

FETAL PIG DISSECTION: (LAB Procedures)

Daily Dissection Routine

Lab Preparation

- Obtain a dissecting “cookie” tray and line it with two layers of paper towels
- Get your pig from the storage box and place the pig on the dissecting tray
- Remove the plastic bags from your pig. You will need to keep the bags.
- Pick up any dissection equipment needed (scissors & probe)
- Pick up the Lab Procedures & have your Fetal Pig Lab “SQ” Guide ready

Clean up

- Place the pig in both plastic bags and squeeze the bag to remove the air and then secure the bag opening with a rubber band
- Make sure the outer bag is labeled with your names and hour
- Place the double-bagged pig in the storage box
- Throw the paper towels, gloves, and any trash into the LARGE trash can
- Wash the equipment with soap and water and set on paper towel-lined tray by the sink to dry
- Rinse the dissecting trays and stack to dry by the sink
- Use disinfectant spray (409 type) to clean your table and then towel dry

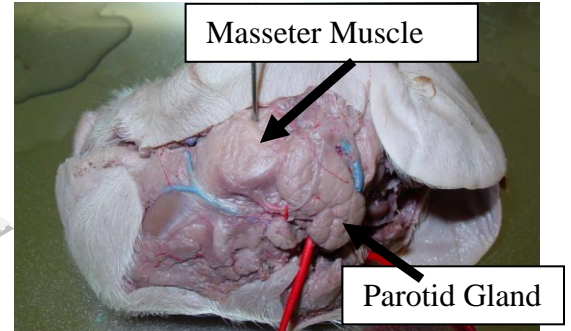
LAB Procedures: Day 1

1. Obtain a fetal pig from your instructor, and thoroughly **rinse** it under cold running water. This will help reduce the preservative odor that can be irritating to some people.
2. Begin by demonstrating the following **Directional Terms** for your team members using your pig:
Anterior (cranial) Dorsal Lateral Proximal
Posterior (caudal) Ventral Medial Distal
3. Next, practice identifying the following **External Anatomy** features with your team members:
ear pinnae nares tongue wrist shoulder elbow
knee hip tail ankle eyelids umbilical cord
4. Spread the upper and lower eyelids apart. (This may be difficult in the younger pigs.) In the corner of the eye locate a third lid-like structure, the nictitating membrane. Does the pig have eyelashes?
5. Study the pig’s appendages. The pig is a quadruped. What does this mean?
How many large toes are on each pig foot? _____ Are the large toes Anterior or Posterior (circle) to the smaller toes? Pigs are in the mammalian order Artiodactyla, meaning “even-toed.” The pig also walks on its toes while humans walk on the soles of our feet.
6. To determine the gender of your pig, you will need to look under the tail. The female will have both a urogenital opening and an anus. Female pigs also have genital papilla underneath the tail just ventral to the anus. The papilla covers the urogenital opening (urethra and vagina). The male will have only the anus under the tail and the urogenital opening will be just posterior to the umbilical cord. Since these pigs are not fully developed the penis and testes may still be internal.
What is the gender of your pig?
7. Examine the trunk’s ventral surface. Locate the two parallel rows of mammary papillae (nipples). Midventrally on the trunk is the umbilical cord, which was connected to the placenta within the uterus of the mother. If your pig was injected you will see two pink umbilical arteries and a blue umbilical vein within the umbilical cord.
Locate the mammary papillae (nipples) on the abdomen. Are they present in both male and female?
How many mammary papillae does your pig have?
What is the function of the mammary papillae in females?
Humans have 2 mammary papillae; why do pigs have so many?

LAB Procedures Day 1

8. Carefully use a scissors to cut the **skin** several inches dorsally from the back corner of the mouth (see diagram below). Notice as you pull the skin it does not just fall off; you have to pull it away from the muscles. This is because of the connective tissue beneath the skin, which attaches to the muscles. Use a dull probe to gently disengage the skin from the body. The muscles have a pinkish color and are surrounded by gel-like connective tissue. Clear away any extra connective tissue. This will expose the **masseter muscle**, a large muscle used to move the lower jaw (mandible) for chewing. Near this muscle laterally you will also find the **parotid gland**, one of several salivary glands that secrete digestive enzymes into the pig's mouth to begin the process of chemical digestion. Compare the texture of these two jaw features with your finger.

How does the masseter muscle feel compared to the parotid gland?



9. Finally, cut the masseter muscle on each side of the mouth and push down on the lower jaw to open the mouth for a view of the oral cavity. You can immediately see the **tongue**, which is lined at the front with papillae containing taste buds. You may also be able to see a few teeth protruding along the outside of the hard palate. Observe the roof of the mouth. On the anterior end is the hard palate and farther back is the soft palate. The palate forms in mammals as bones ventral to the nose grow from each side of the face and fuse together during development.

Touch each palate with your finger; What differences do you notice?

A common birth defect in humans is a cleft palate. What is cleft palate?

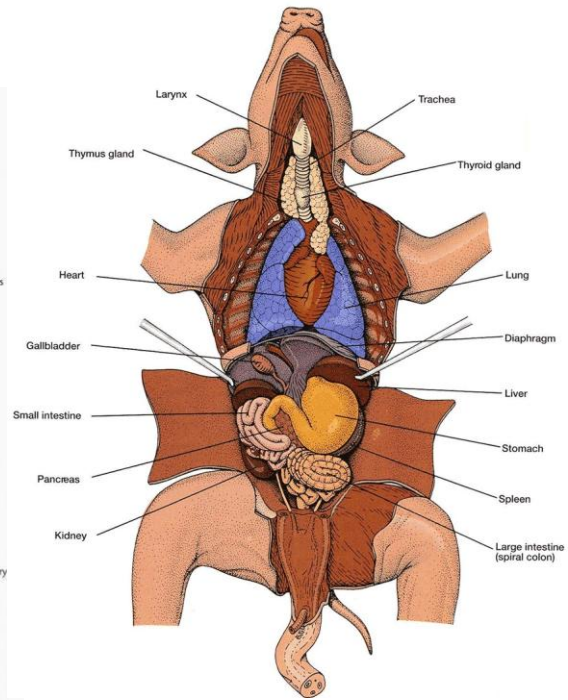
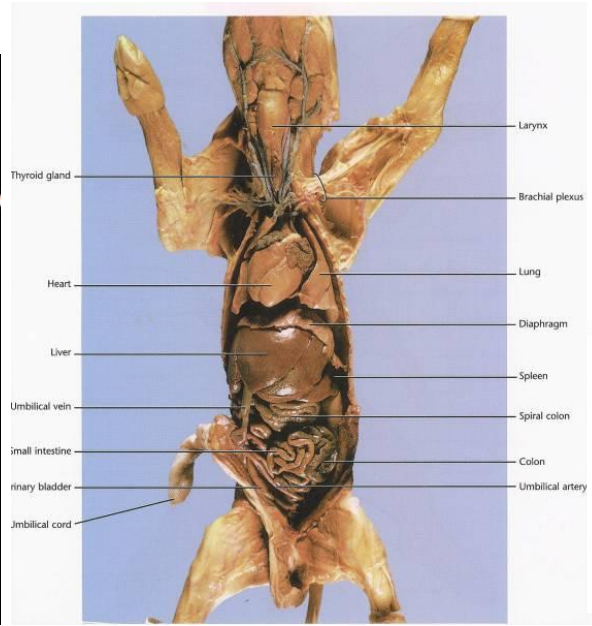
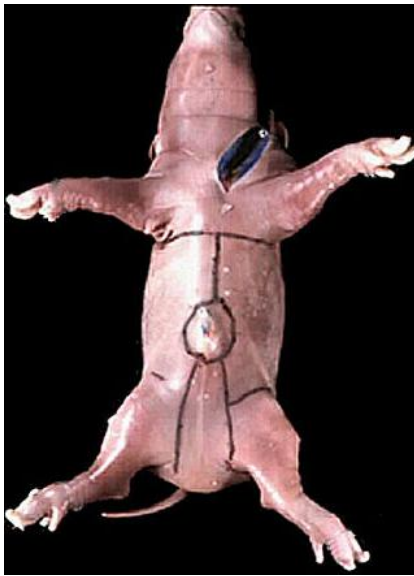
FETAL PIG DISSECTION: LAB Procedures Day 2

***Dissect CAUTIOUSLY** to avoid damaging any structures and make sure all members of your group can identify the structures before removing any part. Study your colored pictures and the provided diagrams to help you locate the structures.*

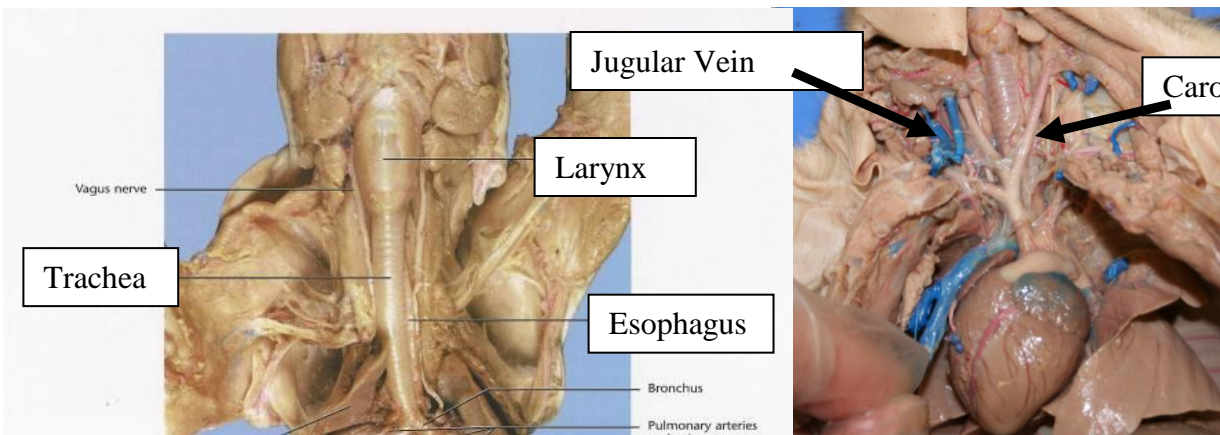
Neck and Thoracic Anatomy

- Examine the oral cavity and follow the tongue back until you locate the **pharynx** -- a cavity at the back of the throat where the openings for the esophagus, trachea, mouth and sinus all meet. Depending on how wide the jaws are opened, you may also be able to see the **epiglottis** – a smooth, arching tissue that moves to cover either the opening to the trachea or esophagus as needed.
 - Why is the epiglottis a crucial development for air breathing animals?
 - CIRCLE which tube connects the pharynx to the stomach? (trachea or esophagus)
- Now place the pig ventral-side-up on a dissecting pan to begin exposing the internal organs.
- Grasp the skin between the pig's hind legs with your fingers and make a small snip with your scissors. Then insert the edge of the scissors under the skin and muscle tissue and begin cutting towards the umbilical cord. **Proceed cautiously using a Lift-N-Cut technique** to cut around the umbilical cord and continue cutting until you reach the chin of the pig. (see diagram below) You may need to cut through the pig's sternum and expose the chest cavity (thoracic cavity) to view.
- Next, make two lateral cuts, begin at the midline, and cut laterally under the armpits and above the hind limbs.
- As you first open the body, identify the **umbilical vein** attaching the umbilical cord to the liver. This blood vessel carries oxygen-rich blood from the placental tissue to the heart for circulation to the body. Next cut this umbilical vein so the umbilical tissue can be moved off to the side to allow for a better view of the body organs.

NOTE: Your pig may be filled with water and preservative, drain over the sink if necessary.



6. First identify several obvious thoracic structures close to the ventral surface. Find the **pharynx, larynx, lungs, heart, and diaphragm**.
7. To better observe the anterior thoracic structures, make a series of shallow snips with your scissors to cut the muscles that run along both sides of the neck.
8. Identify the **larynx**, a bulb-like structure just below the chin of the pig. This wide cartilage “voice-box” in the center of the neck contains the pig’s vocal cords.
9. Also in the middle of the neck, just posterior to the larynx, is the “dark diamond” **thyroid gland**. Identify the thyroid gland which contains traces of Iodine and regulates metabolism and growth.
10. A little further posterior along the sides of the neck and above the top of the heart are the **thymus glands**. Identify these “soft sacks of wrinkly chewing gum” which secretes various immune system molecules.
11. After removing the thyroid and thymus glands, carefully probe the center of the neck just below the larynx to identify the **trachea** and the **esophagus**. The esophagus has a covering of smooth muscle that uses wavelike contractions (peristalsis) to squeeze food from the pharynx to the stomach. The trachea is surrounded by visible rings of cartilage.
 - CIRCLE which tube is located on the dorsal side of the pig? Trachea or Esophagus
12. Carefully expose the **epiglottis** by finding the larynx and snip it at the very top (under the pig’s chin-chin-chin). Notice how the epiglottis flaps down to cover the opening to the trachea (glottis) whenever food is swallowed. This cut will also help you better observe the trachea and esophagus.
13. Carefully probe the lateral areas of the neck to identify the **carotid artery** and **jugular vein**. The carotid artery carries oxygen-rich blood to the brain (red latex) and the jugular vein carries oxygen-poor blood (blue latex) back to the heart.



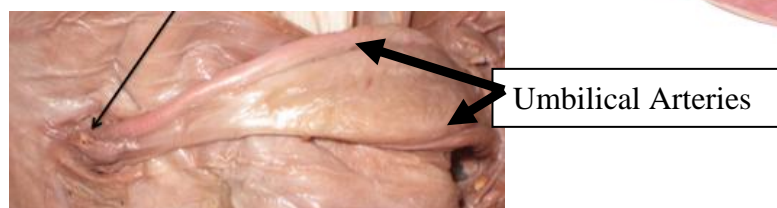
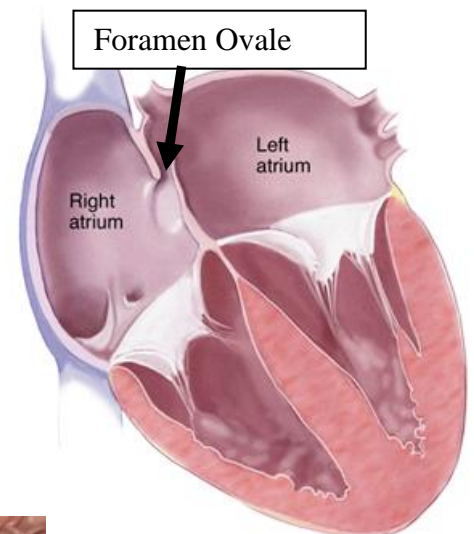
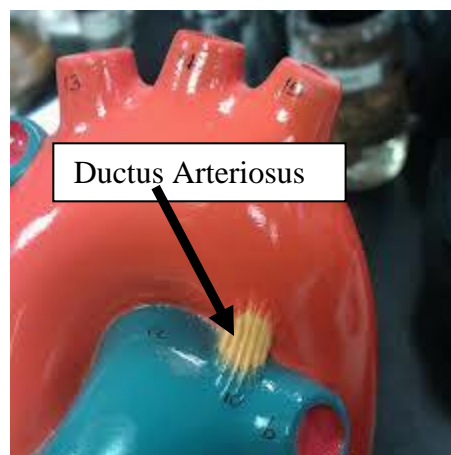
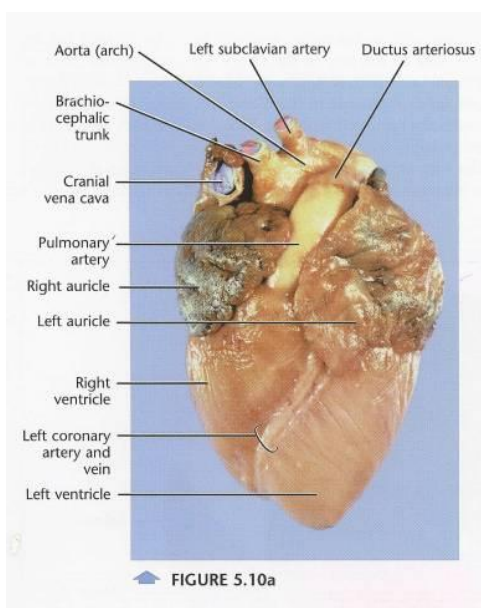
FETAL PIG DISSECTION: LAB Procedures Day 3

Circulatory and Respiratory Anatomy

1. First locate the **diaphragm**, a curving muscular “wall” that separates the lower abdominal cavity from the upper thoracic cavity. As this muscle contracts, it flexes downward (posterior) and the negative pressure helps draw in air that is used during respiration. When the diaphragm relaxes it move up and the lung volume decreases, forcing air to be exhaled. Above the diaphragm in the center of the chest, but slightly off to the left side is the heart.

NOTE: As you study the circulation of blood through the heart, remember that arteries (which carry blood AWAY from the heart) are injected with red latex and veins (which carry blood TOWARD the heart) with blue latex. One key feature of mammals is the 4-chambered heart which pumps blood through two separate circuits: the systemic circuit (body cells) and the pulmonary circuit (lungs).

2. Notice the thin, clear membrane around the heart. This “slippery sac” which serves to reduce friction as the heart beats is called the **pericardium**. Carefully use your scissors to remove the pericardium to expose the features of the heart.
3. Identify the **coronary artery** which angles across the lower half of the heart’s surface from right to left as you look at the heart. This vessel supplies oxygenated blood to the heart muscle itself.
4. Next use your scissors to remove the heart. CAUTION: try not to cut any major blood vessels too close to the heart. It is quite a challenge to remove the heart without damaging the **Aorta**
5. Review the major features of the heart anatomy and (adult) circulation: The dark flap-like structures on top of the heart are the **right and left atria**. Note that the left and right sides of the heart are NOT determined by looking at the heart, but from the perspective of the heart in the animal’s body. Deoxygenated blood returns from the body into the right atrium via the **anterior and posterior vena cava**, which collect blood from the tissues of the upper portion and the lower portion, respectively, of the body. The greatest portion of the heart consists of the lower **left and right ventricles**. The left ventricle can be identified by the **coronary artery** which angles across its surface. Deoxygenated blood is next squeezed through a tricuspid valve into the right ventricle where it is pumped to the lungs through the **pulmonary artery**. This tube is easily seen angling slightly left to right across the upper ventral surface of the heart. Oxygenated blood returns from the lungs via the **pulmonary veins** where it dumps into the left atrium. The blood is next squeezed through a bicuspid valve into the left ventricle, where strong contractions pump the blood out to the body through the arching **aorta**. The aorta is the largest blood vessel exiting the heart and is easily seen at the anterior tip of the heart as it curves up and over the pulmonary artery.
6. Now let’s take a closer look at the inner structures of the heart by carefully cutting the heart almost in half. Using your scissors, begin at the apex (posterior point) of the heart and make a frontal snip, leaving the two heart halves attached at the anterior end. Study the atria and ventricle chambers, and if you are really lucky, you might be able to find the tricuspid valve (connects the right atrium to right ventricle) and the bicuspid valve (connects left atrium to left ventricle).
 - Which of the 4 heart chambers has the thickest muscle tissue?



7. **FETAL CIRCULATION:** Because the fetus develops in the liquid environment of amniotic fluid, it does not need to breathe air. In fact, there is no need for the blood to travel through the pulmonary circuit to the lungs at all. Thus, there are several differences between adult circulation and fetal circulation.
- Oxygenate blood enters the fetal pig not from lung capillaries, but via the **umbilical vein** through the liver and posterior vena cava. Try to trace this pathway for the blood starting at the umbilical cord. (look for the blue latex). Another feature to identify in the umbilical cord are the 2 **umbilical arteries** (look for the red latex) Deoxygenated blood travels through these 2 arteries from the pig to the placenta where CO₂ is exchanged for a new supply of O₂ by the process of diffusion.
 - There is a small opening in the middle of the heart between the L and R atria called the foramen ovale that allows oxygenated blood entering the right atrium to pass through into the left atrium, thus bypassing a trip to the lungs. This small foramen ovale opening will seal shut at birth to restore separate blood flow to the lungs. Who knew fetal pigs had a “holey” heart?
 - The ductus arteriosus is a “temporary tube” that directs oxygenated blood away from the fetal pig’s lungs and instead into the body circuit (systemic). This tube allows blood leaving through the pulmonary artery to take a “shortcut” directly into the aorta. Just like the foramen ovale, the ductus arteriosus disintegrates shortly after birth when it is no longer needed.
8. Now find the trachea and follow it as it splits into **right and left bronchi tubes**.
- CIRCLE which material will travel through the adult pig’s trachea and bronchi? Food or Air
9. Examine each lobe of the **lung**. How many lobes are there? Left= _____ Right = _____
- Why is there a difference in the number of lobes?

Let’s Review:

- Most arteries in the body carry highly oxygenated blood away from the heart. List 2 arteries in the fetal pig that carry **deoxygenated** blood away from the heart?
- Explain 3 differences between fetal circulation and adult circulation.

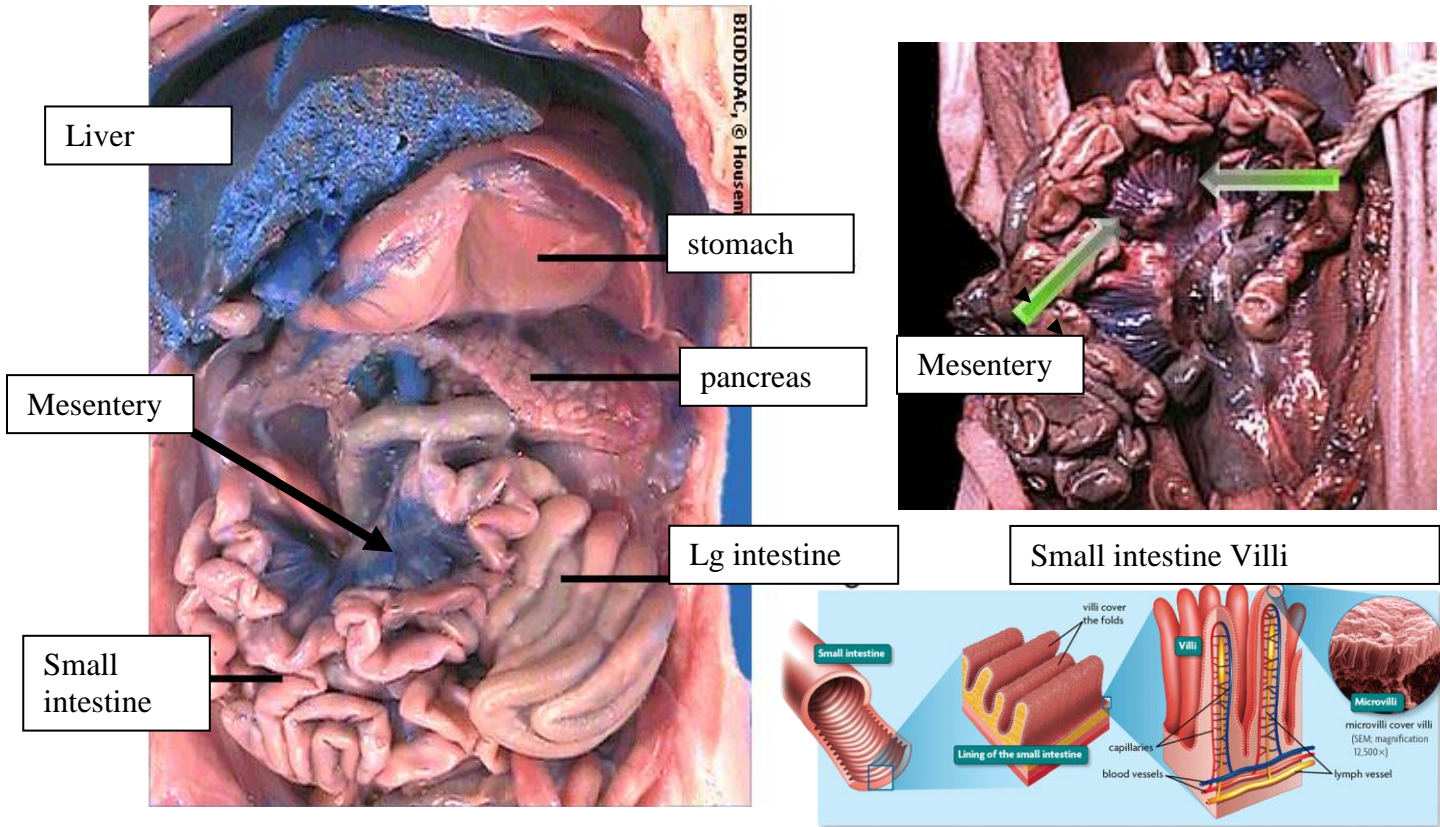
FETAL PIG DISSECTION: LAB Procedures Day 4

Digestive Anatomy

- We will now explore the digestive anatomy located in the abdominal cavity posterior to the diaphragm. The largest and most prominent organ of the abdominal cavity is the **liver**. A human liver has 4 lobes or sections.
 - How many lobes does the pig liver have?

The liver does several important body functions including produce bile for digesting fats, detoxify toxins in the blood, and store excess carbohydrate sugars in the form of glycogen.
- Now let us explore the path that food takes on its journey through the digestive system. Once food has been chewed the tongue pushes the food bolus to the back of the oral cavity where it passes over the **epiglottis** and down the **esophagus**. Wavelike contractions of the esophagus called peristalsis move the food into the stomach.
- Trace the esophagus caudally as it penetrates the diaphragm and ends at the **stomach**. The valve that connects the two is called the cardiac valve.
 - Do you expect to see any partially digested food if we look inside the stomach... Explain?
- Carefully cut open the **stomach** to see the rugae (ridges within the stomach lining or mucosa that allow the organ to expand). The stomach is where enzymes and HCl acid are secreted to begin the digestion of protein. Mucus lines the stomach and helps protect it from being digested by the enzymes and acid. By the time the food reaches the end of the stomach, it consists of an acidic, soupy broth full of nutrients called chyme. Next the pyloric sphincter, a valve-like muscle, controls the passage of partially digested food into the small intestine.
- The **small intestine** is a long convoluted tubule where digestion is completed and nutrients are absorbed. At this point two large organs, the pancreas and the liver, contribute to the digestive process in the upper small intestine.

6. Recall that the liver produces bile for the beginning of fat digestion. This bile is temporarily stored in a tiny pouch-like organ called the **gall bladder**. Lift the liver lobes and you will see the dark green, sac-like gall bladder which releases the bile through the cystic duct into the small intestine when needed. Carefully remove the lobes of the liver at this point to allow for better viewing of the digestive anatomy.



7. The **pancreas** lies between the stomach and the upper portion of the small intestine and looks a bit like a clear sac full of “dip-n-dots” ice cream. The pancreas produces fat-digesting enzymes, insulin for regulating blood sugar levels, and an alkaline solution which neutralizes the acidity of the chyme.
8. Dorsal and lateral to the stomach is a dark, flat, tongue-shaped organ called the **spleen** which helps regulate the quality and volume of the blood and assists the function of the immune system.
9. Follow the small intestine until it joins the large intestine. The **large intestine**, also called the **colon**, is much shorter than the small intestine and is responsible for reabsorbing water back into the blood.
- Describe the main difference in shape between the small and large intestines?
10. Follow the colon as it passes along the dorsal wall of the abdomen; this portion of the tube where feces is stored until it is excreted from the body is called the **rectum**. At the terminal end of the rectum is the **anus**, the opening located at the base of the tail.
11. Now return to the small intestine and notice the clear membrane that holds the coils of the small intestine together; this is called the **mesentery**.
- Why is the mesentery so full of blood vessels?
12. Carefully cut open a section of the small intestine and examine the inside lining. Notice how it is full of tiny, finger-like projections called villi?
- How do these villi assist the function of the small intestine?
13. Use your scissors to remove the entire small intestine and to cut the mesentery membrane to uncoil the intestine.
- How long is the entire uncoiled small intestine in cm? _____ cm

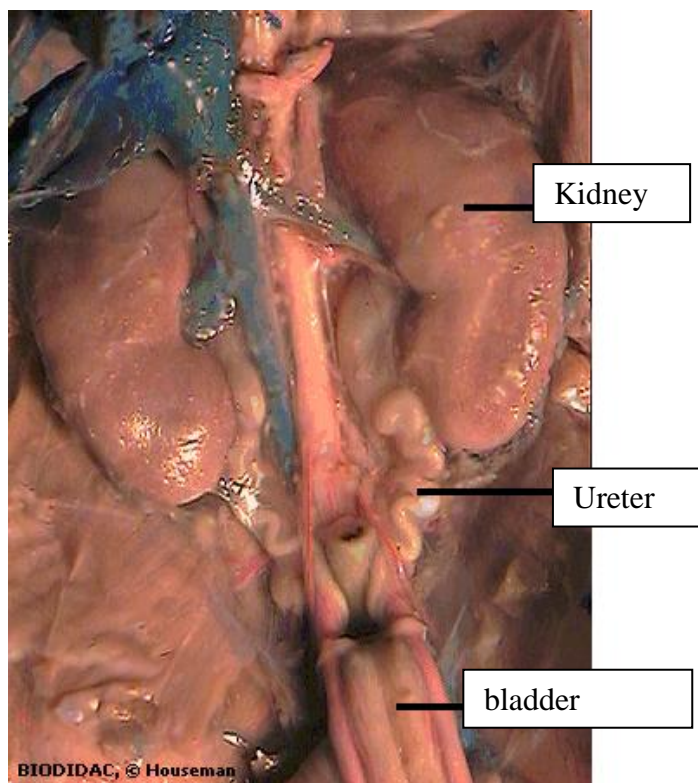
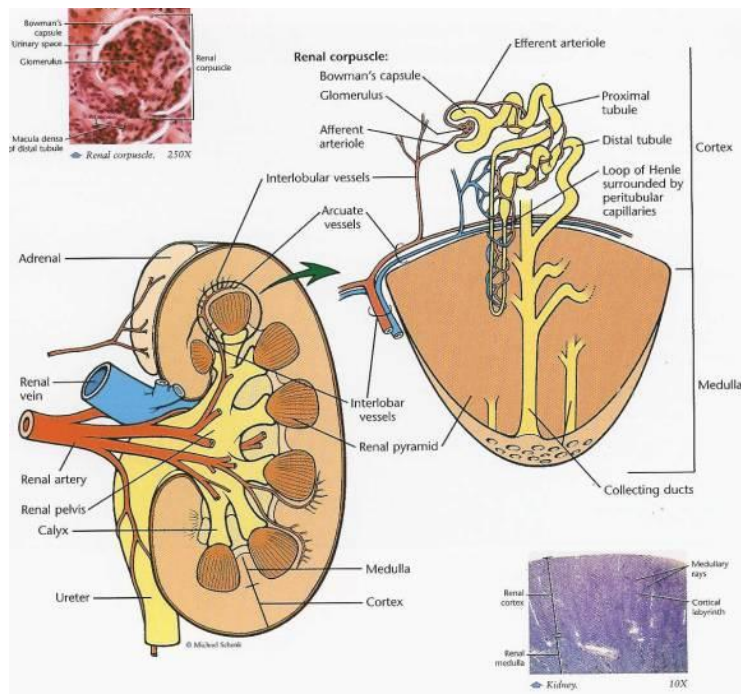
Let's Review:

- 1) List 3 functions for the liver:
- 2) List 3 functions for the pancreas:
- 3) What function do the liver and pancreas have in common?
- 4) Which structure prevents food from entering the trachea when you swallow?
- 5) Explain peristalsis:

FETAL PIG DISSECTION: LAB Procedures Day 5

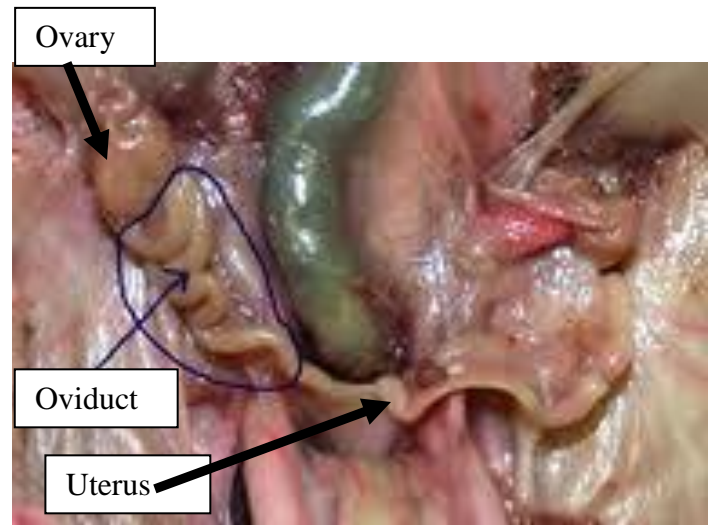
Urinary Anatomy

1. The main function of the urinary system is to help the body maintain a healthy balance between removal of cellular wastes (urine) and retention of water needed for cell function. Two **kidneys** are the primary organs in this system and they are located dorsal to the small intestine. Human kidneys are about the size of a closed fist, but the pig's kidneys are about the size of your thumb.
2. Carefully remove any clear membranes that may cover and protect the kidneys and proceed to identify 3 tubes that emerge from the kidney. One is the renal artery (red) that delivers blood to be cleaned, another is the renal vein (blue) which carries the cleaned blood back to the body; and the third is the **Ureter** which collects the urine produced and carries it to the urinary bladder.
3. Trace the ureter until it reaches the **urinary bladder**, a clear sac between the umbilical arteries where urine is stored until it is periodically released during urination through the **urethra**.
4. Cut the ureter and remove one kidney. To view the internal features of the kidney, slice the kidney lengthwise (from anterior to posterior) so that it looks like the drawing below. The inner kidney reveals a massive network of tiny tubes and capillaries which form millions of miniature filtering and nutrient/water reabsorbing units called nephrons. Urine is filtered from the blood in these nephrons and then funneled into the ureter. Study the diagram below to better appreciate this important process and then trace the path that urine would take from the renal artery until it exits through the urethra.
5. Locate the tube that drains urine from the bladder to the outside called the urethra



Female Reproductive System

- Just posterior to the kidneys lie the female gonads called the **ovaries**. This is where meiosis cell division occurs and the mother's chromosomes follow the famous "Mix-E, Mix-E, Cut it in half" dance moves to ensure each egg has a different mixtures of the mother's DNA. Each ovary is kidney-shaped and about 5 mm long (pencil diameter). A minute **oviduct** attaches to the ovary and escorts the ripe eggs to the **uterus**. The oviduct is also the location where the egg is usually fertilized. Notice the "wavy ribbon-like" shape of the uterus as it lies medially (horizontal) just posterior to the colon. The horns of the uterus form these curls and waves and will expand in the adult to make room for 8 -10 piglets to develop.
- Follow the uterus caudally to where it joins with the vagina (birth canal) and eventually unites with the urethra to form the urogenital opening.



Male Reproductive System

- The location of the male gonads called the **testes** depends on the animal's age. In young pigs, the testes are in the lower abdomen posterior to the kidneys. As the pig matures, the testes drop into the scrotal sacs, which are ventral to the anus. The testes are also the site of meiosis cell division which ensures unique DNA combinations in each sperm.
- Cut open the **scrotal sac** (right below the tail) to reveal the testis, which is usually dark brown and kidney-bean shaped.
- Sperm produced in the testes travel through a tube called the **vas deferens** (in humans this is the tube that is cut during a vasectomy procedure) and are carried through the penis and finally exit through the urogenital opening. Trace the path that sperm would take during mating when they are delivered to the vagina of the female. Note that the fetal penis tissue is located just ventral to the umbilical cord tissues. Keep in mind that these reproductive structures are minimally developed in the fetal pig and are often difficult to identify.

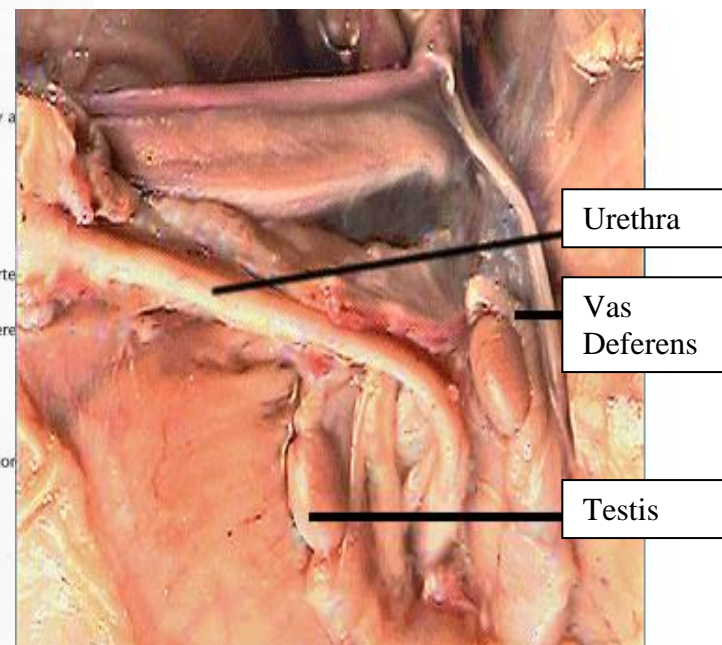
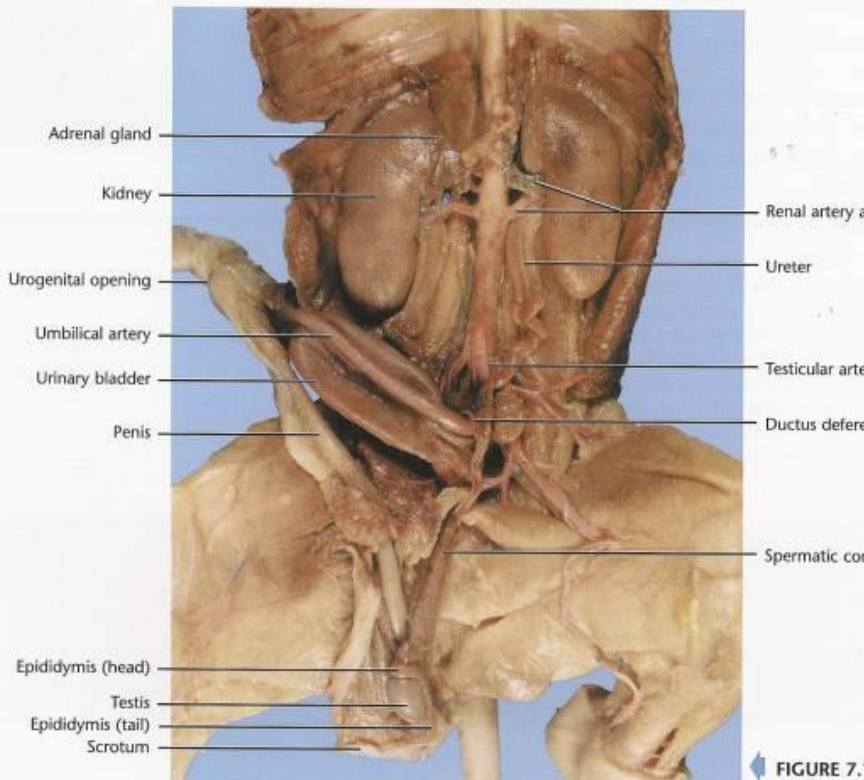


FIGURE 7.1a