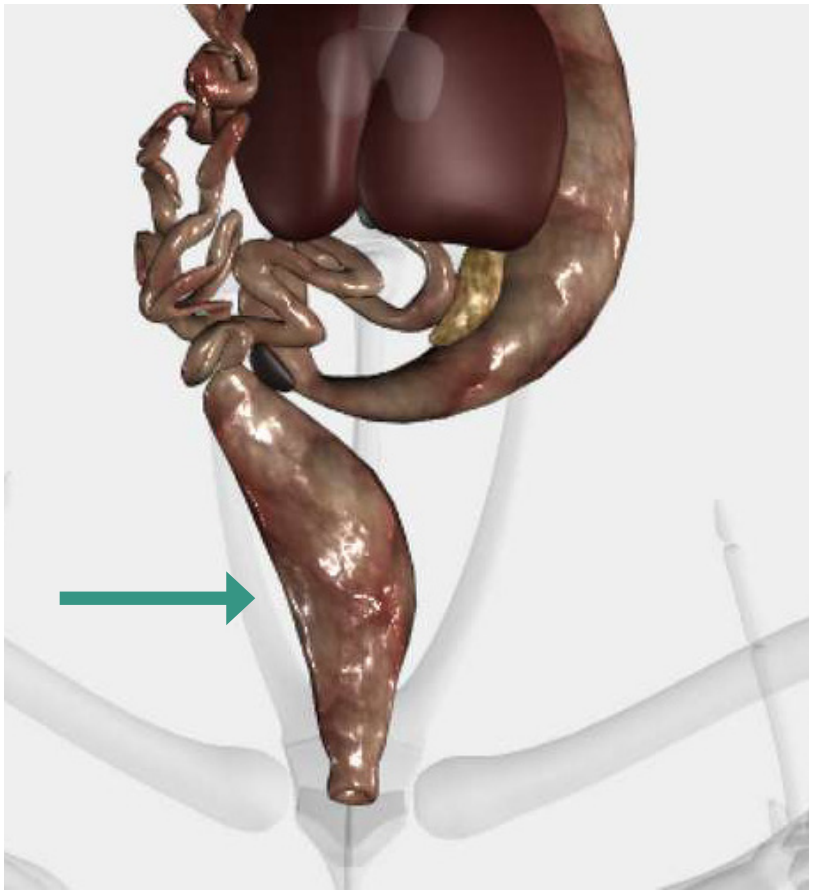


The **large intestine** runs between the small intestine and the **cloaca**

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



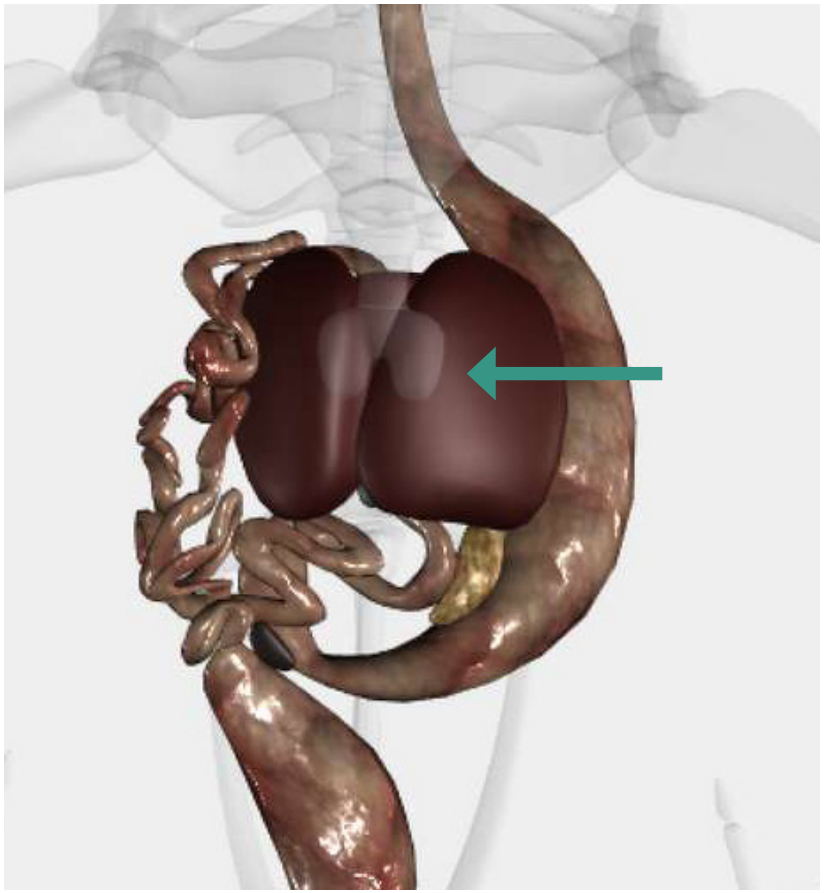
Structure: consists of descending **colon** and **rectum**

Muscular contractions in large intestine initiate defecation

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

Reabsorbs water from food

Liver



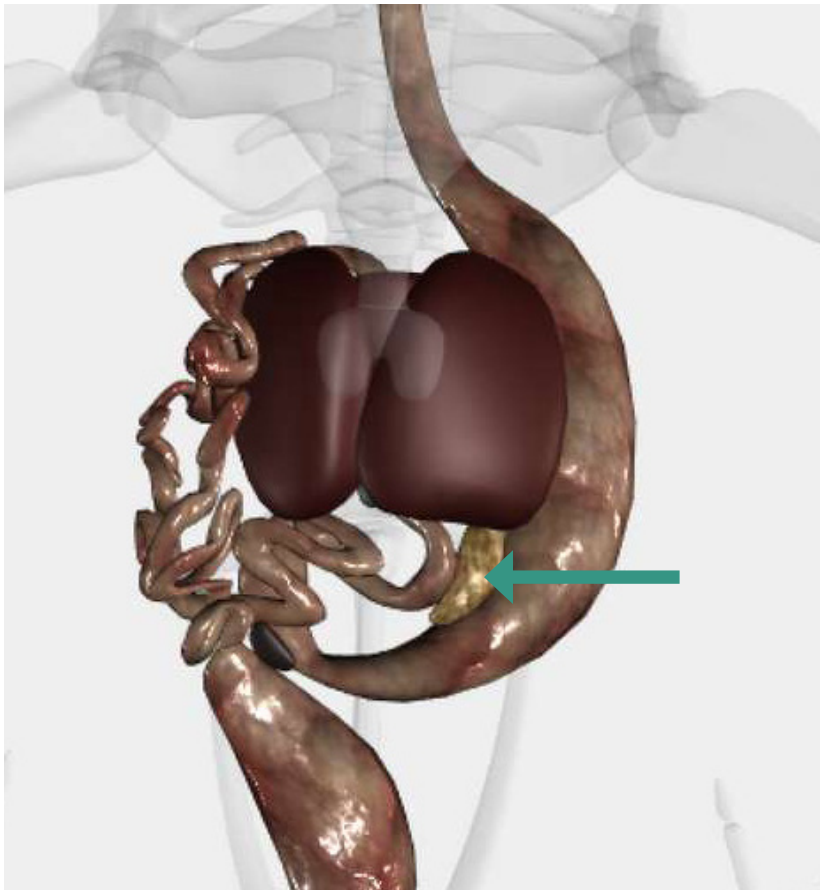
Location: ventral and anterior to the **stomach**

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

Spleen

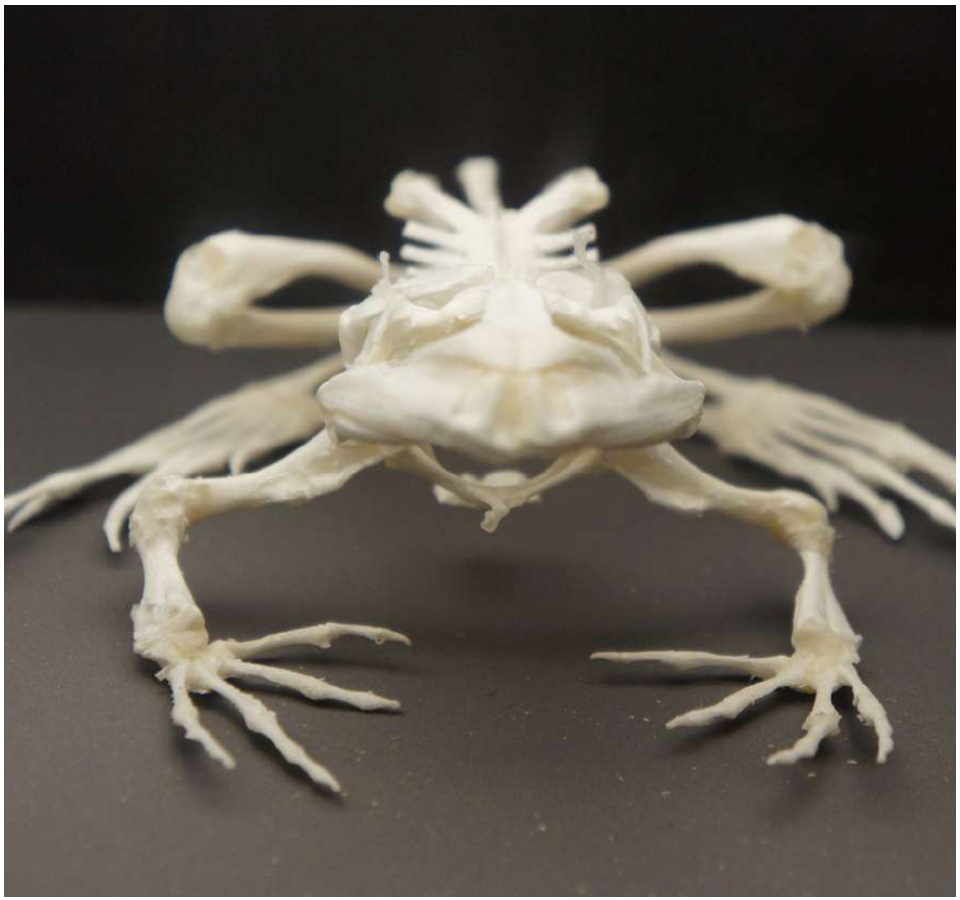
Finally, let us locate the **spleen**. It is a bean-shaped, red organ found on the right side of the frog's body.

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.

REVIEW BREAK

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: :: Skeleton

Bones

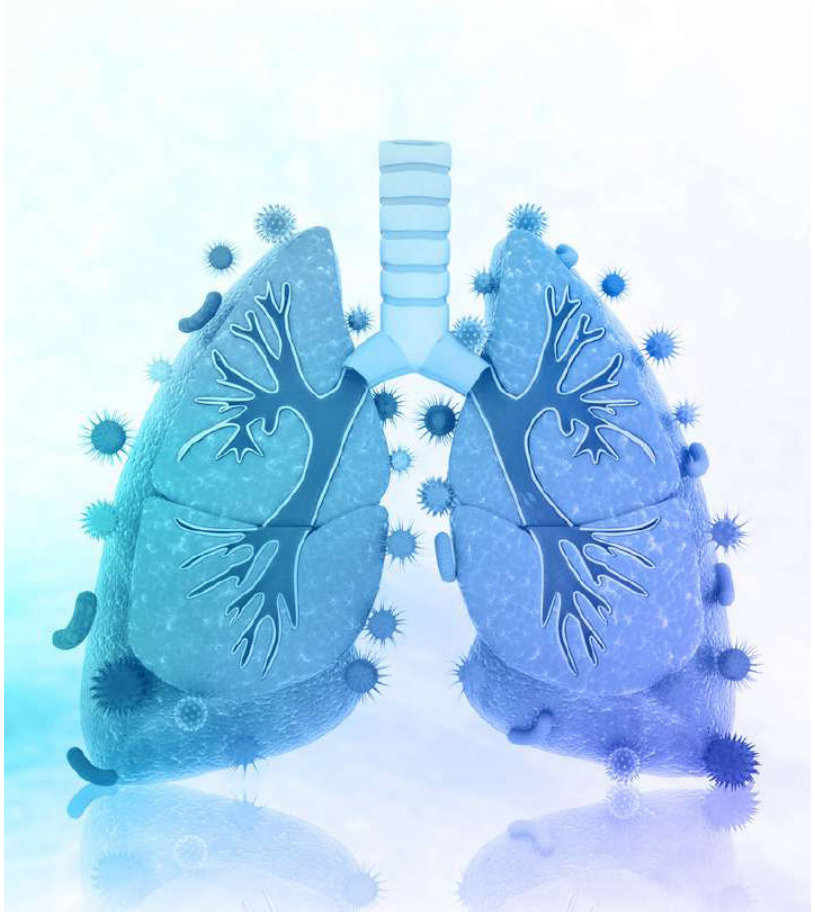
Use your 3D Frog Anatomy app to label all the bones on this frog skeleton

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!

REVIEW BREAK

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

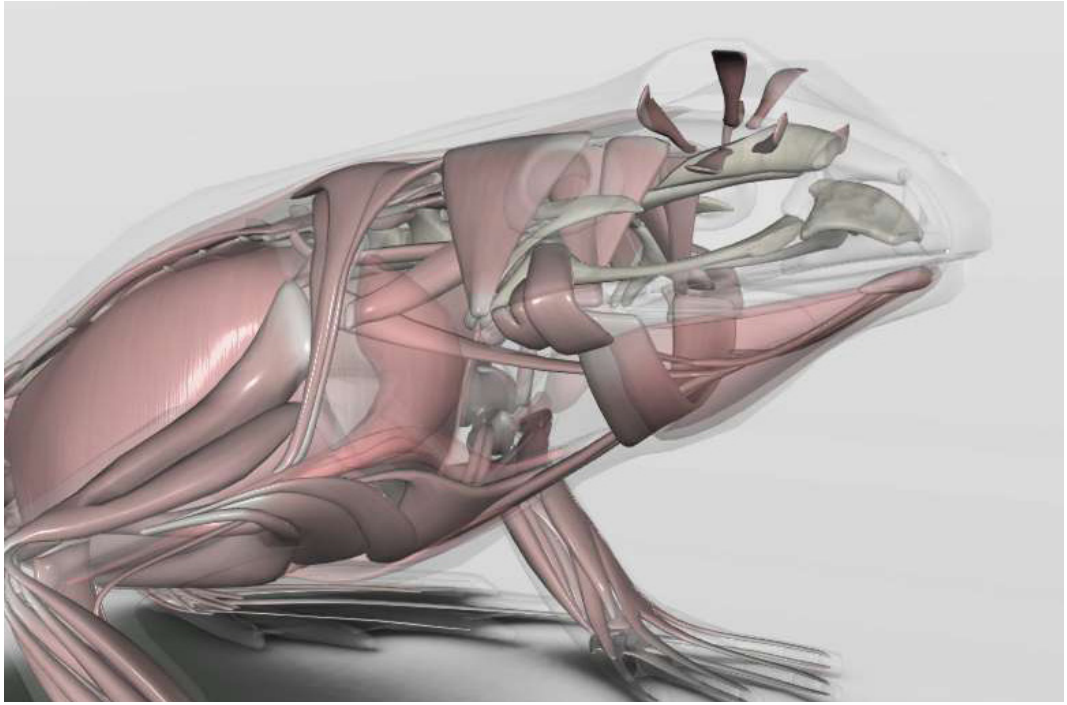
What makes it possible for frogs to "breathe" through their skin?

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.

: Skeleton ::: Muscle

Bucco-pharyngeal Respiration

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

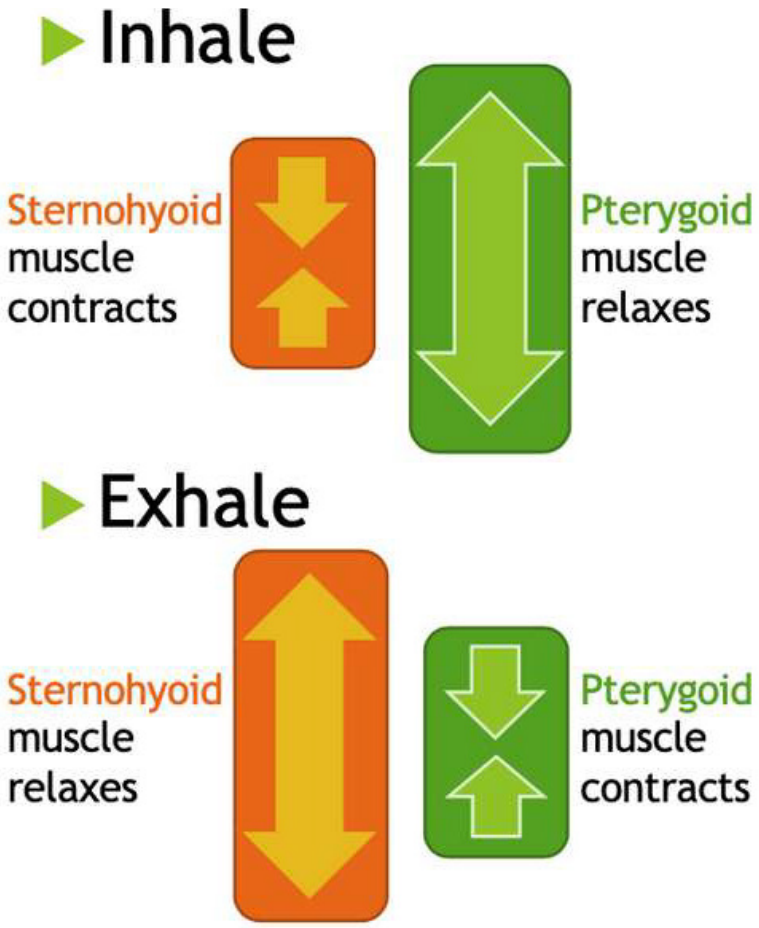


Locate the **pterygoid** and **sternohyoid** muscles.

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

TURN OFF ALL OTHER BODY SYSTEMS AND FOCUS ON THESE: : Skeleton :: Respiratory

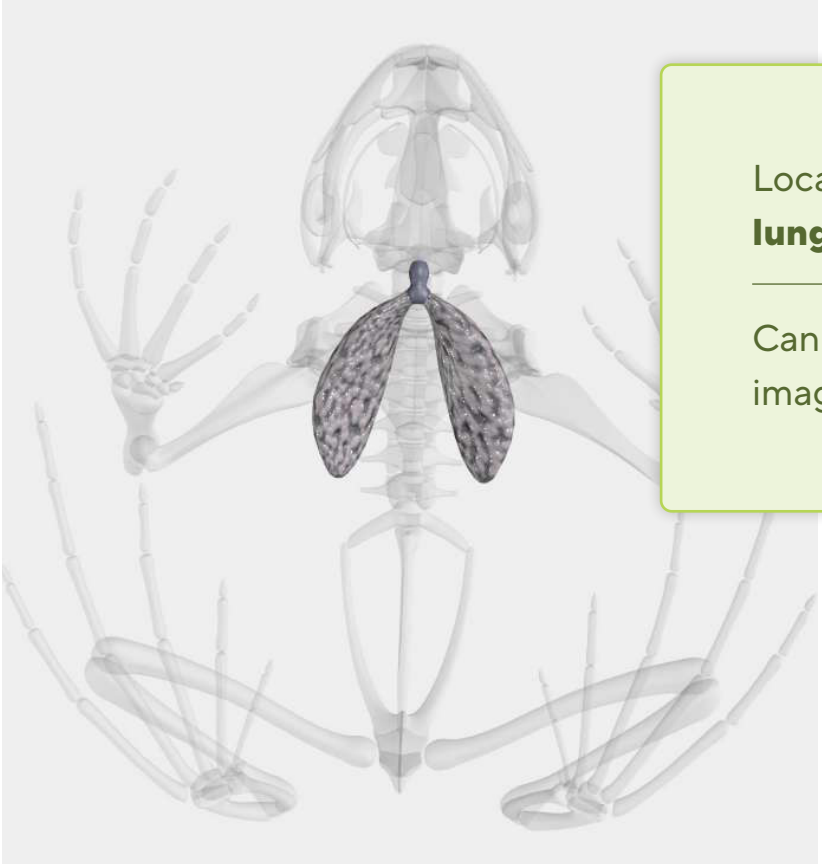
Pulmonary Respiration

LUNGS

Location: chest cavity

Structure: large, spongy expandable organ

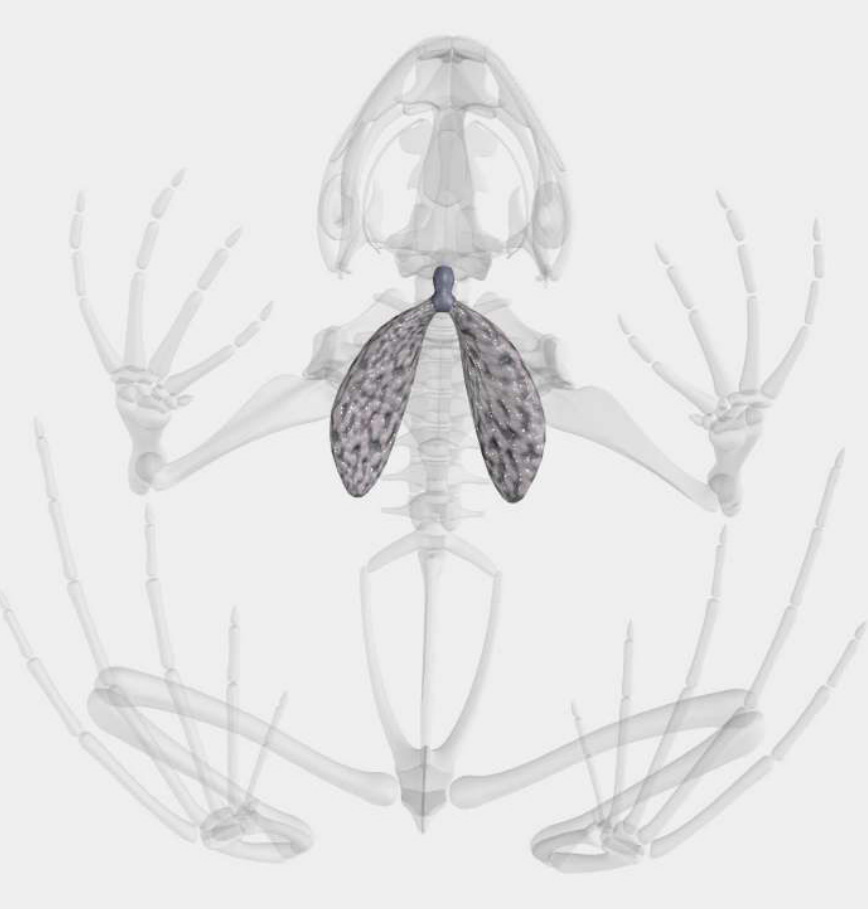
Function: the **site of gas exchange** between the respiratory and circulatory systems



Locate the **larynx** and **lungs**

Can you label them on the image?

Pulmonary Respiration



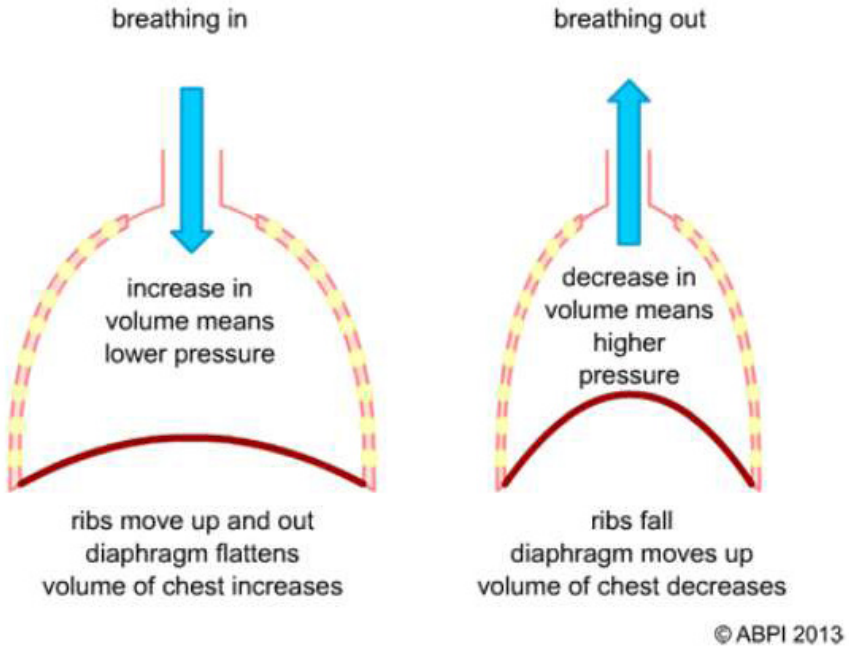
In most mammals, the diaphragm pushes and pulls on the lungs to help inhale and exhale. **How do you think frogs do this?**

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**.

Trachea	**glottis** opens and air travels down the **trachea** (a small nodule in frogs rather than a long tube)—air moves into each lung through the divided branches of the **bronchial tube**
↓	
Bronchial tube	within the lungs, it branches further into **bronchioles**
↓	
Bronchioles	tiny thin walled sacs are on the end of the bronchioles, called **alveoli**
↓	
Alveoli	site of **oxygen exchange**

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

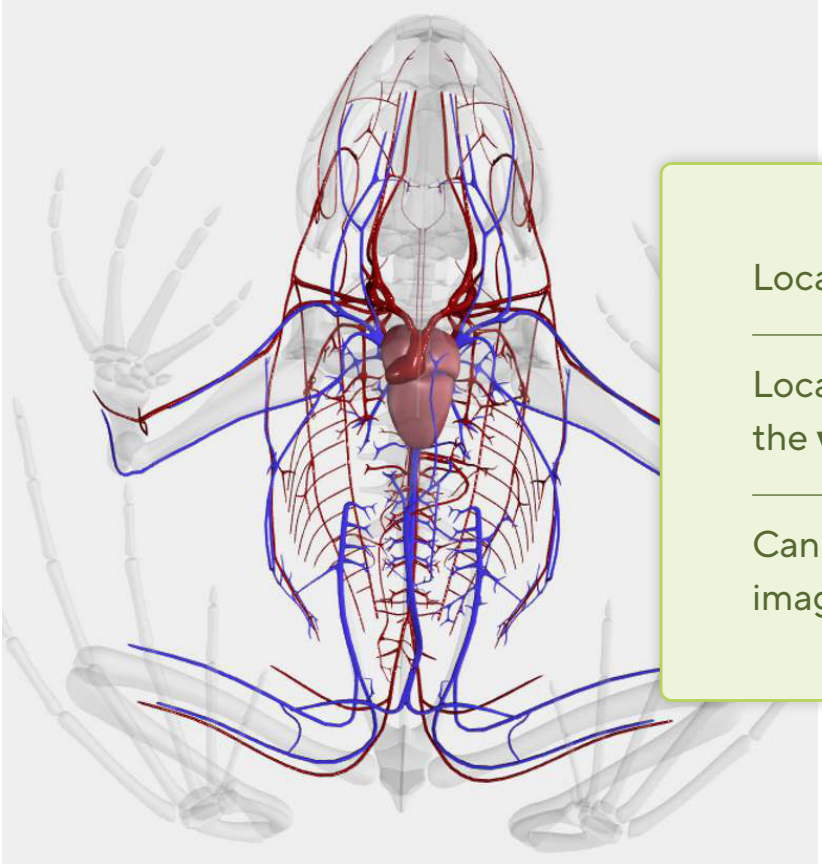
TURN OFF ALL OTHER BODY SYSTEMS AND FOCUS ON THESE: : Skeleton :: Circulatory

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

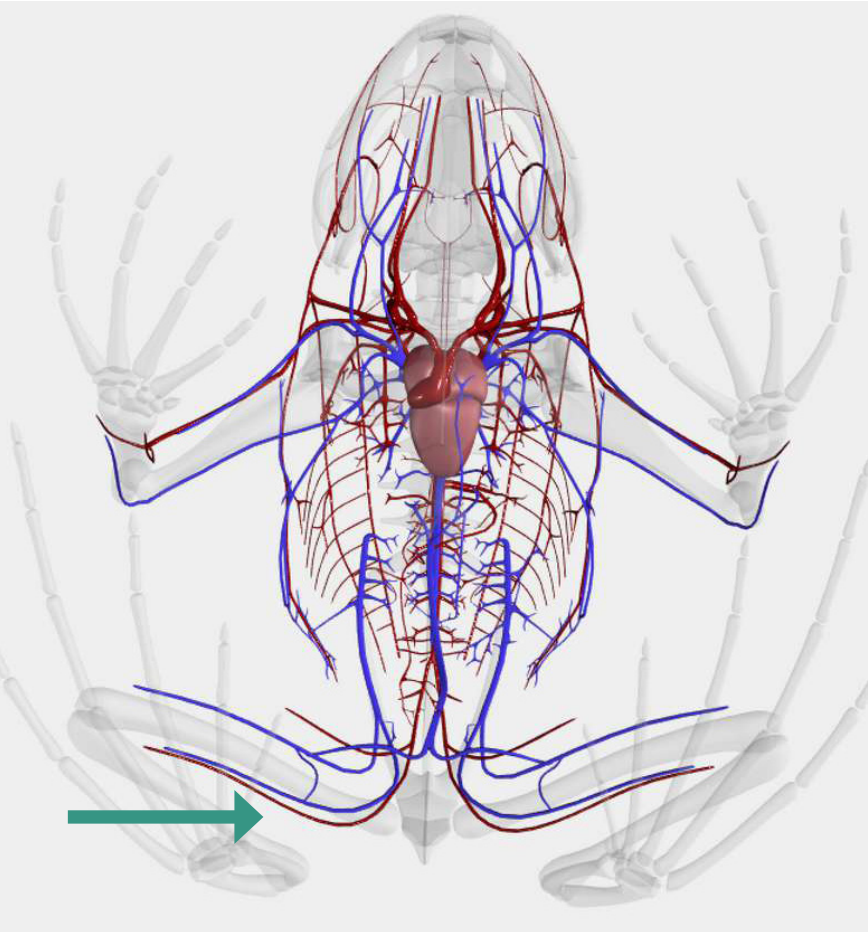


Locate the frog's **heart**.

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

Can you label them on the image?

Heart



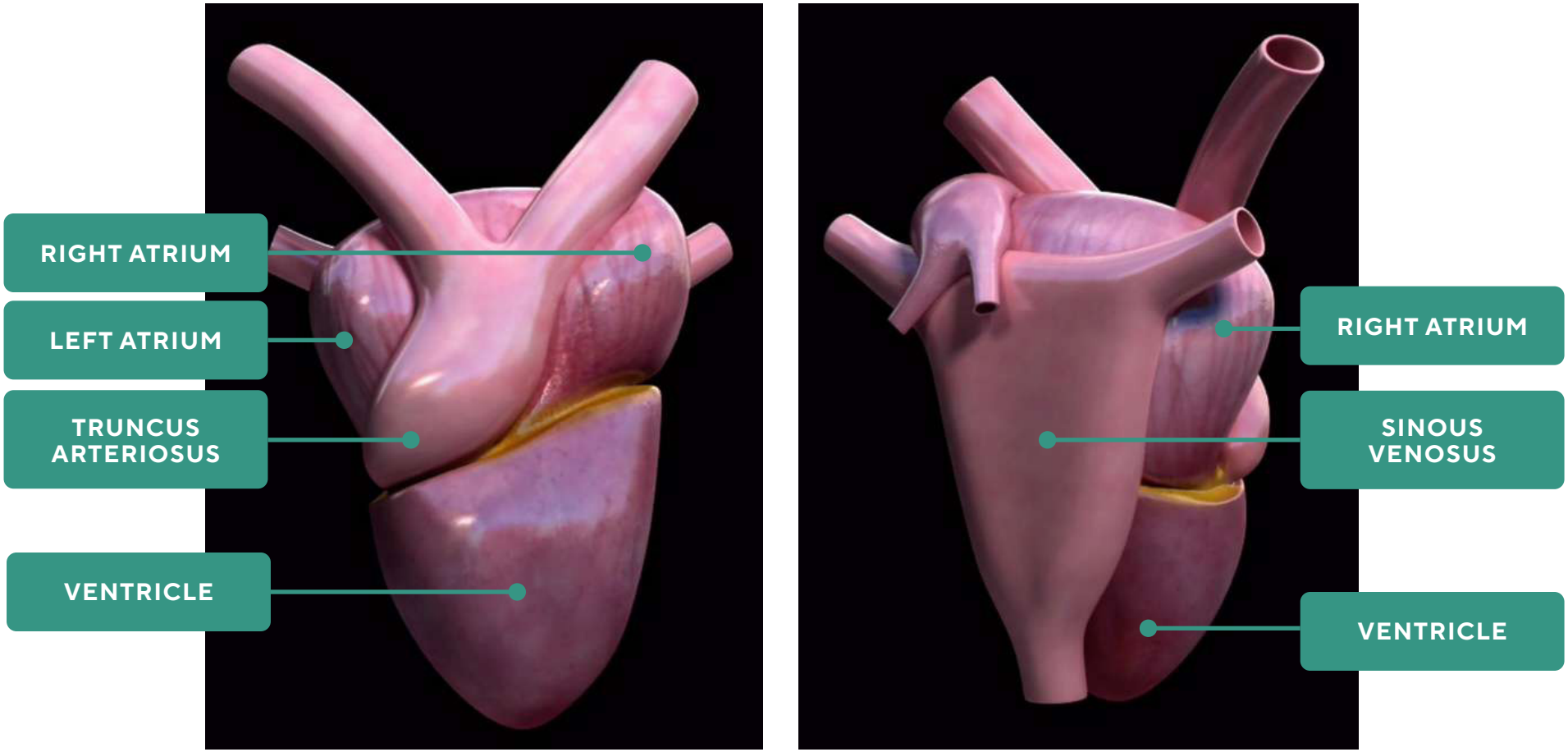
Do arteries **always** carry oxygenated blood and the veins deoxygenated blood?

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

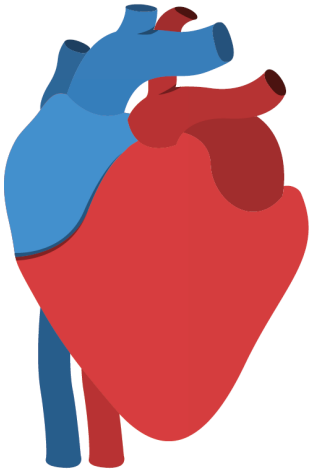


Bloodflow Through the Heart

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.



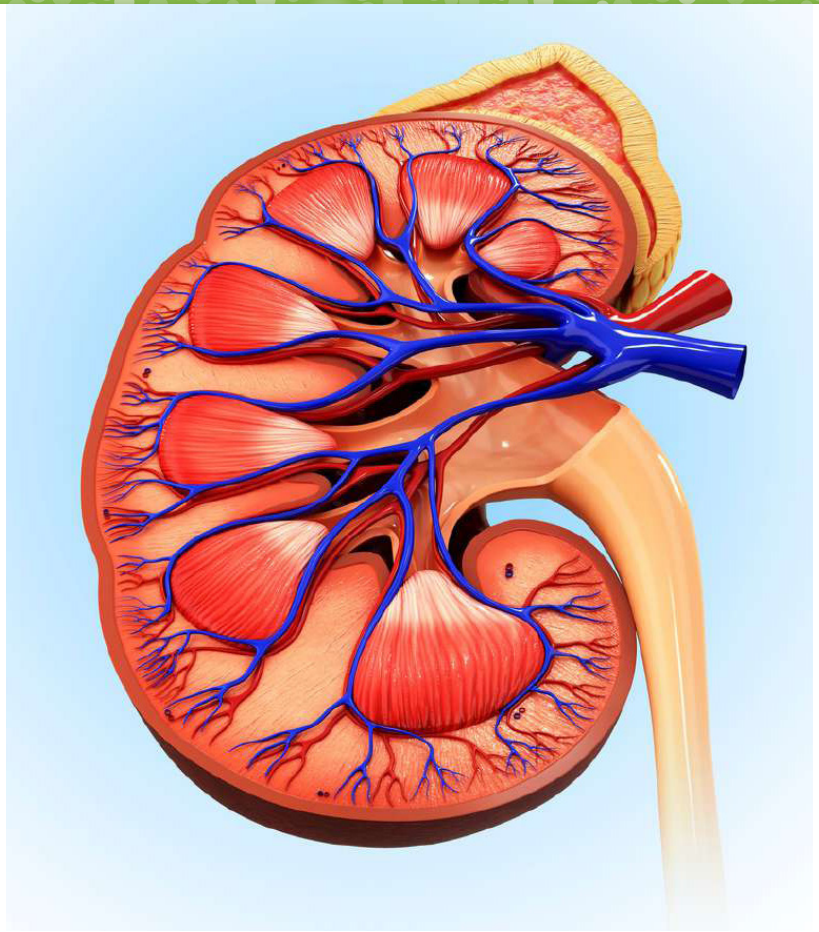
Pulmonary veins carry oxygenated blood back to the heart and into the **left atrium**.

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

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

REVIEW BREAK

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

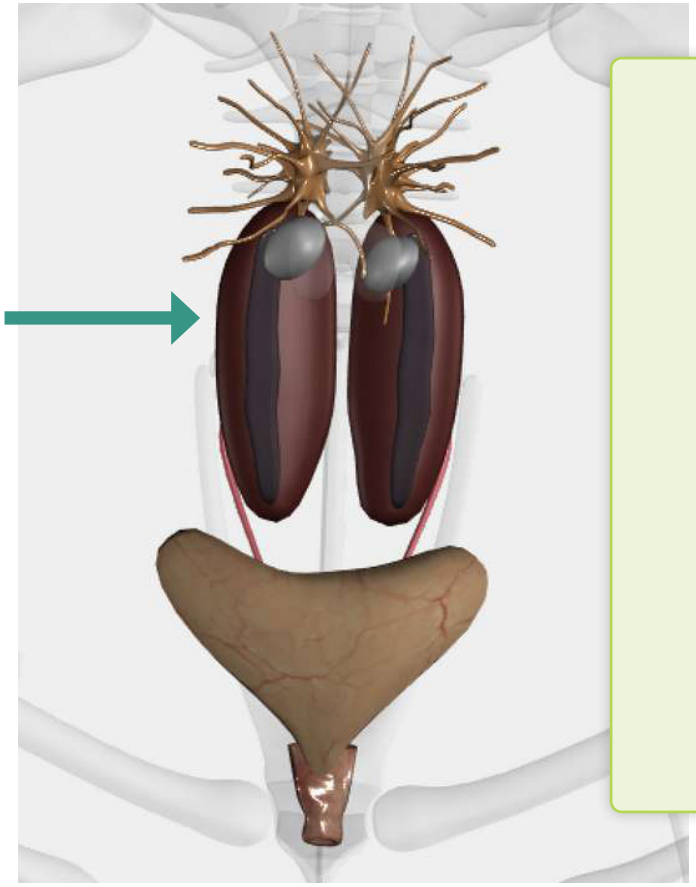
TURN OFF ALL OTHER BODY SYSTEMS AND FOCUS ON THESE: : Skeleton ::: Urogenital

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?

Ureter and Urinary Bladder

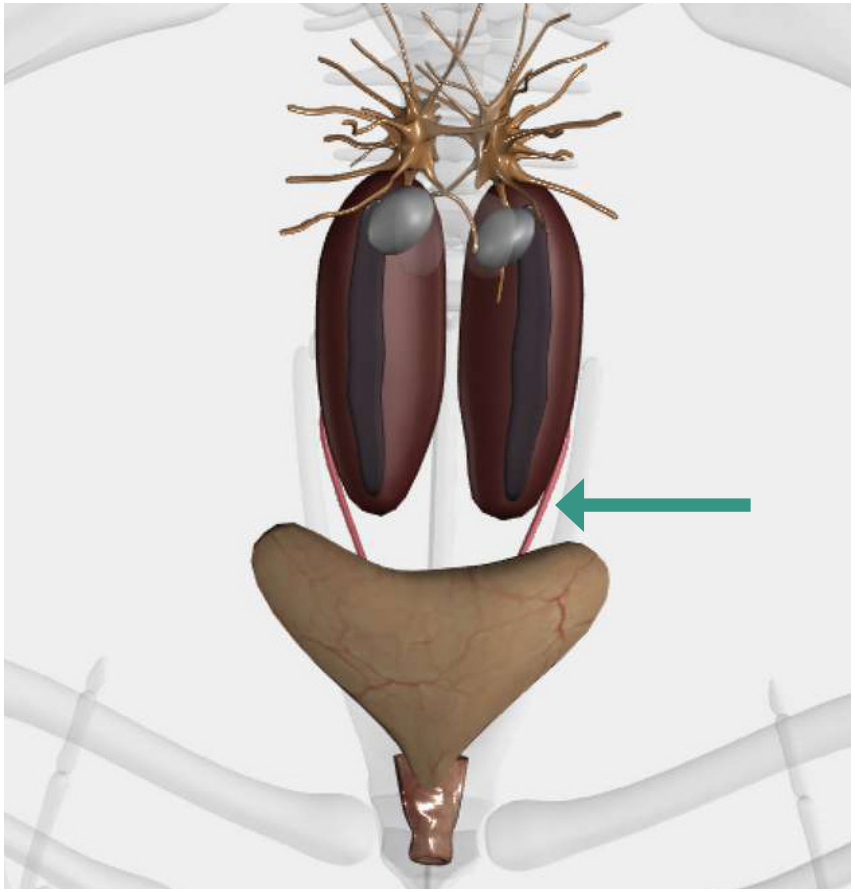
Locate the **ureter** and **urinary bladder**.

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

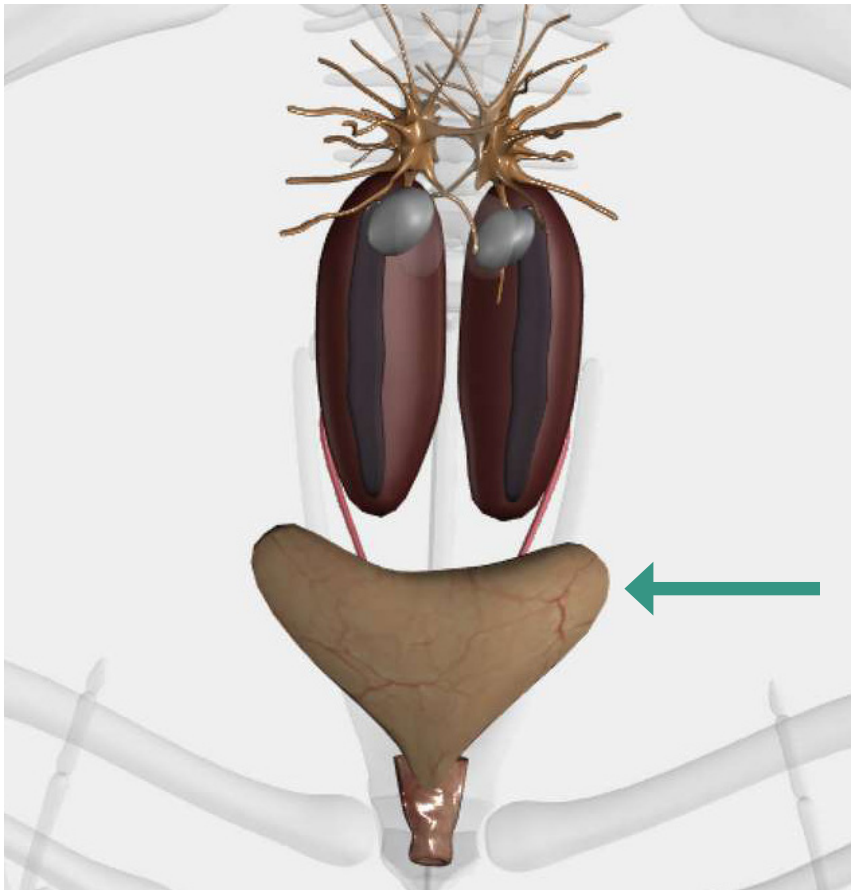


Location: a vessel running between the **kidneys** and the **urinary bladder**

Structure: thin tube

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

Urinary Bladder



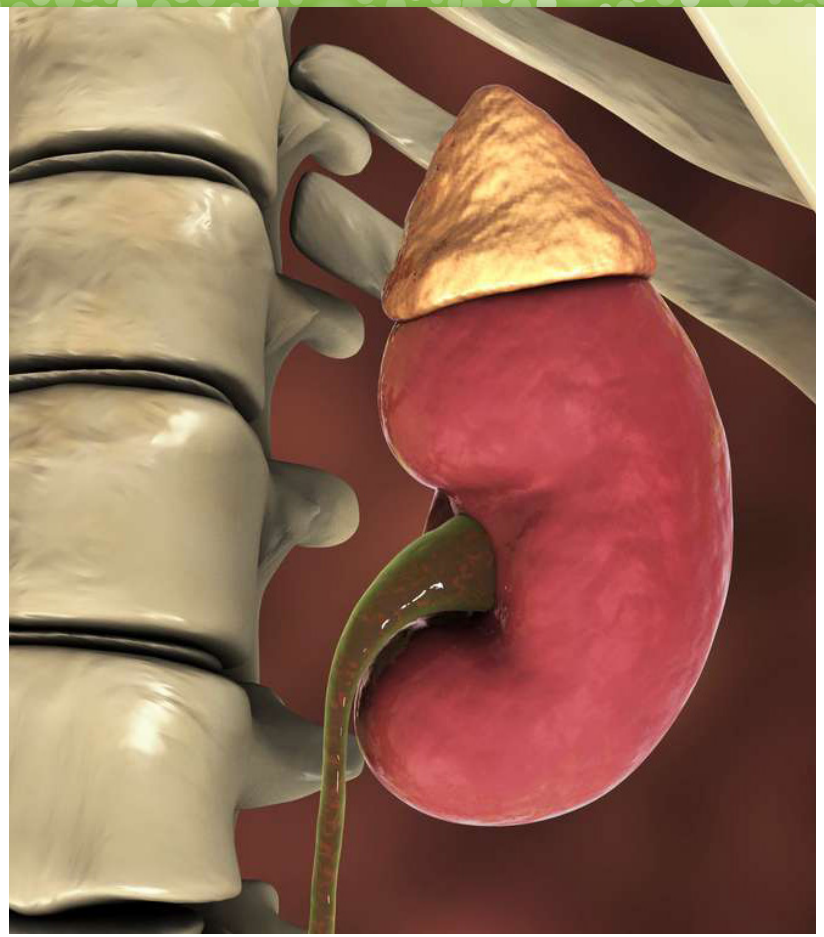
Location: connected to the **ureter** and **urethra**

Structure: sac-like structure

Function: **stores** urine produced by **kidneys** and releases it into the **cloaca**

REVIEW BREAK

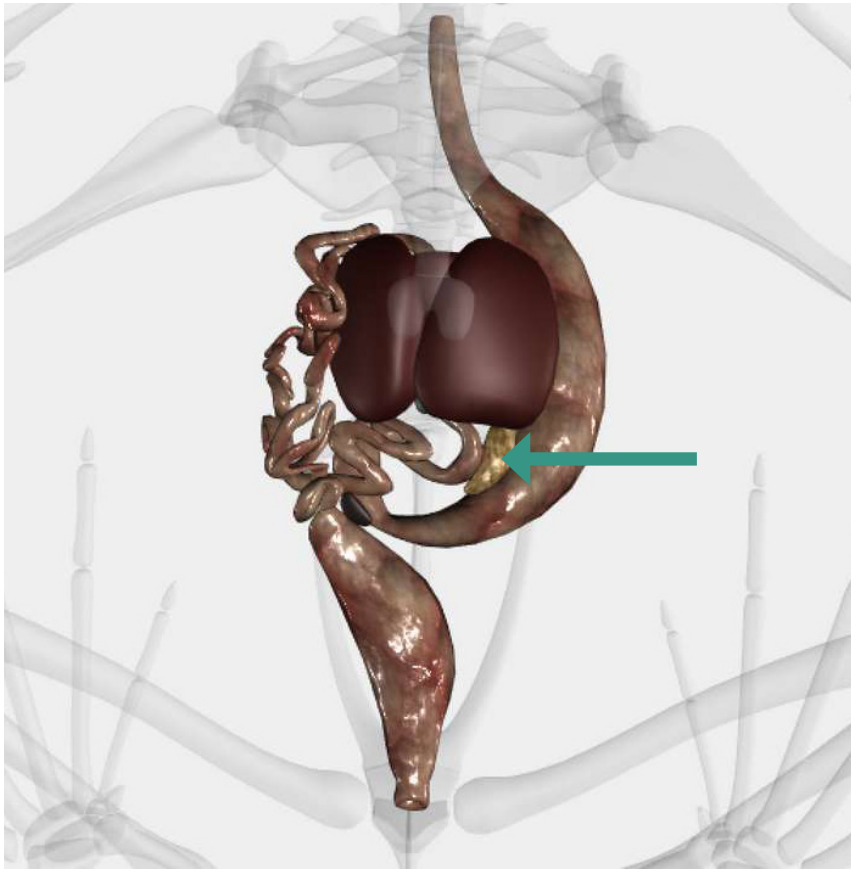
With your group, trace the path of urine from the kidneys to the outside of the body. Choose one person to explain it to the class.



ENDOCRINE SYSTEM

TURN OFF ALL OTHER BODY SYSTEMS AND FOCUS ON THESE: : Skeleton :: Digestive

Pancreas

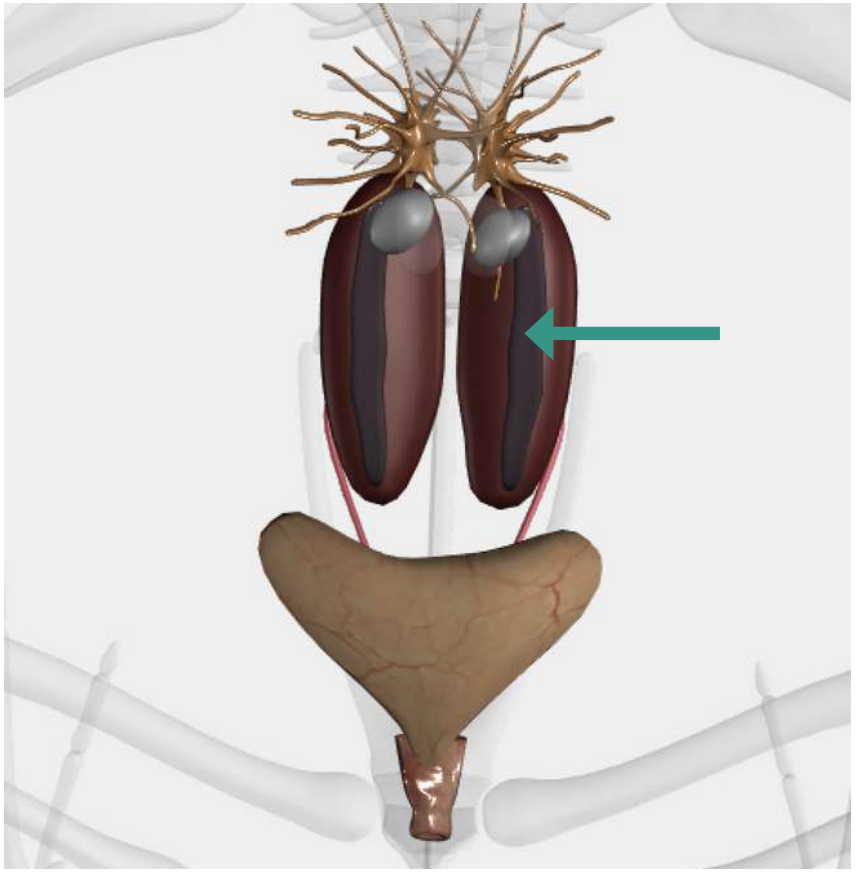


Location: near stomach in abdominal cavity

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

TURN OFF ALL OTHER BODY SYSTEMS AND FOCUS ON THESE: : Skeleton :: Urogenital

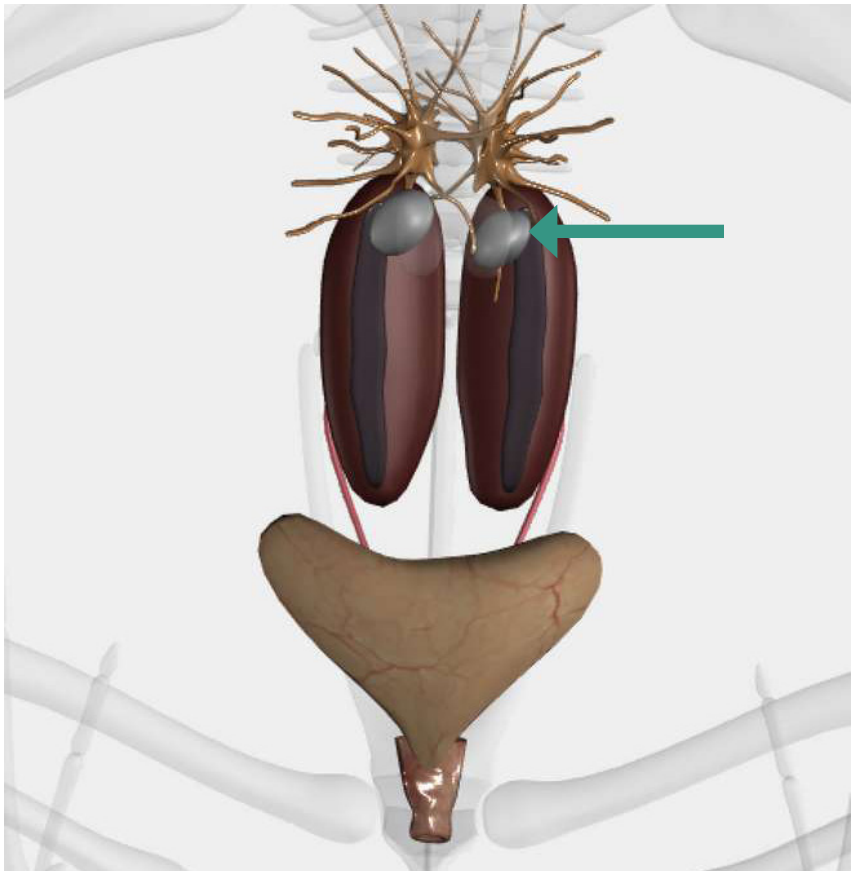
Adrenal Glands



Location: anterior end of kidneys

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

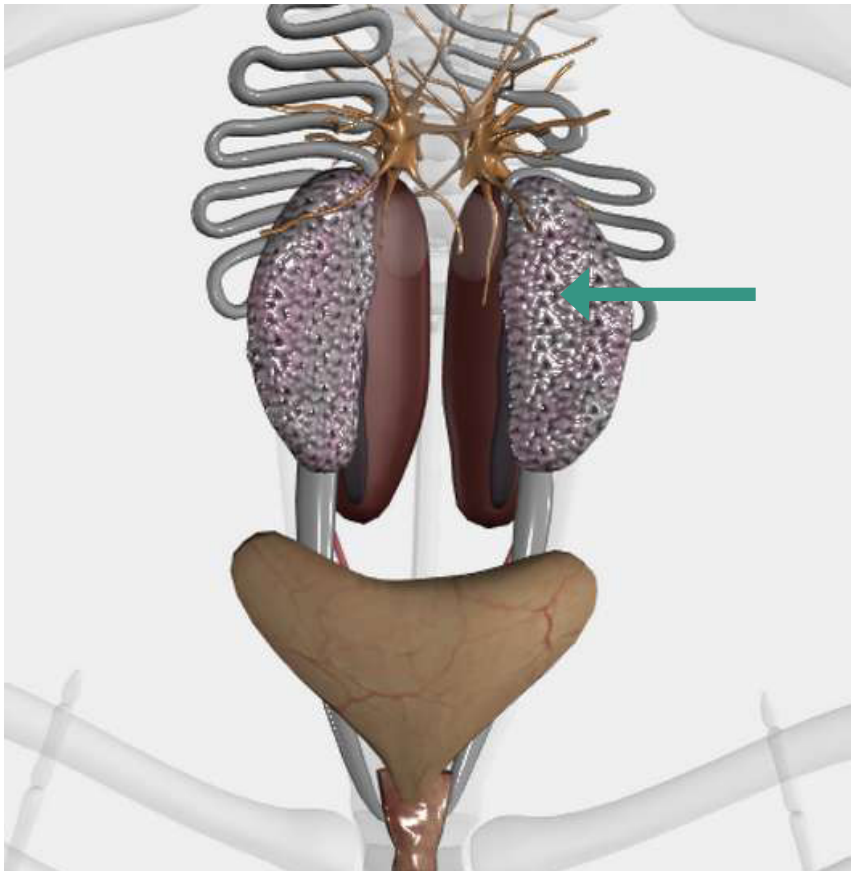
Testes



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

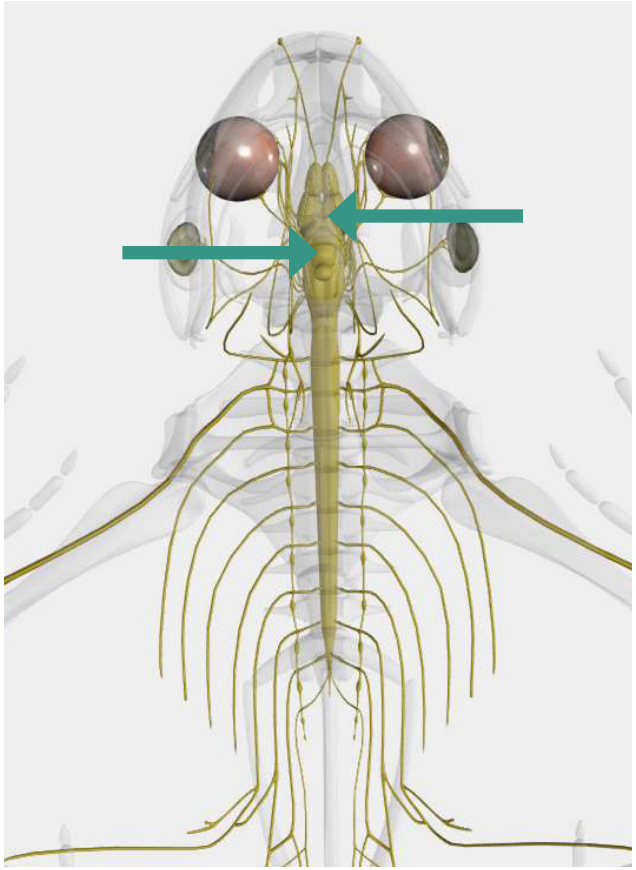
TURN OFF ALL OTHER BODY SYSTEMS AND FOCUS ON THESE: : Skeleton :: Nervous

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.

REVIEW BREAK

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

TURN OFF ALL OTHER BODY SYSTEMS AND FOCUS ON THESE: : Skeleton :: Nervous

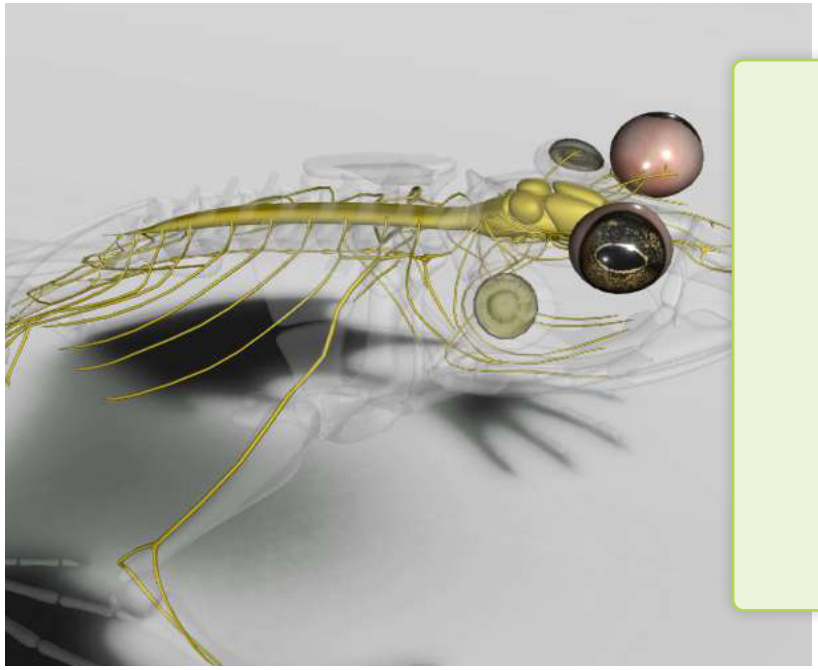
Central Nervous System

BRAIN

Location: in the skull

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

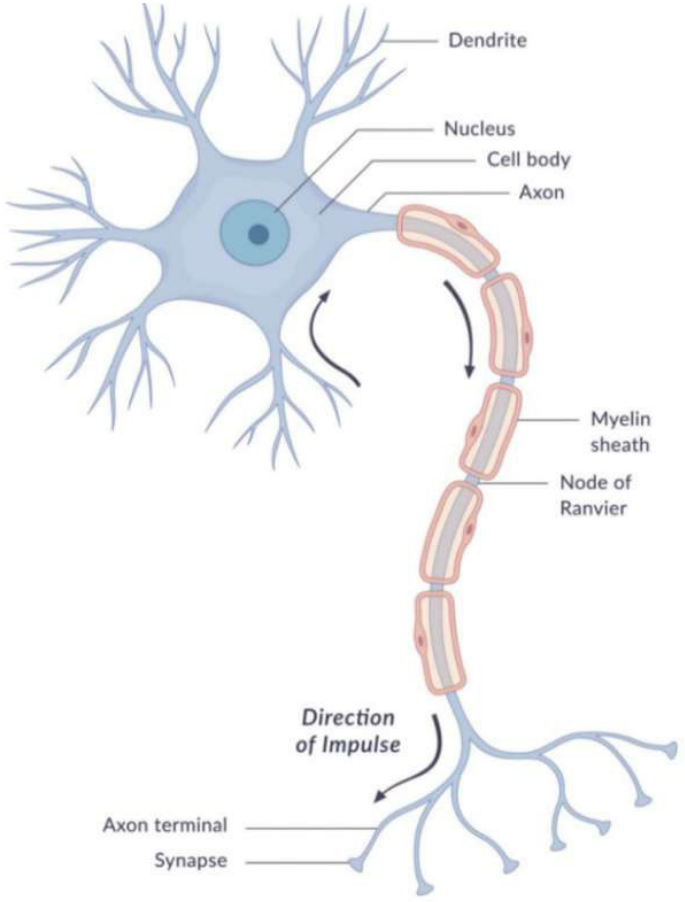
Function: the frog's **central information processor**



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

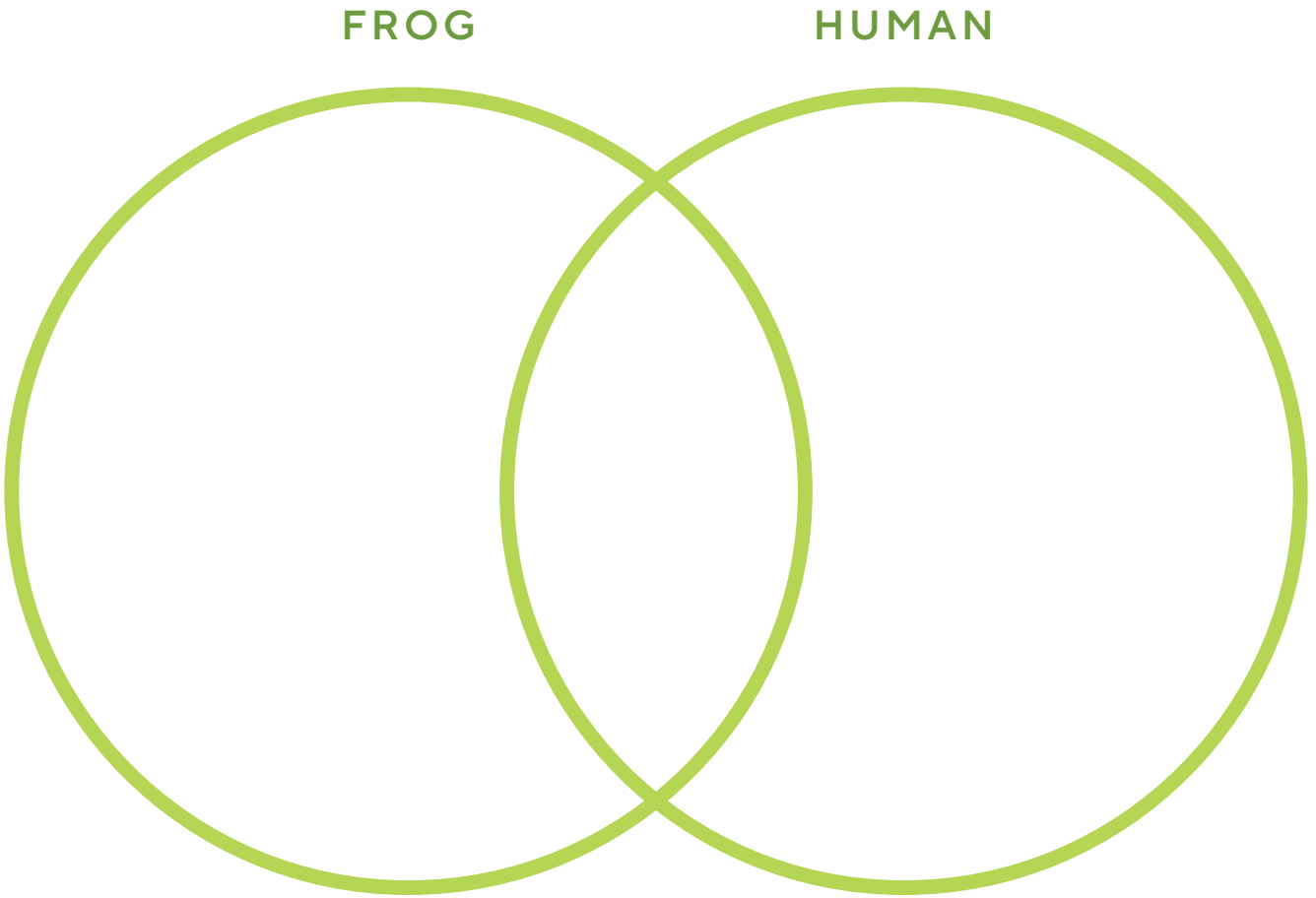


Nerves are bundles of **neurons** (like the one pictured to the left) that transmit electrical "nerve impulses". Nerve impulses are part of a special information system in the body. For example, when you touch something warm with your hand, the nerves in your hand transmit the information about temperature to your brain, which then translates that into your feeling of "warmth" in your hand.

REVIEW BREAK

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?