



Frog Anatomy Workbook

(accompanies 3D Frog Anatomy app by Biosphera)

The background of the slide is white, framed by a thick green border. It is decorated with numerous overlapping circles of various sizes and shades of green, ranging from light lime to a darker sage green. The circles are scattered across the page, creating a bubbly, organic pattern.

© Elisabeth Ormandy, 2020.

Do not make copies and/or distribute the material contained in this document without explicit, written permission.

Contents

Learning Objectives.....	4
Getting To Know 3D Frog Anatomy.....	6
Digestive system.....	16
Musculoskeletal system.....	30
Respiratory system.....	34
Circulatory system.....	44
Urinary system.....	50
Endocrine system.....	56
Nervous system.....	64
Similarities between frogs and humans.....	68
Extra study questions.....	69

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

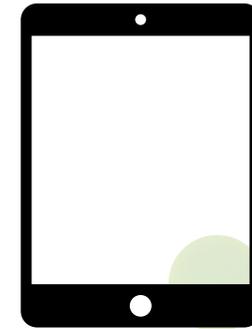
Endocrine

Nervous & Sensory

Getting To Know 3D Frog Anatomy

By: Biosphera

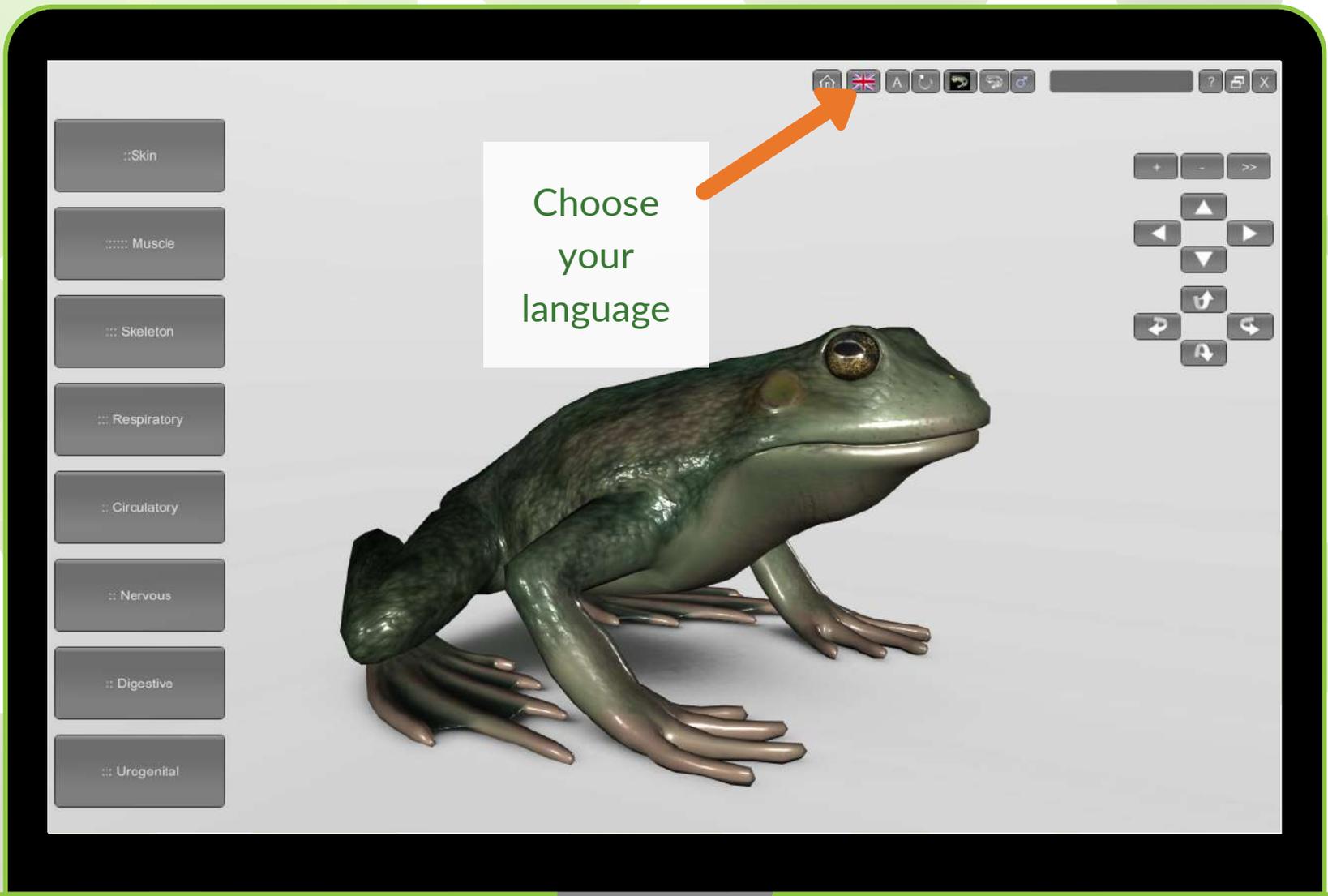
The app is available for iPads, Android tablets and desktop: www.biosphera.com

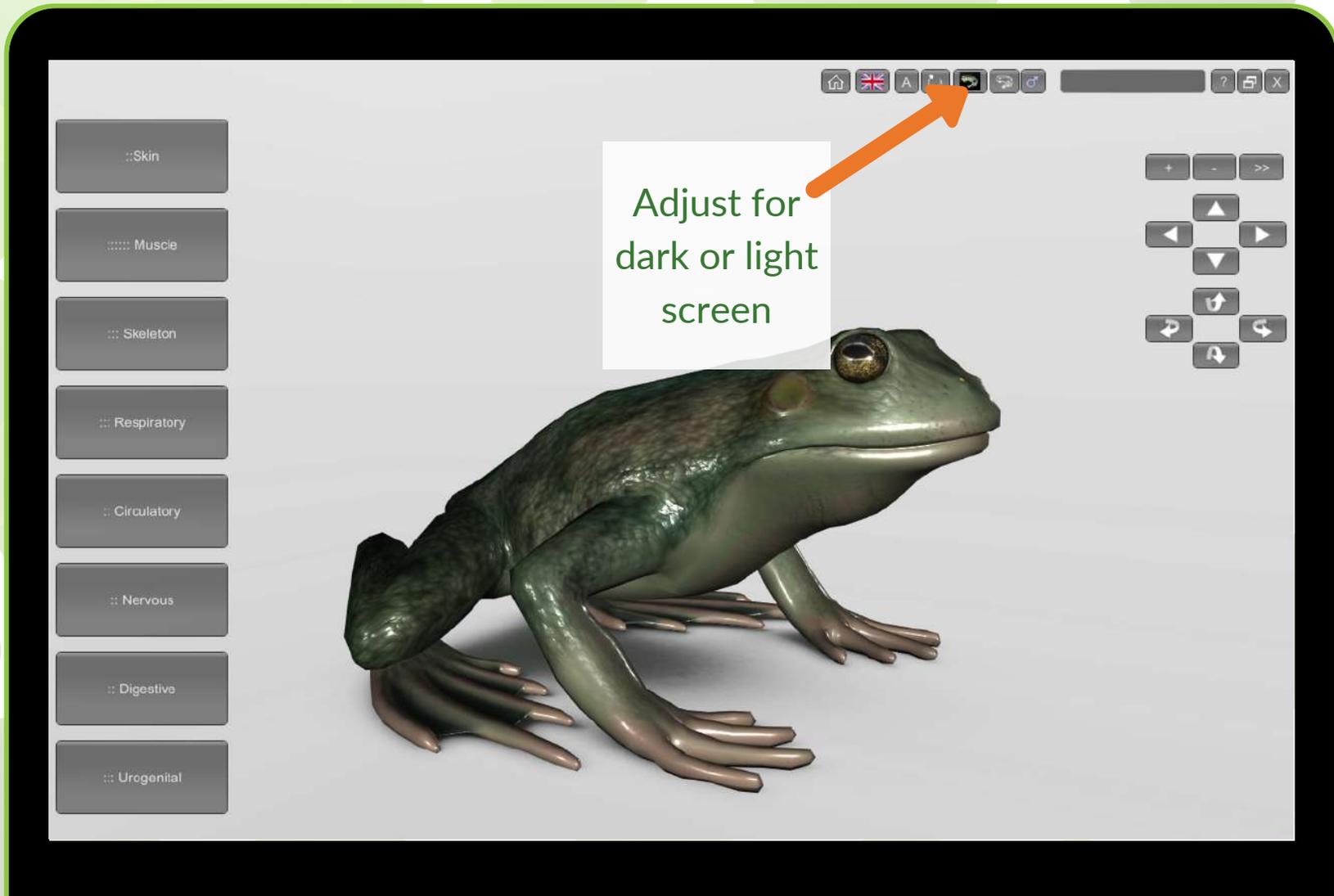


**Lets get comfortable with
the app!**

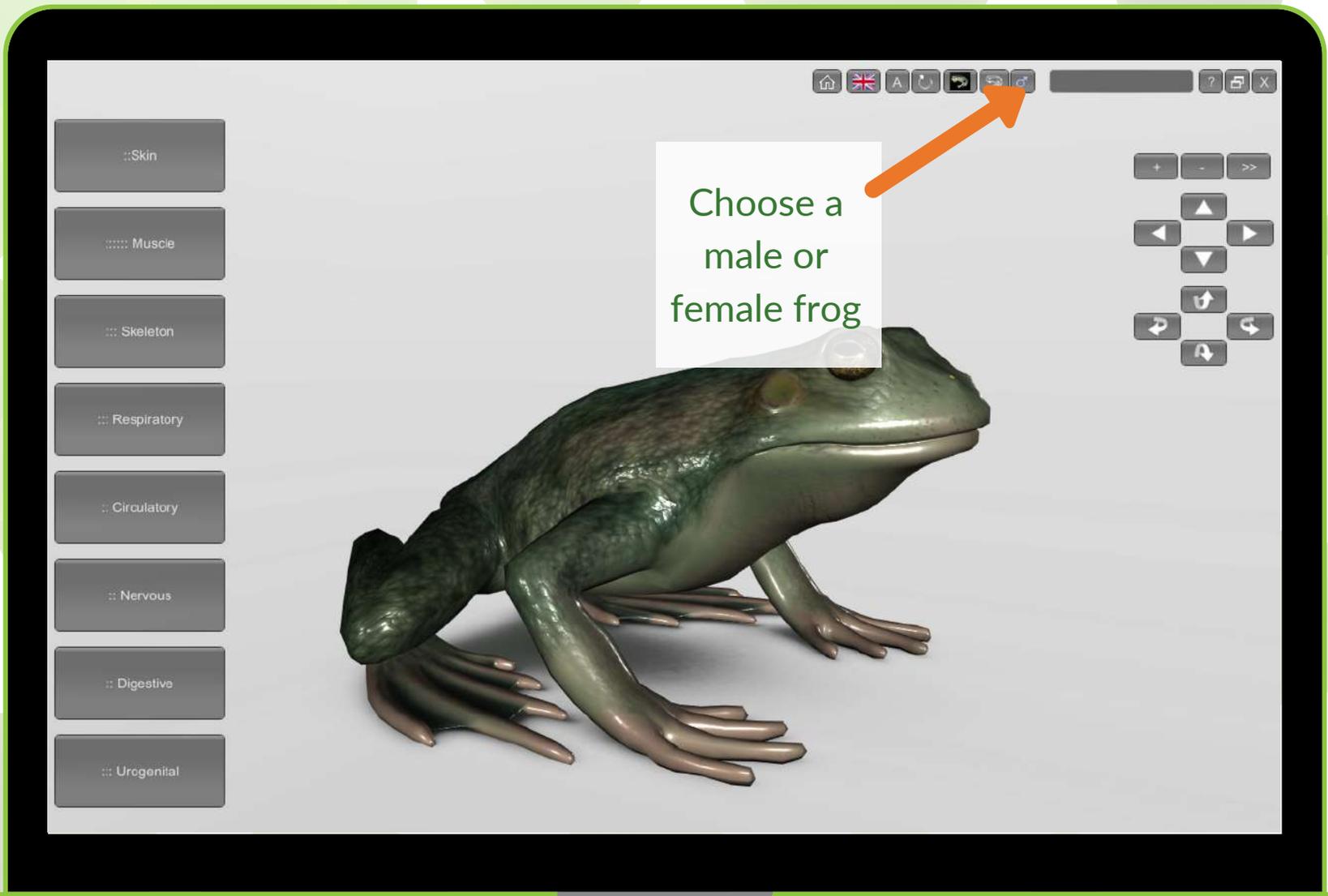
Take a few minutes to explore
the app.

Press buttons, move the model
around, and touch/hold the
organs... See what happens!

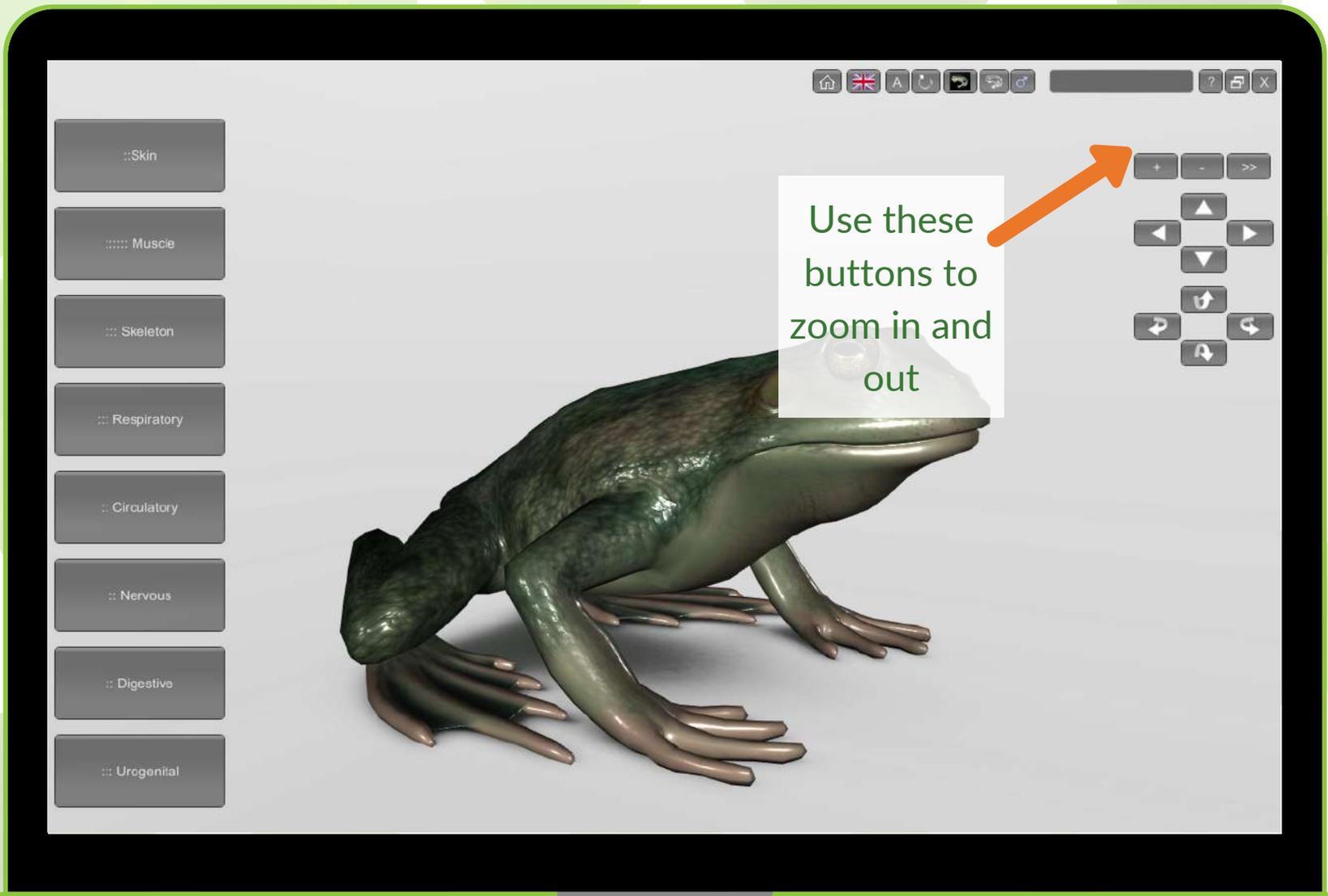




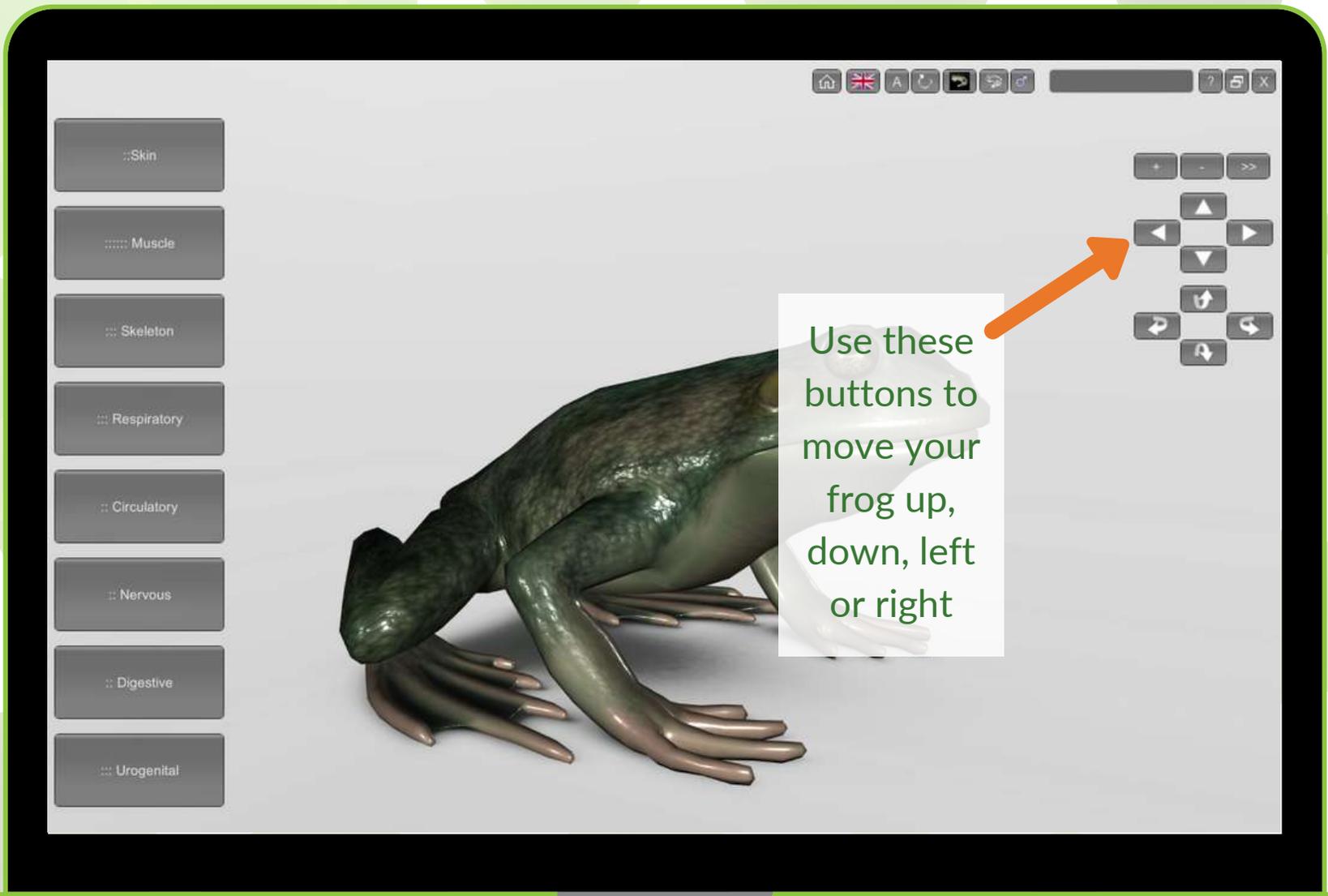
Adjust for
dark or light
screen



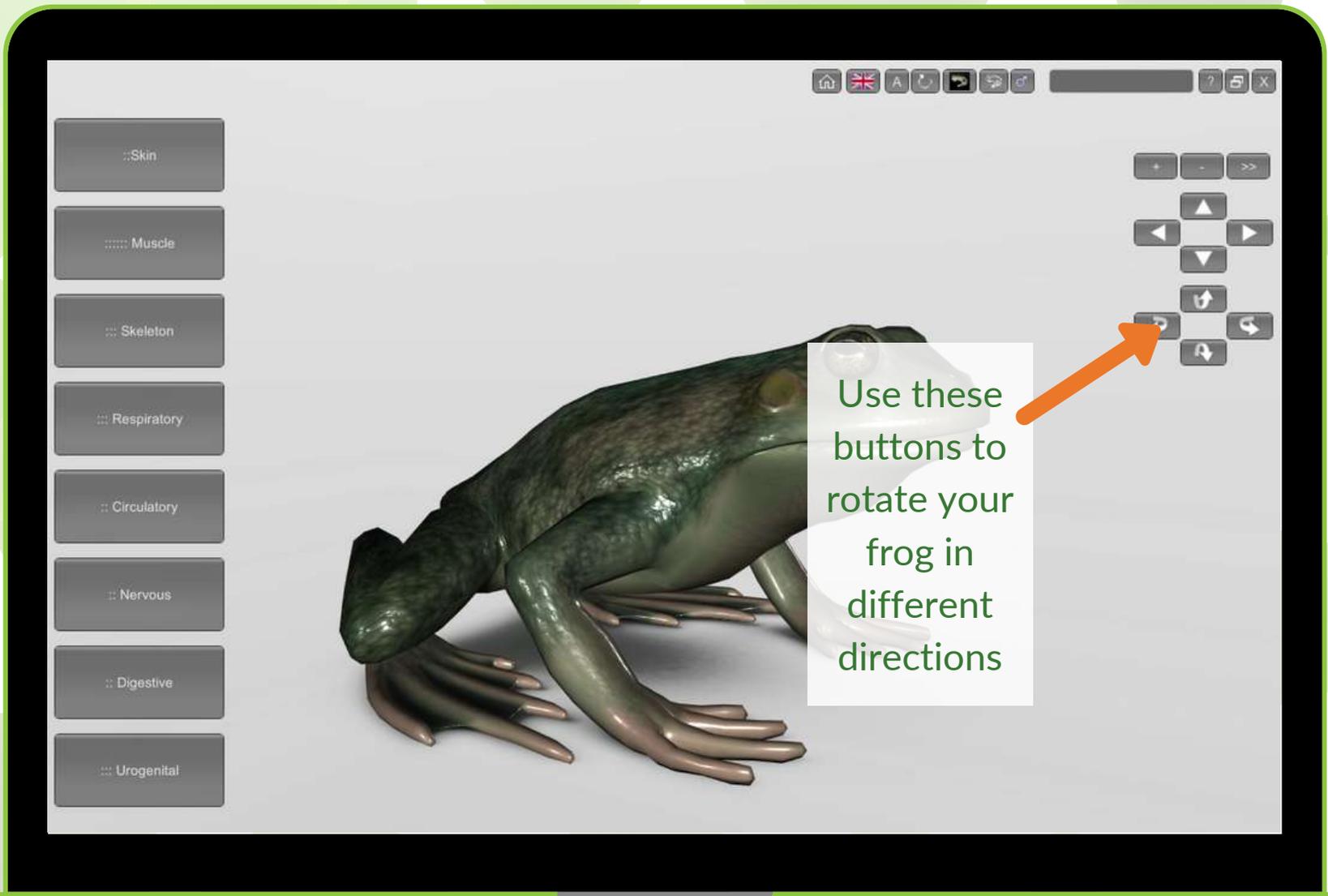
Choose a
male or
female frog



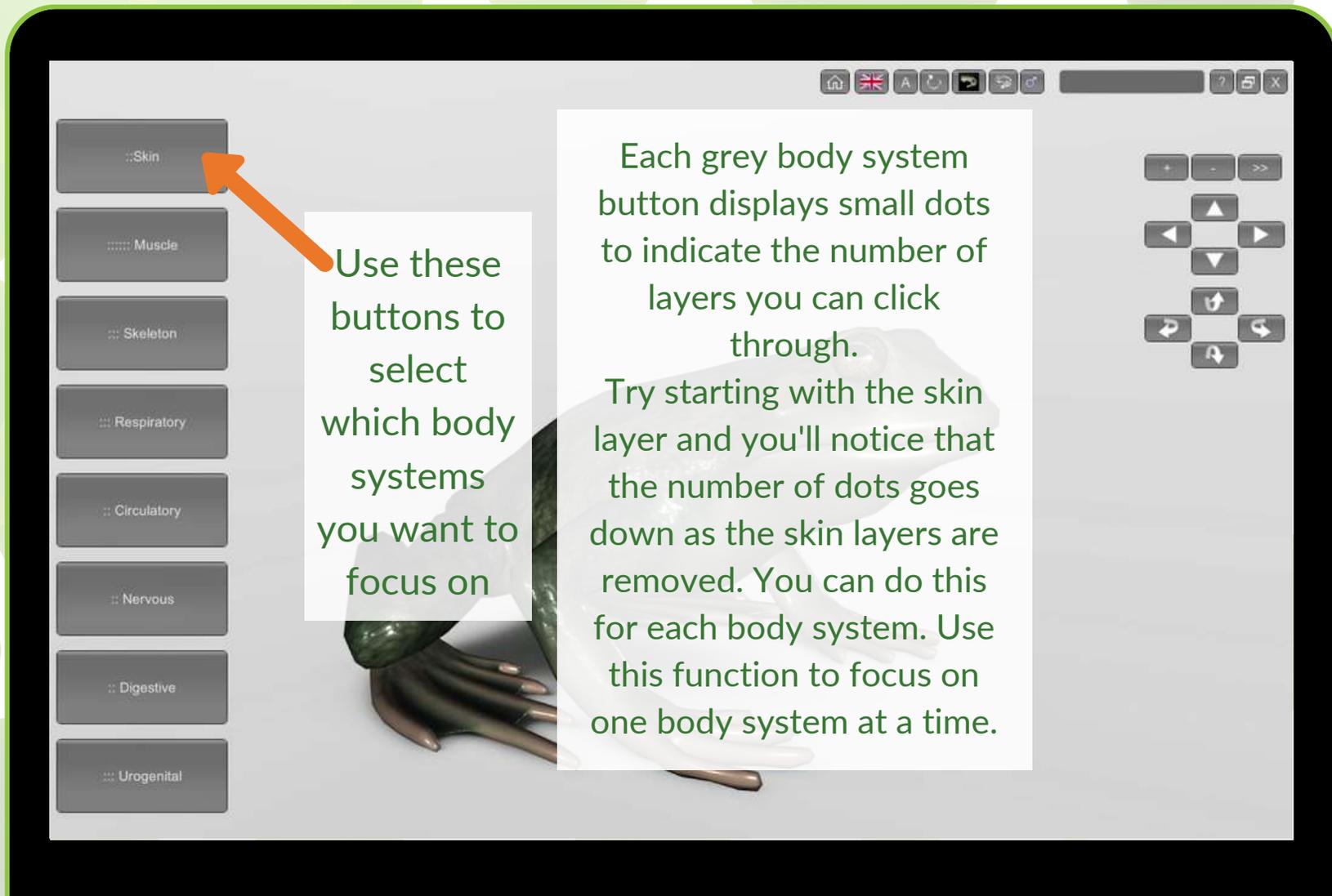
Use these buttons to zoom in and out



Use these buttons to move your frog up, down, left or right



Use these buttons to rotate your frog in different directions



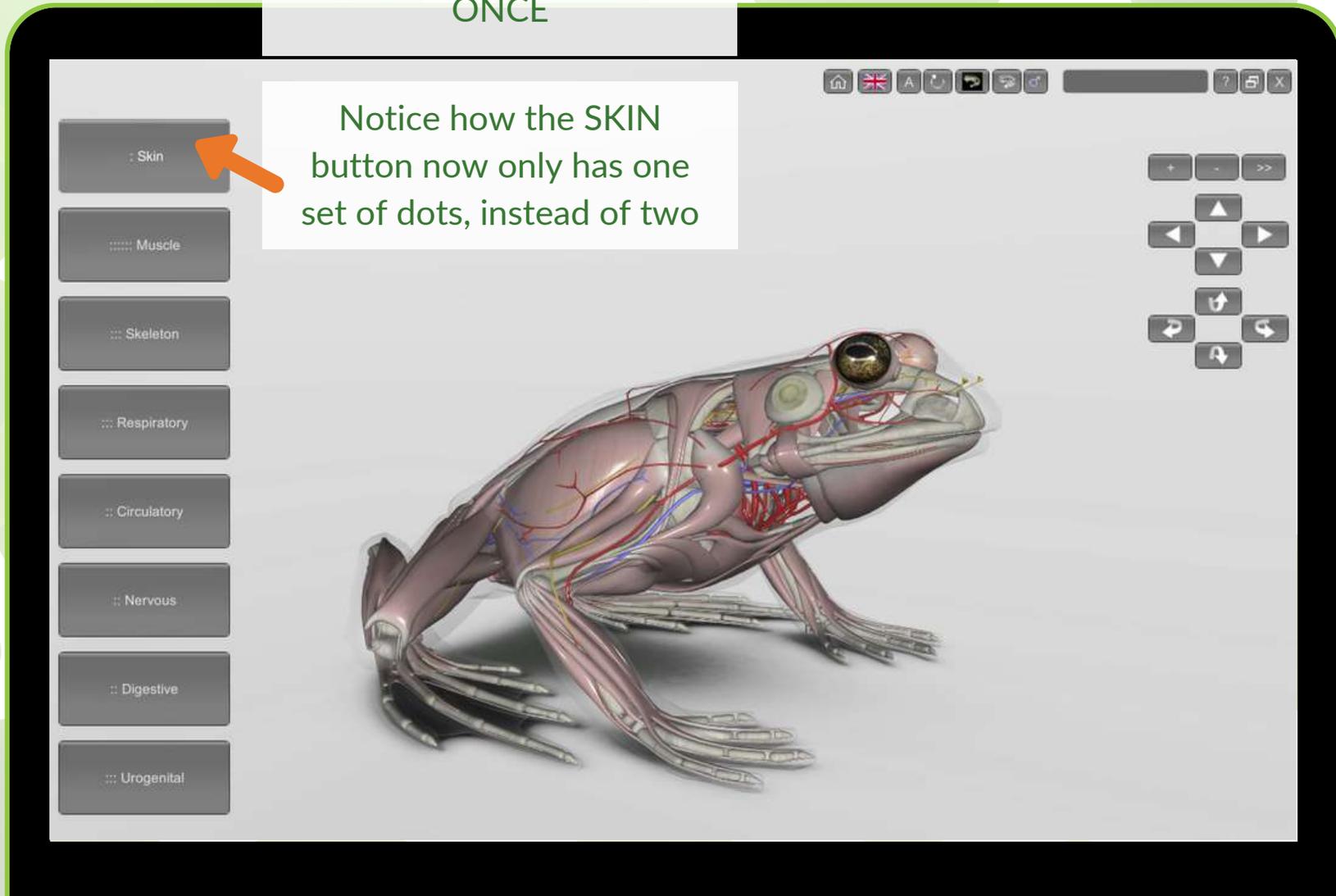
Use these buttons to select which body systems you want to focus on

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.

Here's what your frog should look like when you click the SKIN button ONCE

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

Digestive System - External Anatomy

: Skeleton

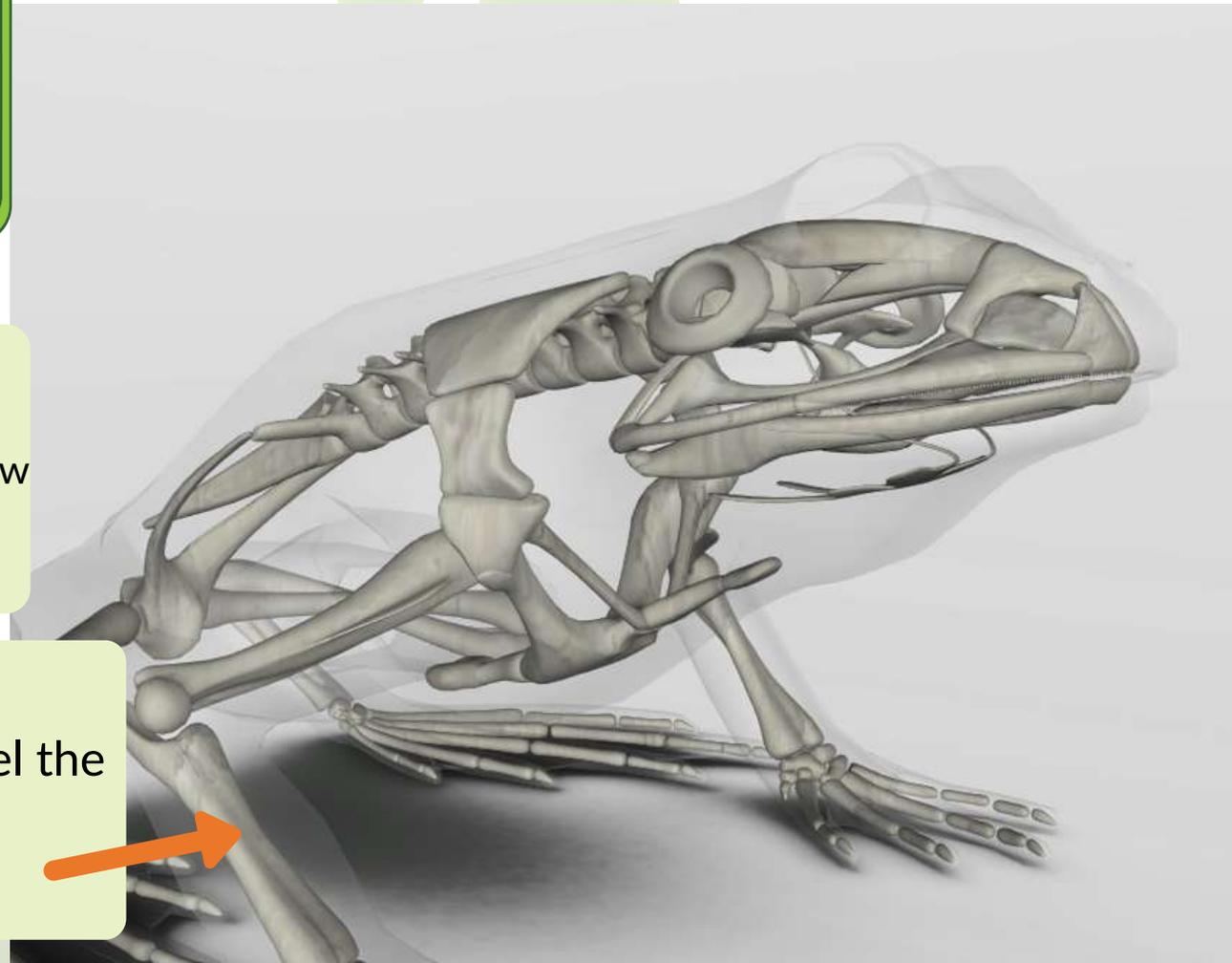
:: Digestive

Turn off all other body systems and focus on these

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

: Skeleton

:: Digestive

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

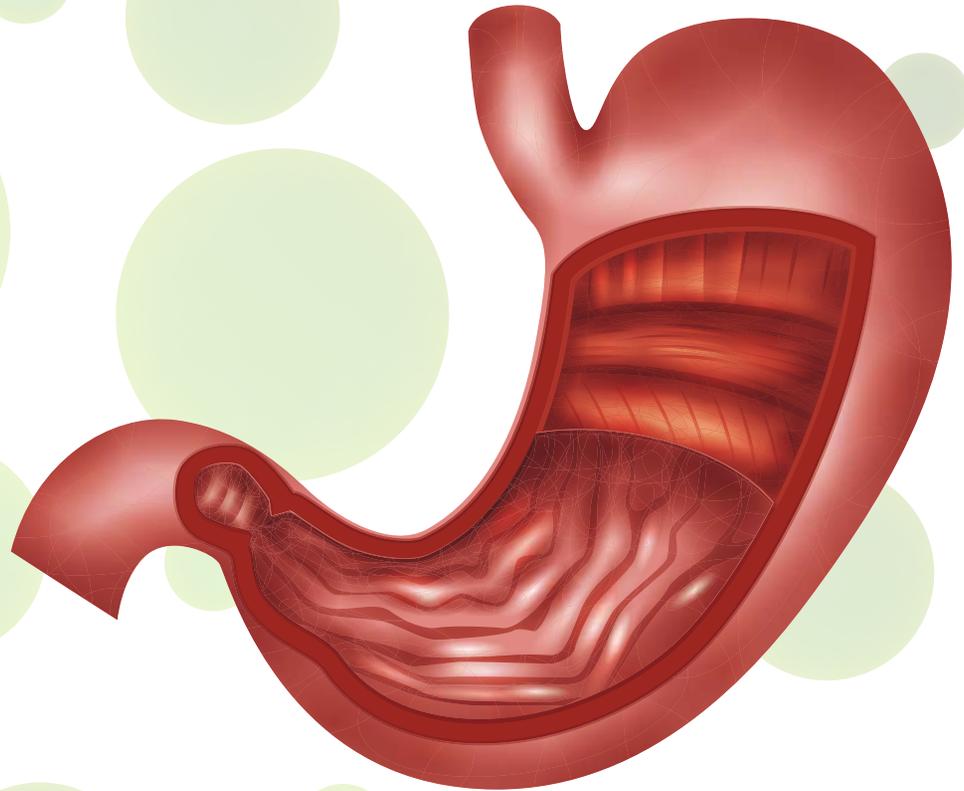
After mechanical and chemical digestion in the mouth, the chewed food (called a **bolus**) is swallowed

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



Stomach

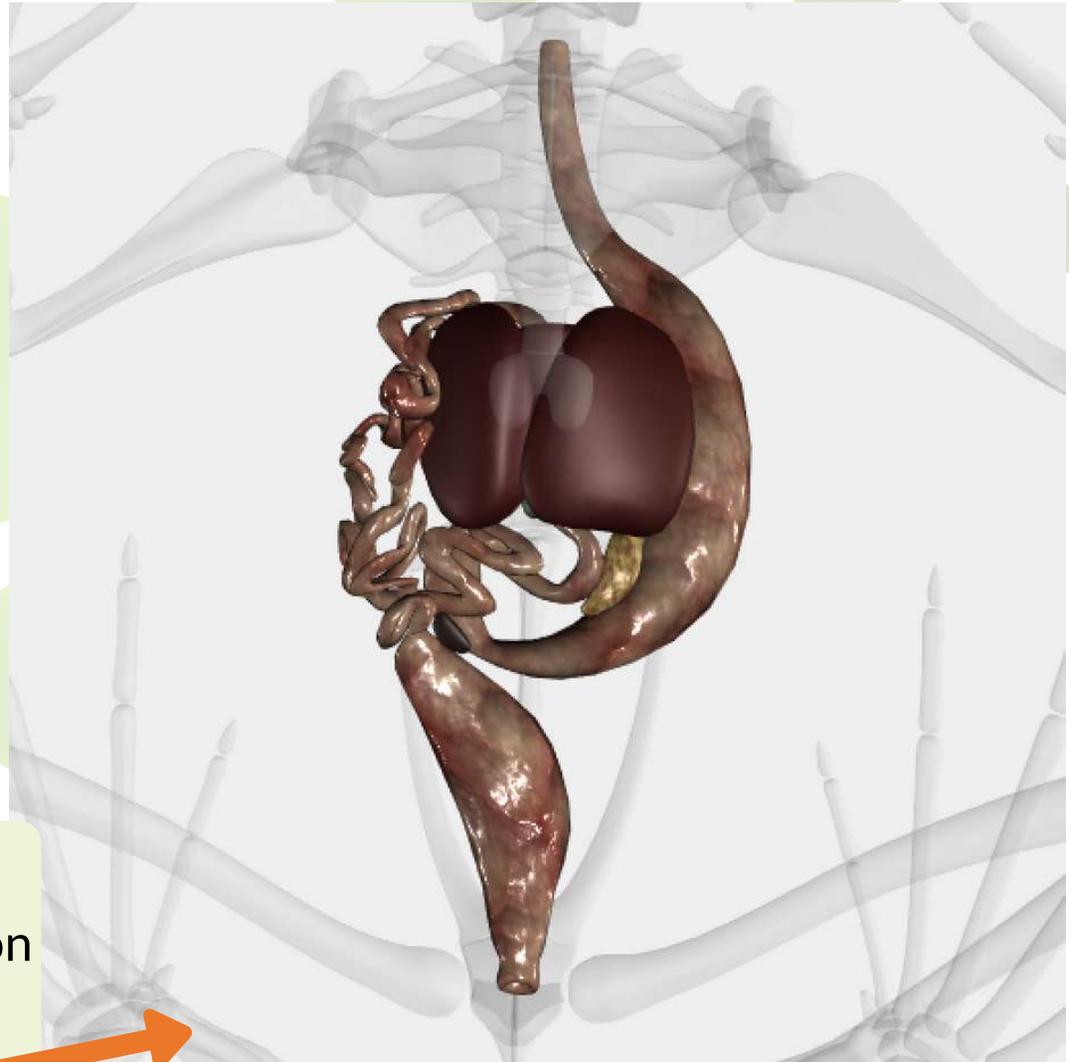
- **Location:** dorsal and posterior to the liver
- **Structure:** muscular organ
- **Function:** muscular organ that continues the chemical and mechanical digestion that started in the mouth



The food travels to the **small intestines** from the **stomach** through the **pyloric sphincter**

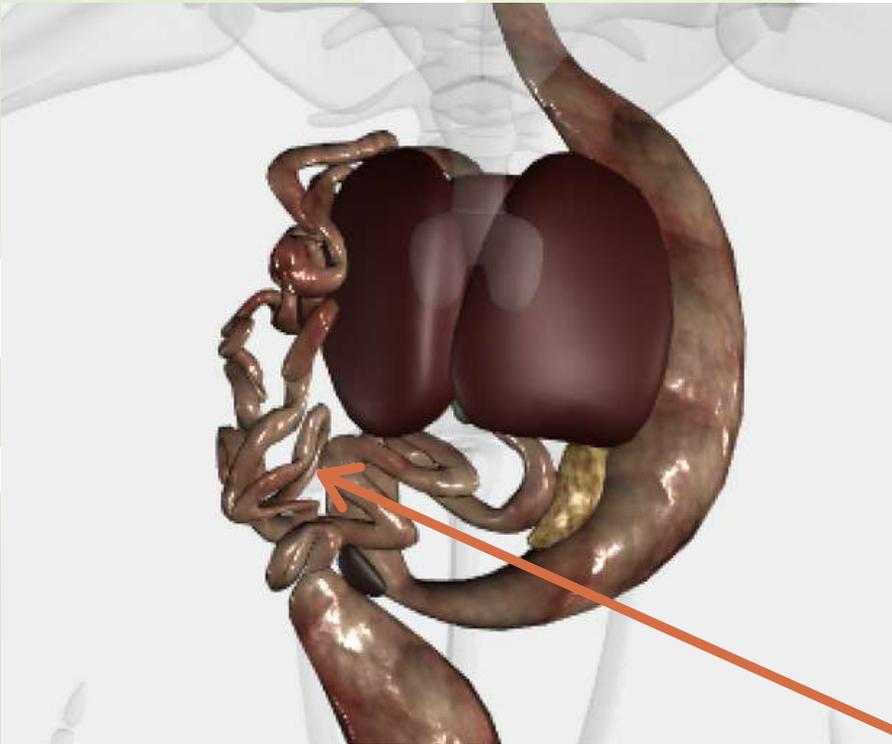
Find the small intestine on your frog

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
 - Completes **digestion** started earlier
 - Most food **absorption** and **chemical** digestion occurs here

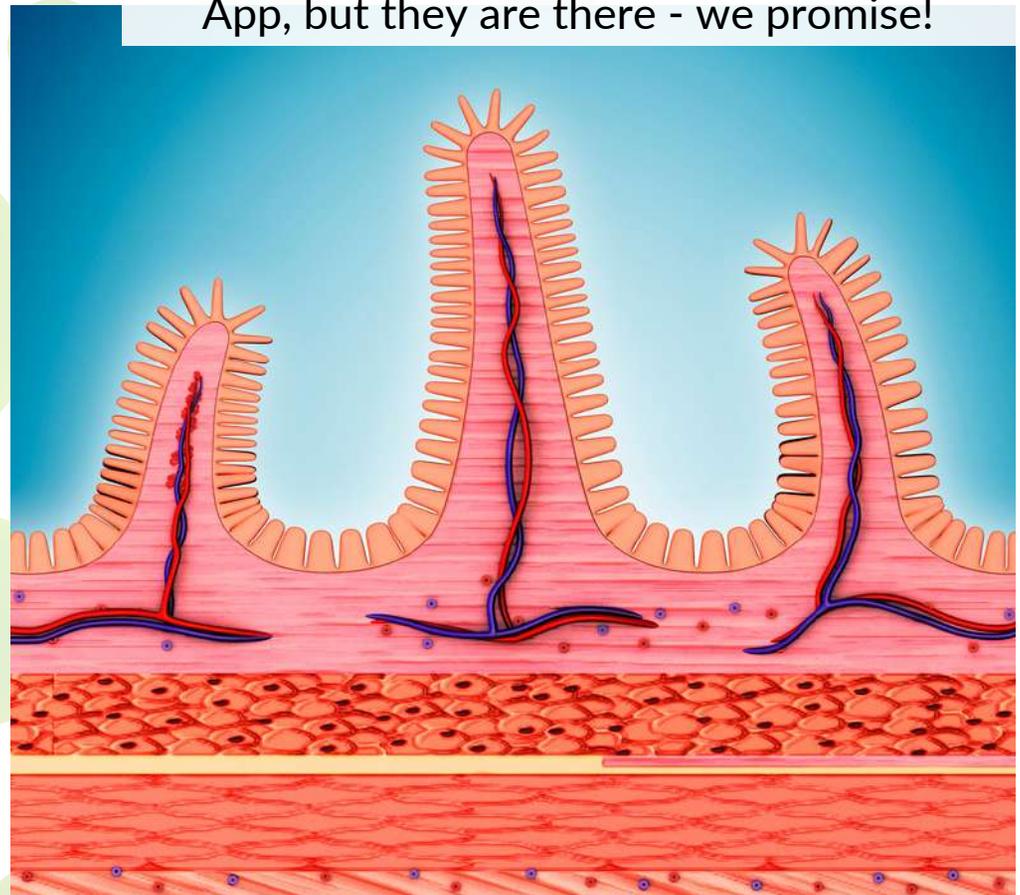
SMALL INTESTINE

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, more area for absorption

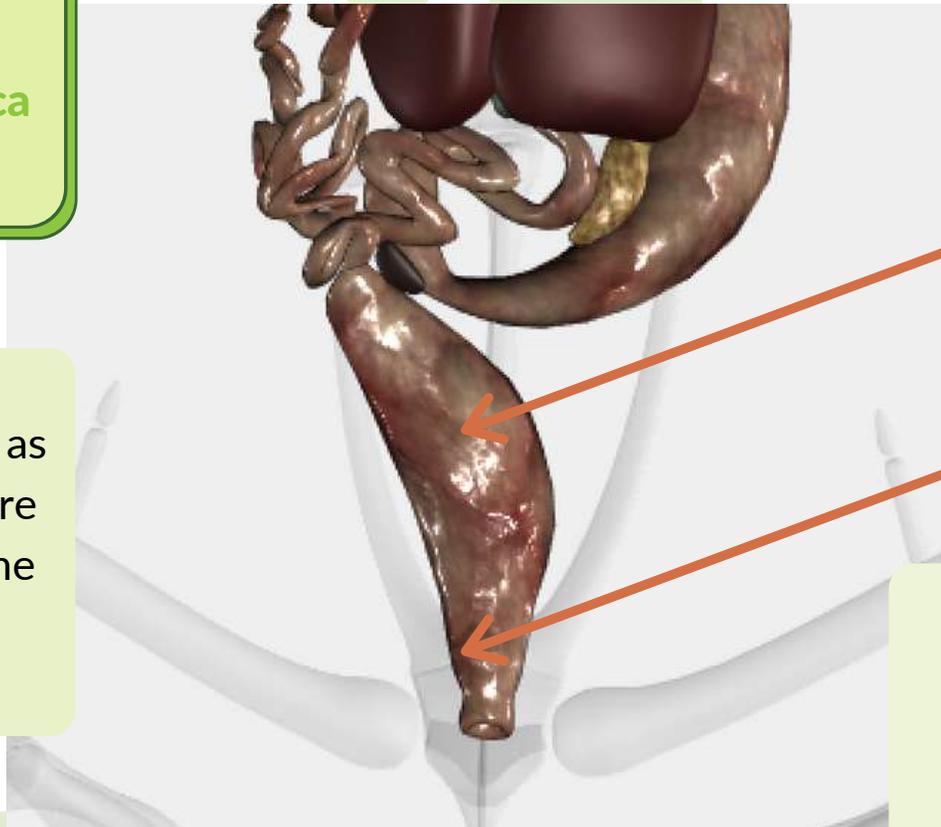
You won't see villi on the 3D Frog Anatomy App, but they are there - we promise!



Large Intestine & Cloaca

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

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



LARGE INTESTINE

CLOACA

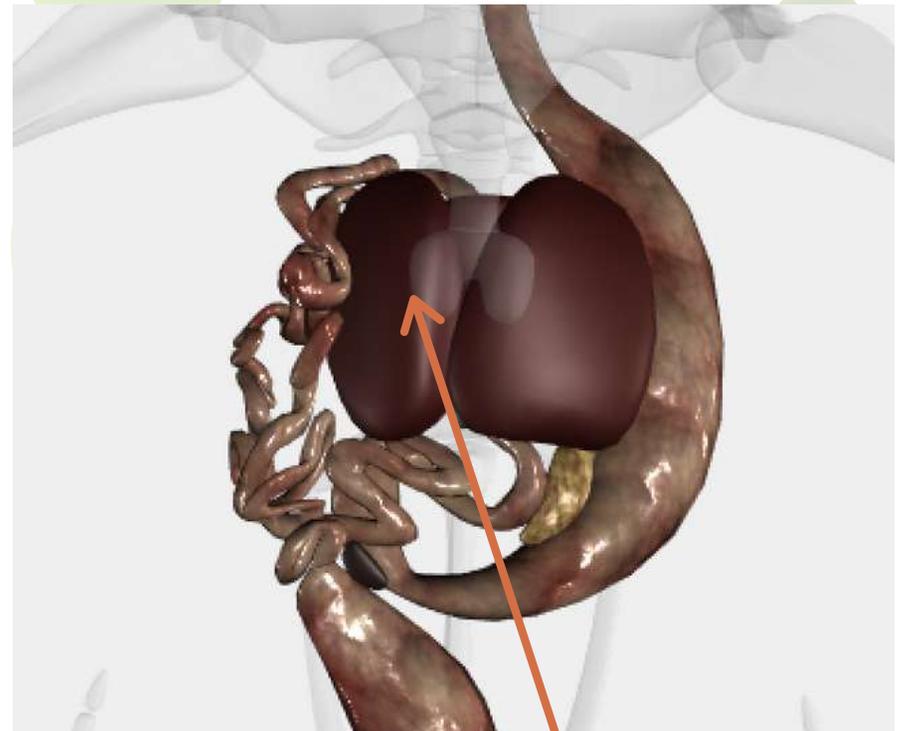
The cloaca is the one exit hole for liquid waste, solid waste, sperm and eggs!

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

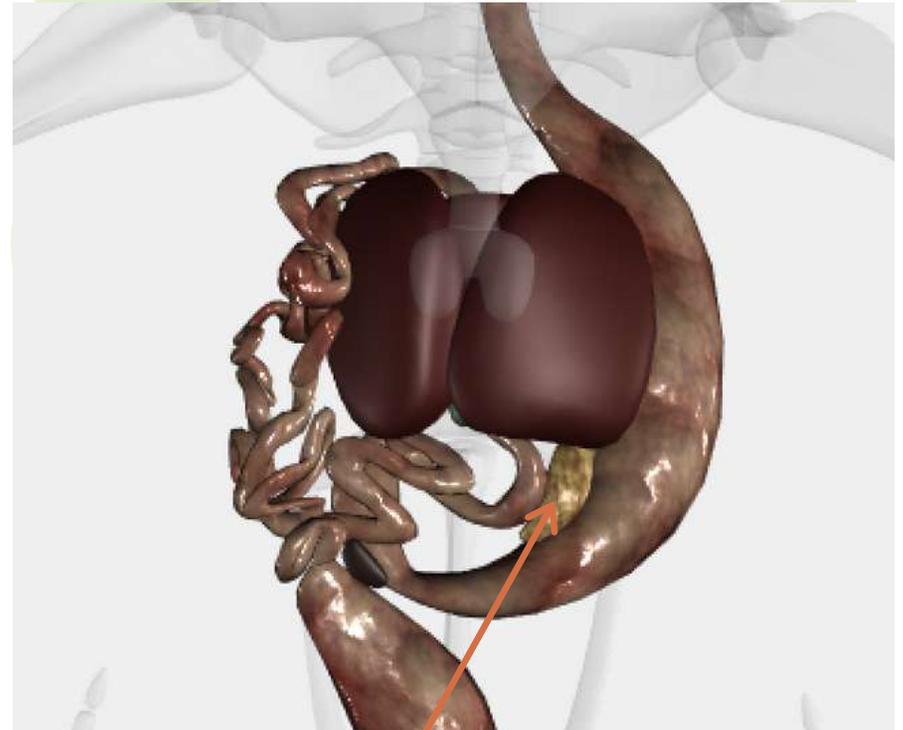
- **Location:** ventral & anterior to the **stomach**
- **Structure:** dark red/brown wedge-shaped organ with **3 lobes**
- **Function:** multipurpose organ
 - Produces bile
 - Removes toxins
 - Stores carbs
 - Regulates blood sugar levels



LIVER

Pancreas

- **Location:** dorsal to **stomach**, wrapped in the **duodenum**
- **Structure:** flattened gland found in between stomach and small intestine
- **Function:** produces 2 major secretions
 - 1) **digestive enzymes:** responsible for breakdown of fats, carbs, and proteins
 - 2) **insulin:** a hormone which allows cells to absorb glucose



PANCREAS

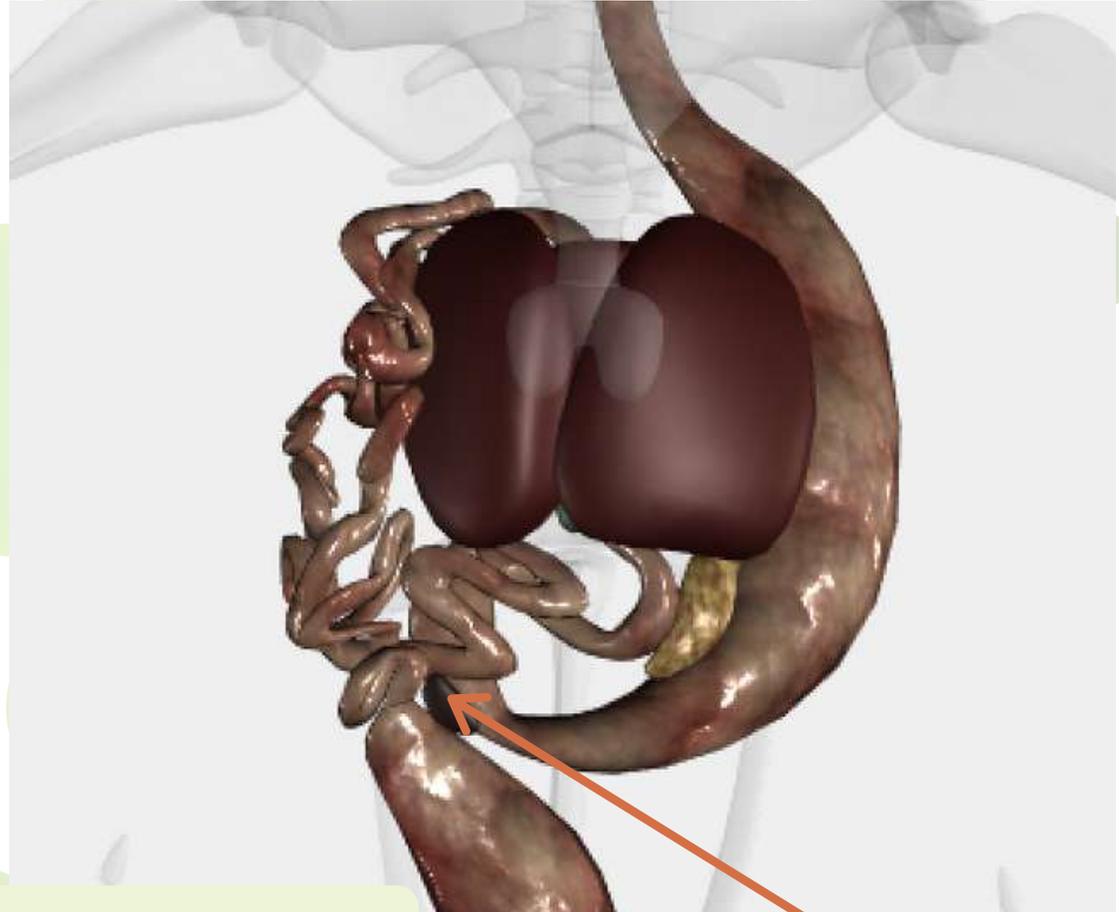
Spleen

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 break them down.



SPLEEN

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

Bones

Turn off all other body systems and focus on the skeleton



:: Skeleton

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



Muscles

Turn off all other body systems and focus on the muscles



⋮ Muscle



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

Different Types of Respiration in Frogs

- **Gills** > during tadpole stage, then disappear as they mature
- **Skin** or Cutaneous
- **Bucco-pharyngeal** > through the mouth
- **Pulmonary** > 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

Secretion of mucus to always keep skin moist



- Respiration takes place through the skin
- Occurs in water and during periods of low metabolism/demand for oxygen
- Skin absorbs oxygen dissolved in water through blood capillaries
- Cant occur if skin is dry

Bucco-pharyngeal Respiration

: Skeleton

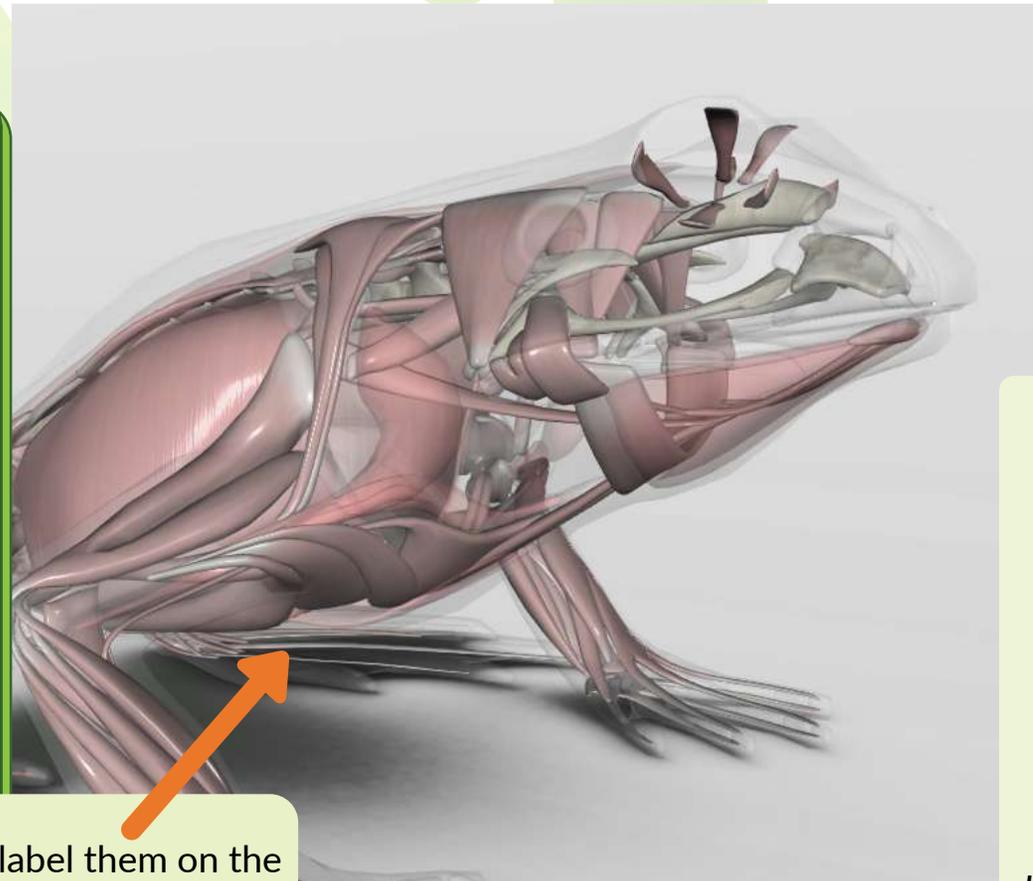
::: Muscle

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

Can you label them on the image?



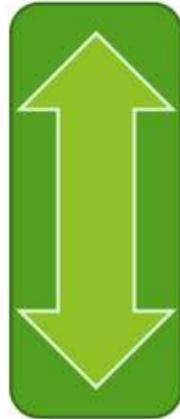
- Respiration occurs through **lining** of the mouth
- Lining is very **moist and capillary rich**
 - Why is this needed?

HINT: Think about why the skin stays moist so frogs can breathe through their skin

Bucco-pharyngeal Respiration

Inhale

Sternohyoid
muscle
contracts



Pterygoid
muscle
relaxes

Exhale

Sternohyoid
muscle
relaxes



Pterygoid
muscle
contracts

- Floor of the mouth **lowers on inhale**
- Air enters buccal cavity through **external nares**
- **Gas exchange** occurs
- Floor of buccal cavity **raises on exhale**
- Air escapes through external nares

Pulmonary Respiration

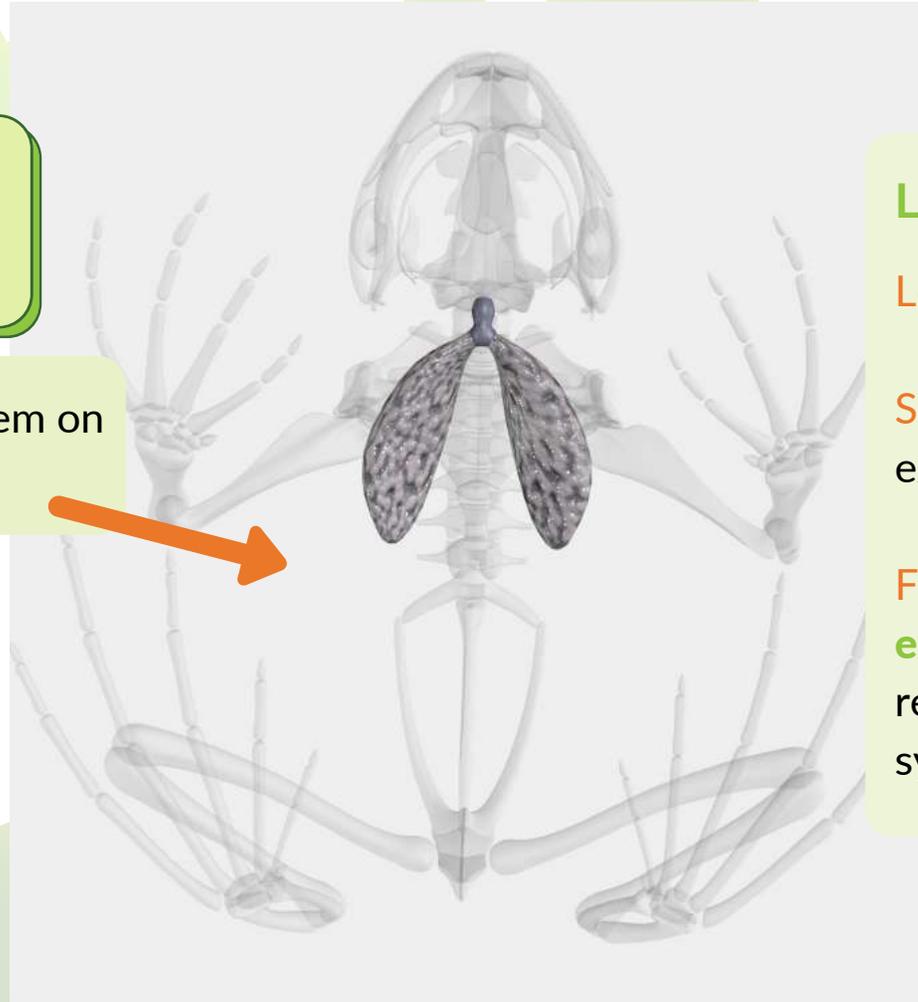
Turn off all other body systems and focus on these

: Skeleton

:: Respiratory

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

Can you label them on the image?



Lungs

Location: chest cavity

Structure: large, spongy expandable organ

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

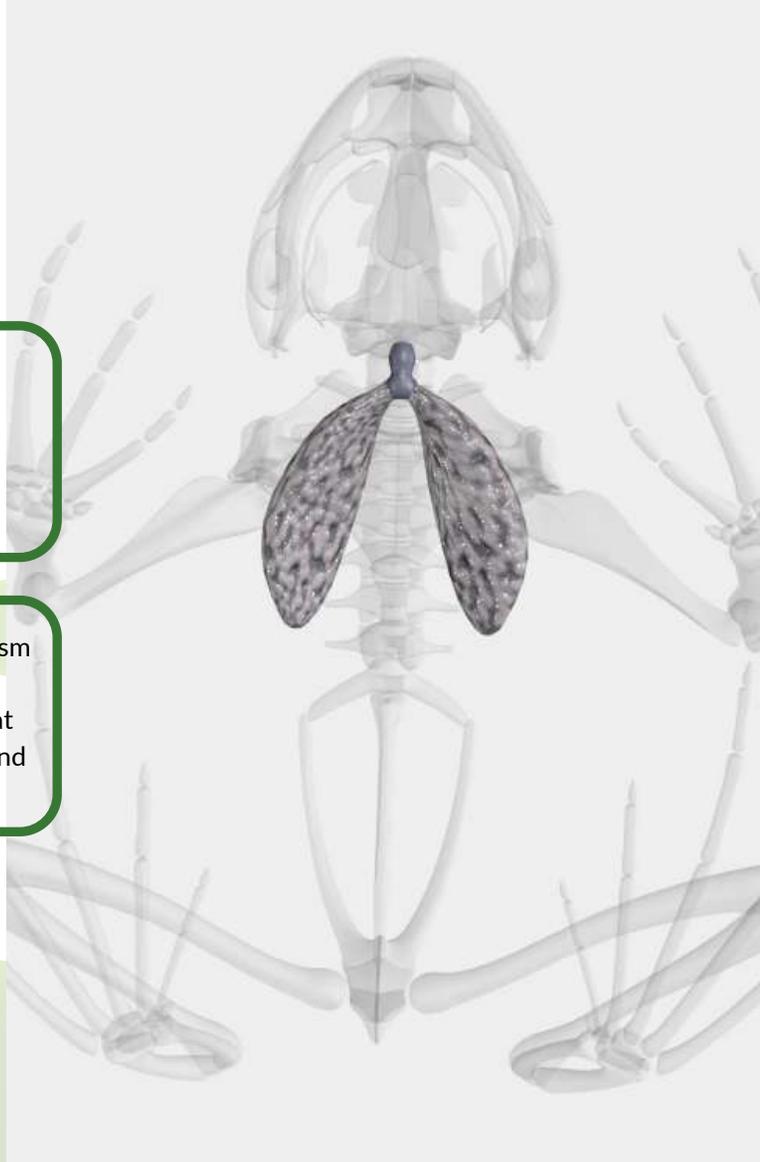
Pulmonary Respiration

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**.



Lungs

Location: chest cavity

Structure: large, spongy expandable organ

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

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

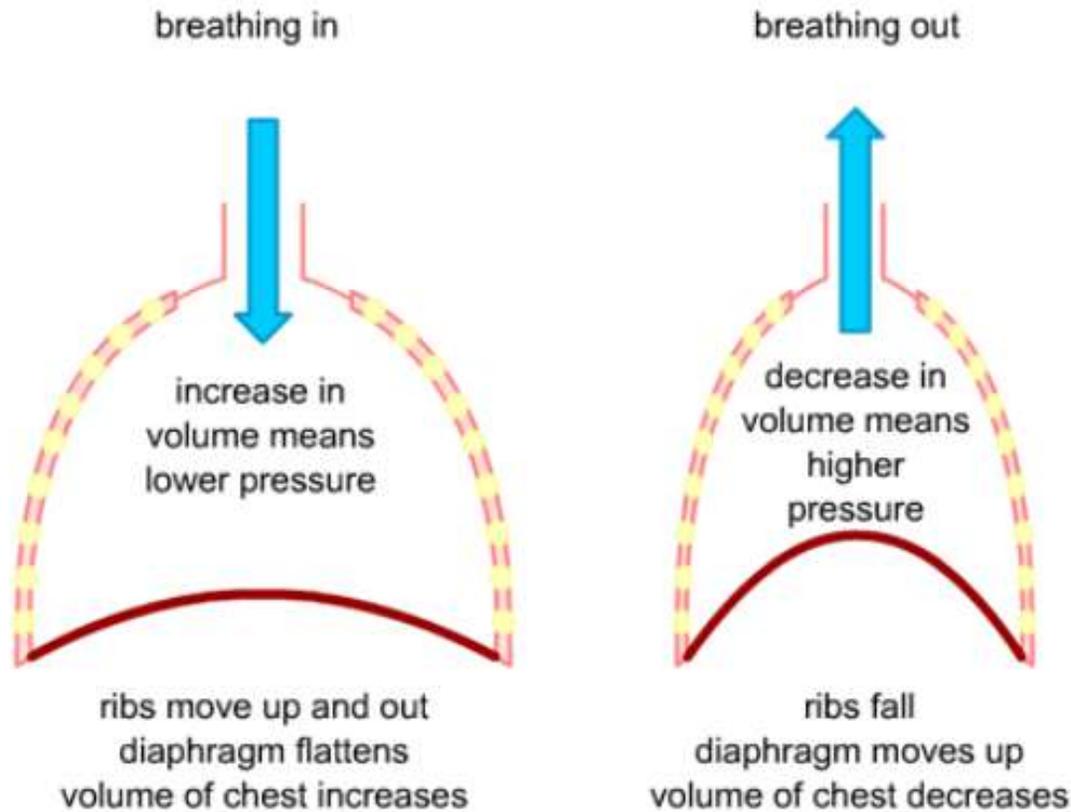
- Tiny thin walled sacs are on the end of the bronchioles, called **alveoli**

Alveoli

- Site of **oxygen exchange**



Most animals breath using **negative pressure** breathing



© ABPI 2013

FUN FACT!

Frogs don't have a **diaphragm** so they create a negative pressure gradients using their mouth and throat sack.

- Gases move from **high** pressure areas to **low** pressure areas
- **How is this different in animals like frogs?**

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

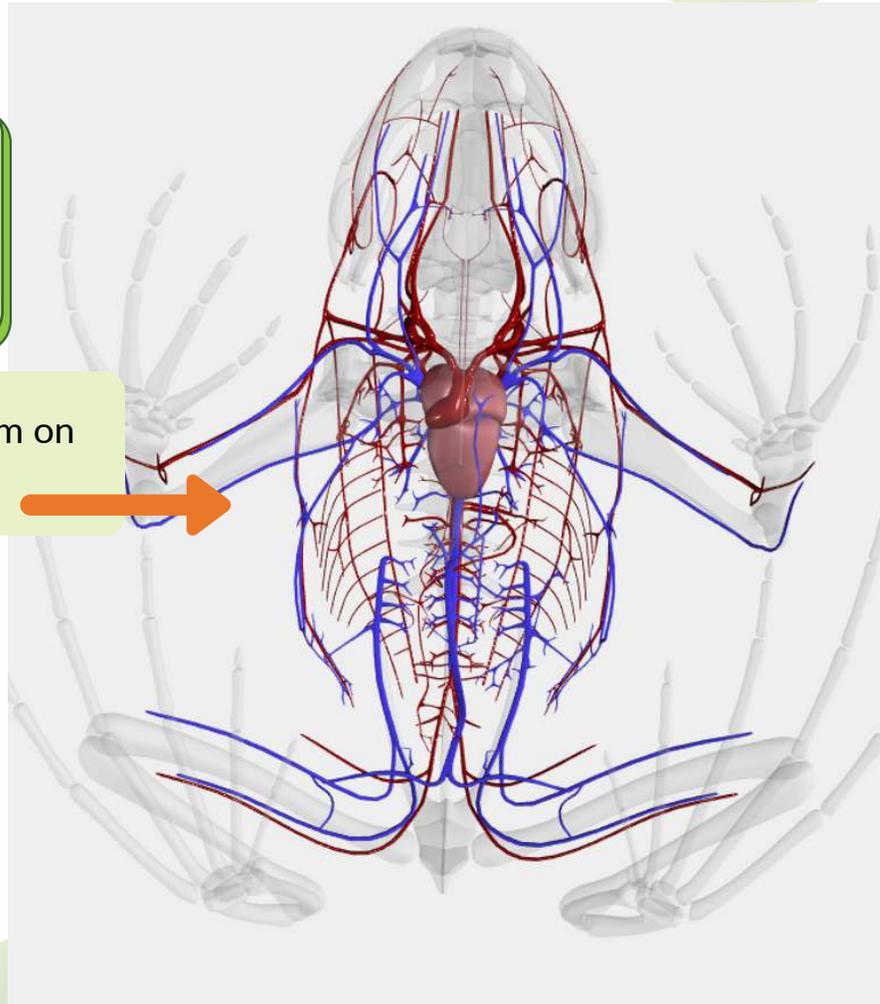
: Skeleton

:: Circulatory

Locate the frog's **heart**

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

Can you label them on the image?



Heart

Location: centre of the chest, nestled between the two lungs

Structure: strong muscular organ with three chambers (x2 atria, x1 ventricles)

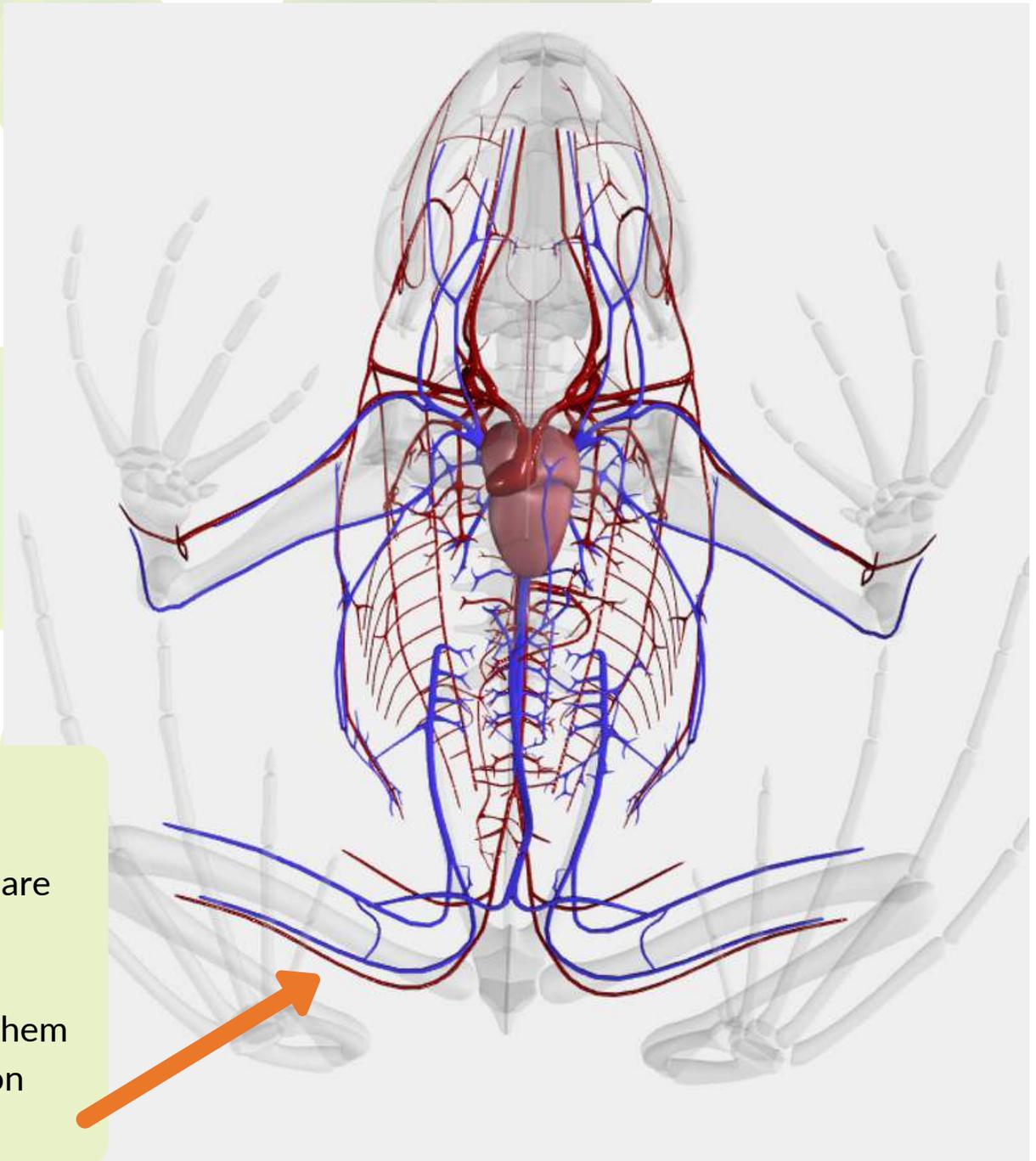
Function: **pumps blood** to lungs and the rest of the body through strong rhythmic contractions

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?



The Heart

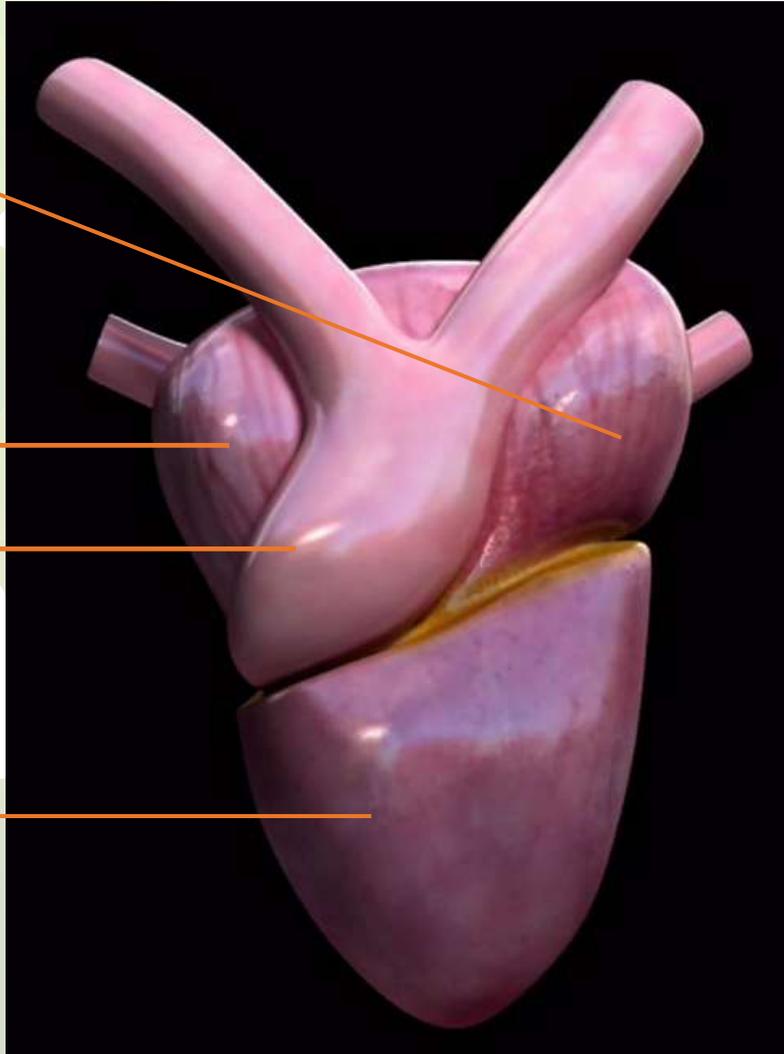
For this more detailed view of the heart, we're using screenshots from the [Emantras Virtual Frog Dissection](#).

RIGHT
ATRIUM

LEFT
ATRIUM

TRUNCUS
ARTERIOSUS

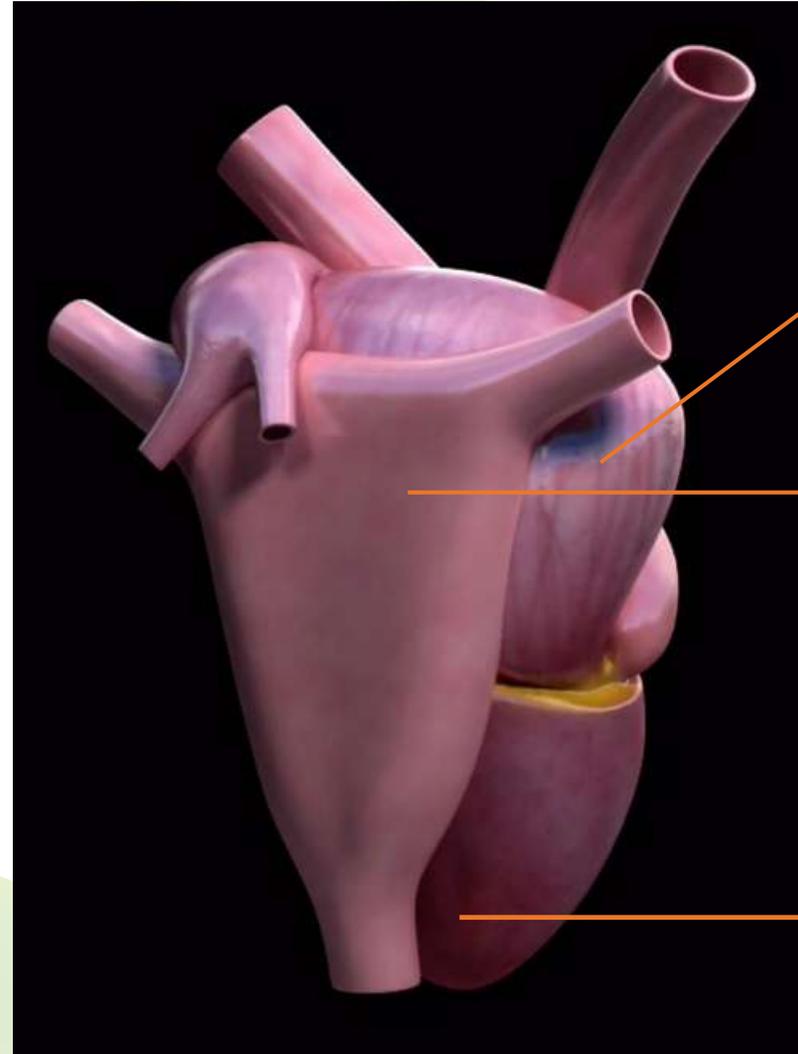
VENTRICLE



RIGHT
ATRIUM

SINOUS
VENOSUS

VENTRICLE

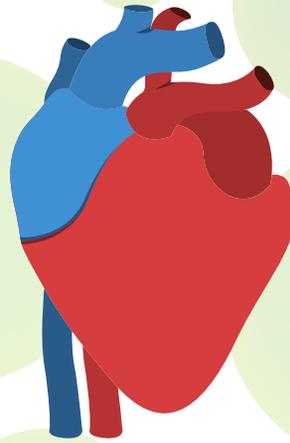


Blood Flow Through The Heart

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**

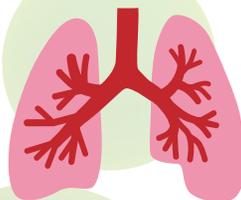
Blood is pumped from the right ventricle out to the **pulmonary arteries**, which carry the blood to the lungs to receive oxygen.



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

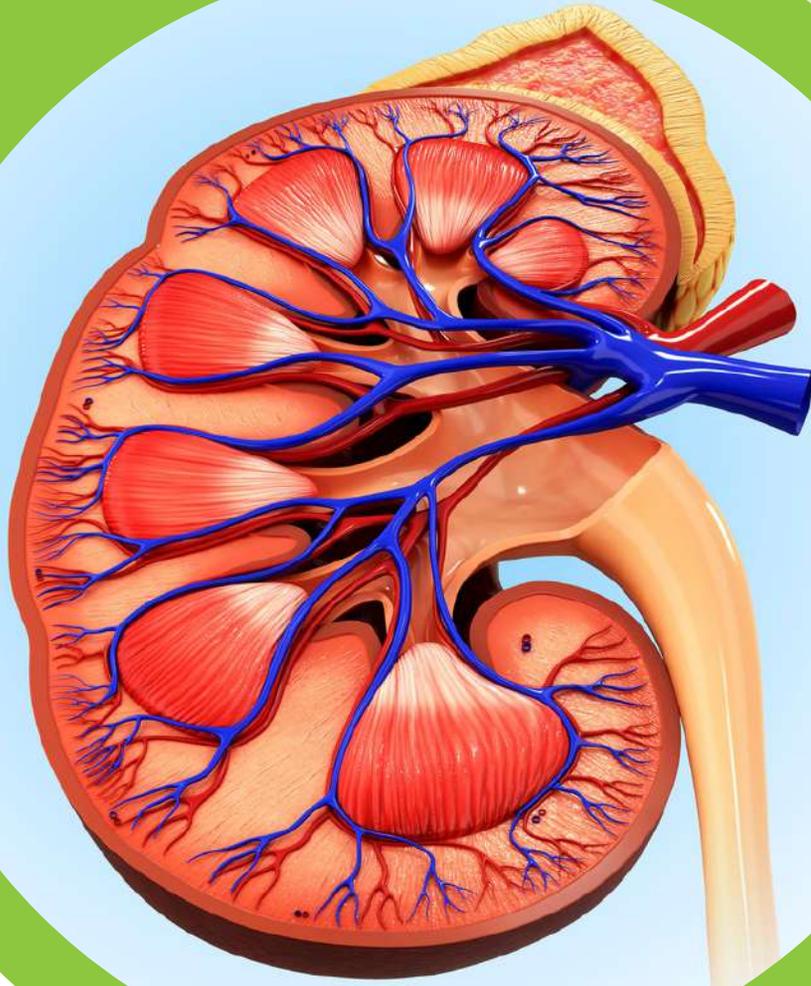
Blood is then pumped from the left atrium to the **ventricle**

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



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

The Kidneys

Turn off all other body systems and focus on these

: Skeleton

::: Urogenital

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?



Kidneys

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

Structure: bean-shaped, surrounded by tough fibrous tissue

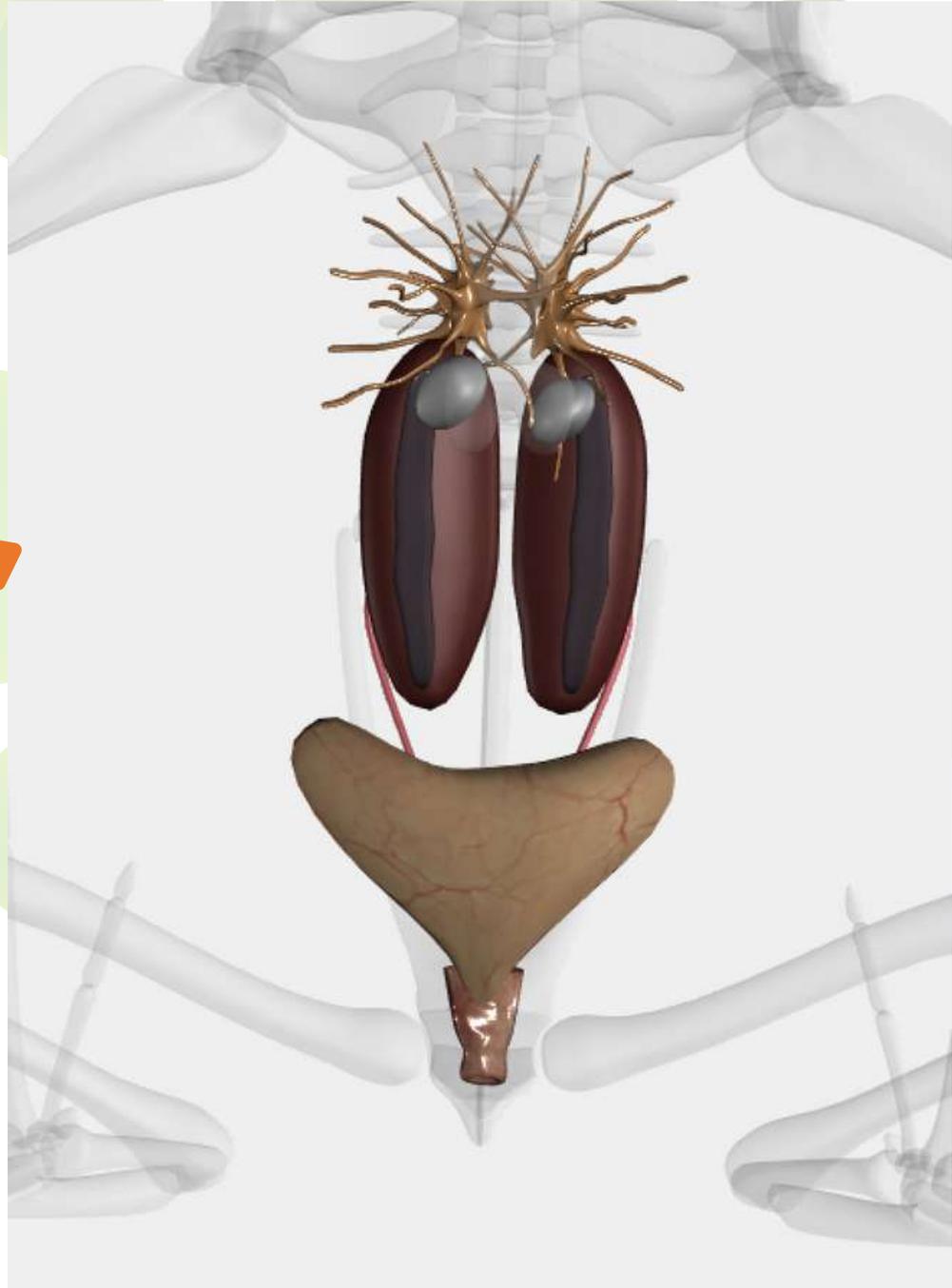
Function: removes **nitrogenous wastes** (eg. urea/urine) from the blood & **maintains osmolality** (salt balance) in blood

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

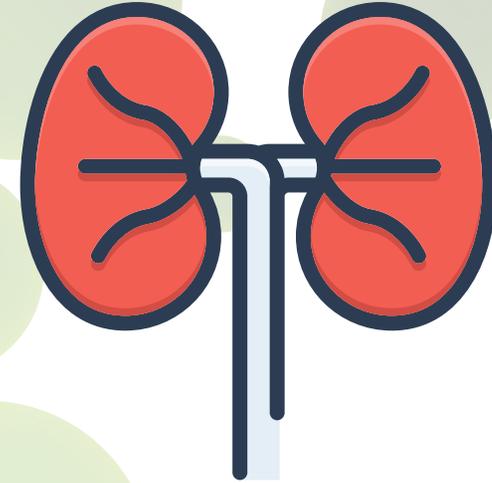
Locate the **ureter** and **urinary bladder**

Can you label them on the image? 

The urinary bladder empties into the **cloaca**

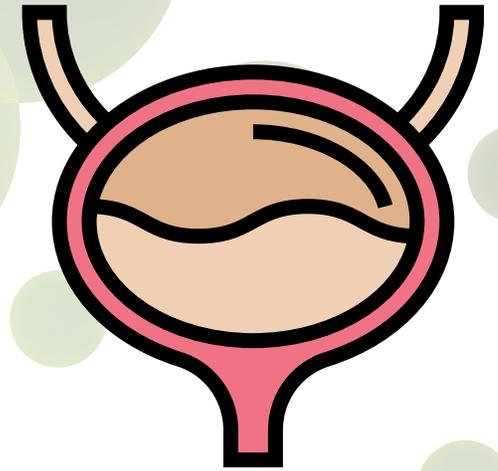


Ureter



- **Location:** a vessel running between the **kidneys** and the **urinary bladder**
- **Structure:** thin tube
- **Function:** **carries** excretory products produced by the **kidneys**

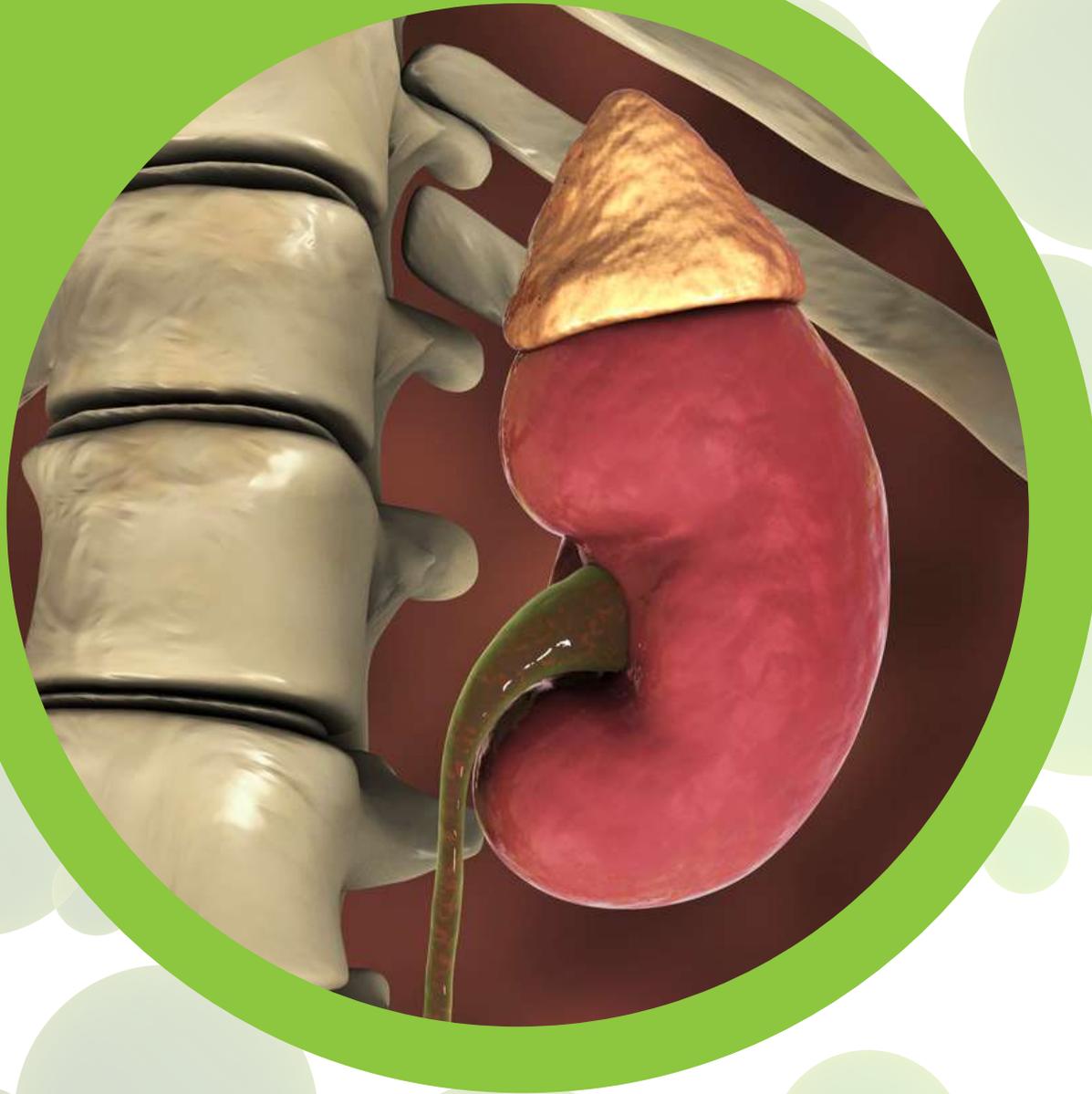
Urinary Bladder



- **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

Pancreas

Turn off all other body systems and focus on these

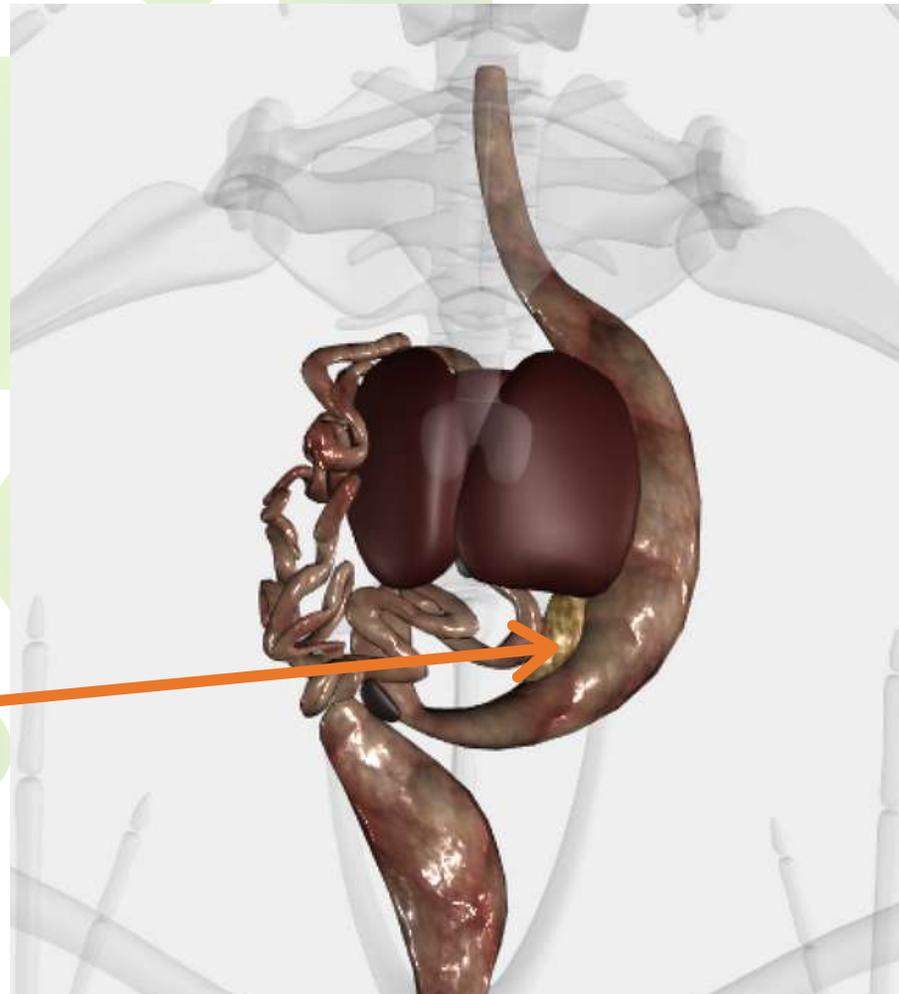
: Skeleton

:: Digestive

Pancreas

Location: near stomach in abdominal cavity

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



Adrenal Glands

Turn off all other body systems and focus on these

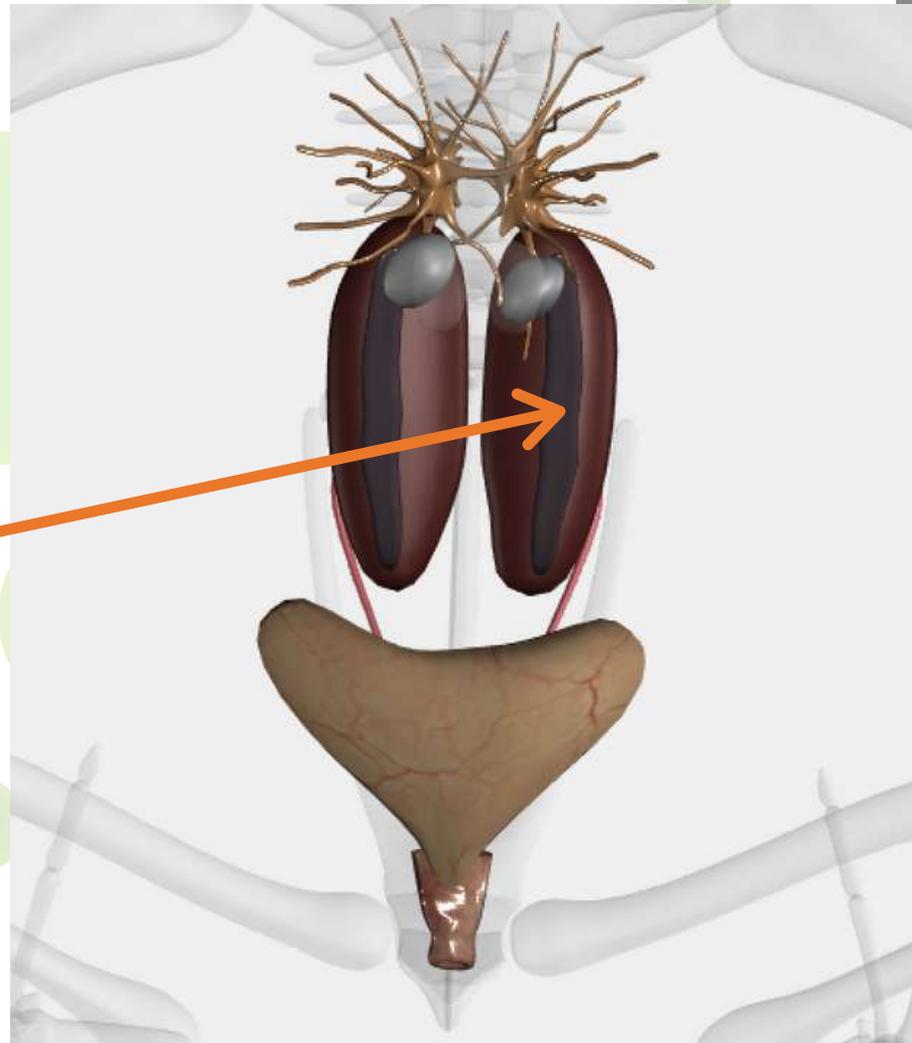
: Skeleton

:: Urogenital

Adrenals

Location: anterior end of kidneys

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



Testes

Testes

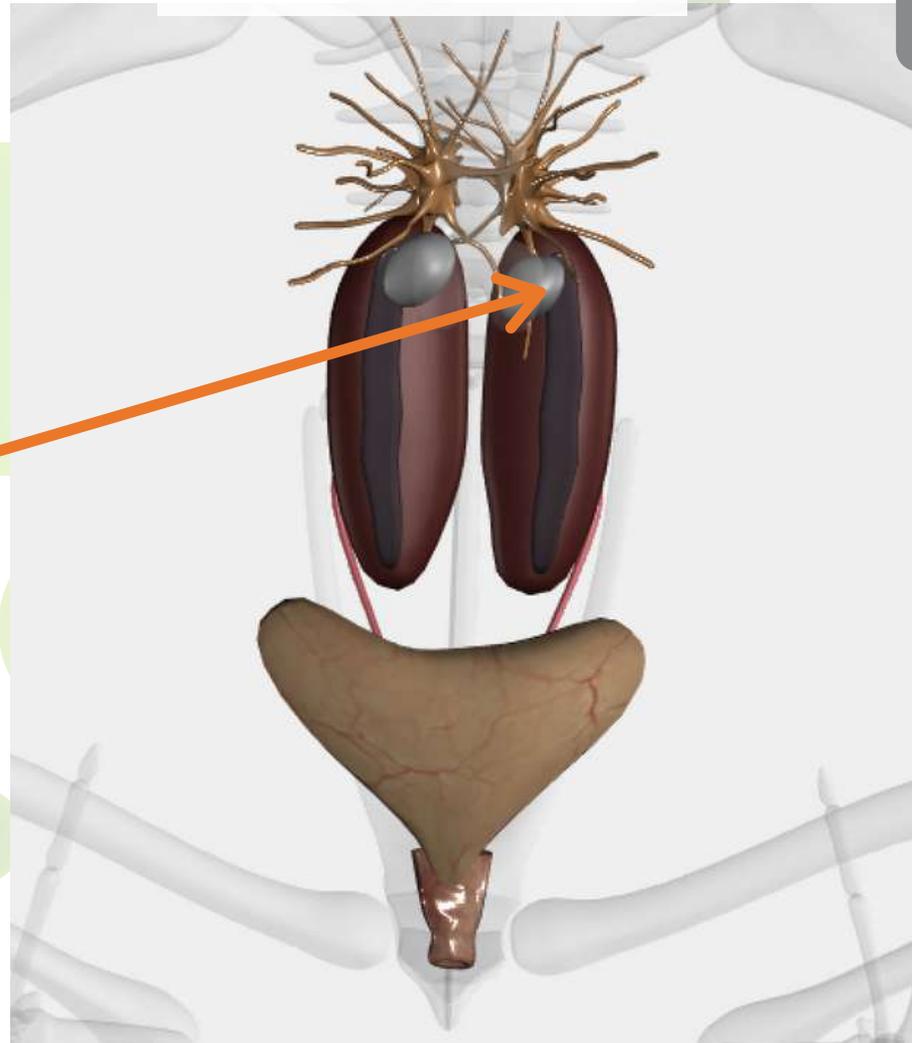
Location: in the abdominal cavity of male frogs

Function: produce testosterone - male sex hormone, and produce sperm.

Turn off all other body systems and focus on these

: Skeleton

:: Urogenital



Ovaries

Ovaries

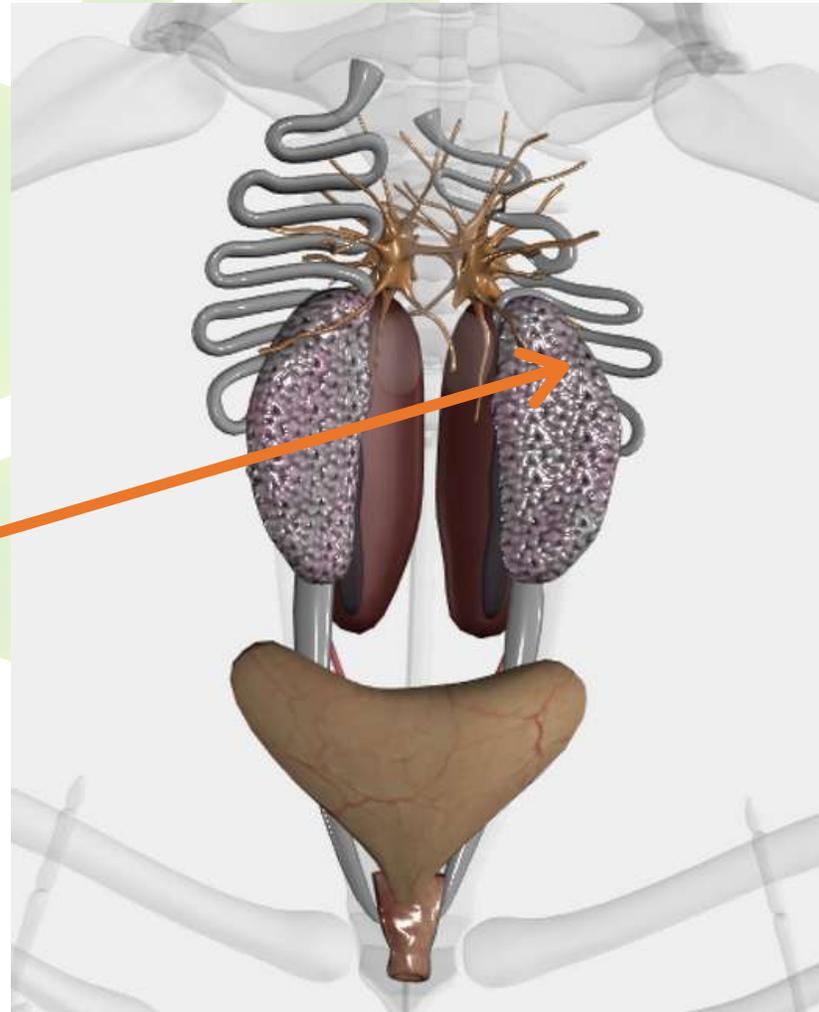
Location: in the abdominal cavity of female frogs

Function: produce estrogen and progesterone - female sex hormones, and produce eggs

Turn off all other body systems and focus on these

: Skeleton

:: Urogenital



Pituitary and Hypothalamus

Turn off all other body systems and focus on these

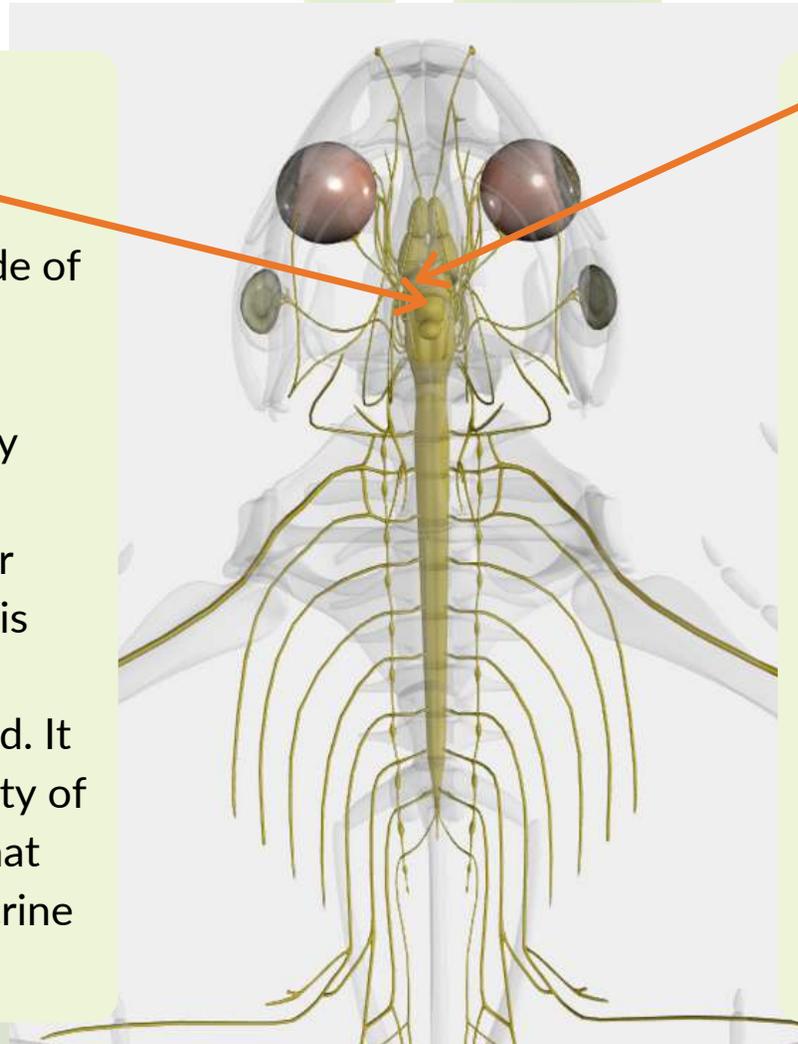
: Skeleton

:: Nervous

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

Central Nervous System

Turn off all other body systems and focus on these

: Skeleton

:: Nervous

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

Can you label them on the image?

Use the app to label more features of the nervous system!



Brain

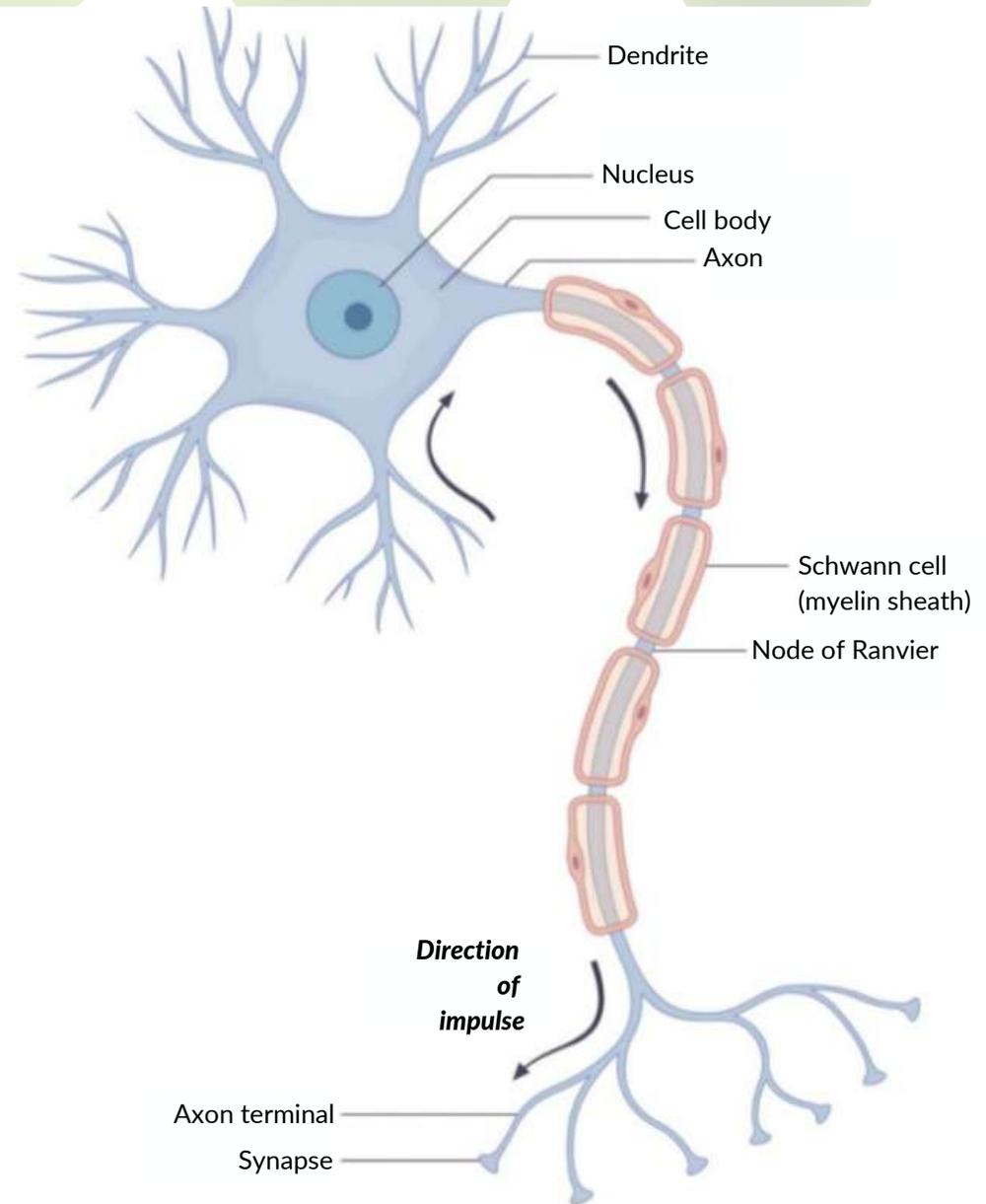
Location: in the skull

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

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

Nerves

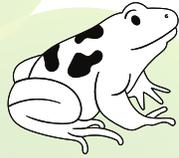
Nerves are bundles of **neurons** (like the one pictured to the right) that transmit electrical "nerve impulses". Nerve impulses are part of a special information system in the body. For example, when you touch something warm with your hand, the nerves in your hand transmit the information about temperature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



Review Break

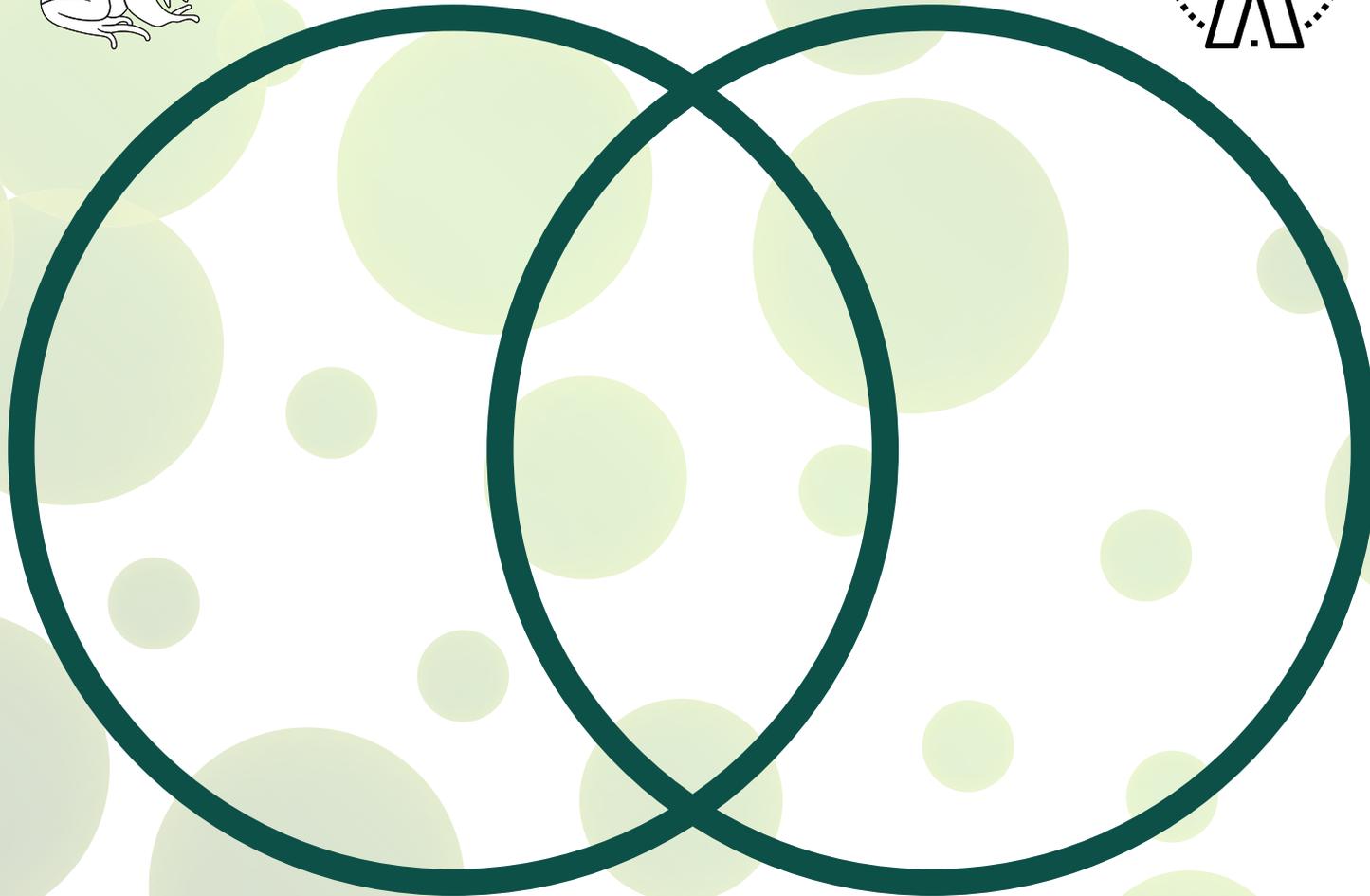
- With your group, try to draw the major features of the frog nervous system - include the brain, spinal cord, and some nerves. Can you name some of the nerves?
- With your group, draw a single nerve cell (neuron) - try to label it
- Choose one person to explain these to the class.

Identify Some Key Similarities and Differences Between Frogs and Humans



FROG

HUMAN



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?

Thank you for choosing these materials to support your anatomy adventures!

These Humane Science Education materials were developed by **Elisabeth Ormandy** for the Canadian Society for Humane Science (2015-2022) working to achieve better science without animals. By choosing these unit plans, you have joined a growing family of Humane Science Educators!



We gratefully acknowledge the support of the following funders of this Humane Science Education Program:



THE ROBERT AND JUDITH CLARK FOUNDATION

THE MCLEAN FOUNDATION