**Mammalian Anatomy: A Fetal Pig Dissection**

**Introduction**:

Eutherian, or placental, mammals share many physical traits such as body hair, mammary glands and nipples, a four chambered hear, specialized teeth, a diaphragm and specialized digestive, respiratory, circulatory, excretory and reproductive systems. As we study this fetal pig’s anatomy we will learn more about these common traits and therefore more about our human body systems.

Anatomists have specific terms to describe position/orientation.

**Sagittal plane** – spits into left and right portions

**Midsagittal** – divides exactly into right and left sides

**Frontal plane** – divides top and bottom (horizontal)

**Transverse plane** – cuts across the animal creating front and back portions

**Left/right** – stated relative to subject, not to viewer

**Anterior** (**cranial**) – towards front/head of animal

**Posterior** (**caudal**) – towards back/tail of animal

**Superior** – higher on subject; typically used on subjects such as humans

**Dorsal** – towards the back

**Ventral** – towards the belly

**Medial** – toward the midsagittal section (middle)

**Lateral** – away from the midsagittal section (sides)

**Proximal** – towards midsagittal section along a limb

**Distal** – away from midsagittal section along a limb

Procedure: WEAR GLOVES AT ALL TIMES WHEN HANDLING THE PIG.

**A. External anatomy**

1. Rinse pig with cool tap water to remove excess preservative.
2. Place pig in a dissecting tray. Locate the *snout*, *nares* (nostrils), *hairs* on chin, *ear flaps* and *rooter*. Take a clear photo with the iPad and *label each of the italicized items*. It might be best to have one unlabeled picture for future reference.
3. Feel the thick neck muscles on the dorsal side. How do adult pigs find food and how would these muscles help?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Now locate the *umbilical cord, tail, hind limbs* and *forelimbs*. Label these on the picture. What is the orientation of the limbs and what is the number of digits on each limb? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. What is the purpose of the umbilical cord? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Locate the double row of *nipples* on the ventral surface and then label them on the photo. Examine other pigs in the classroom. Do these nipples indicate the sex of your pig? Explain. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. What is the purpose of the nipples? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Determine the sex of your pig by locating the urogenital opening of your pig. A female has a *urogenital opening* ventral to the anus under the tail. A small pointed projection called the *genital papilla* can also be seen under the urogenital opening. The male’s *urogenital opening* is found posterior to the umbilical cord. Only the *anus* can be found below the male’s tail. A male pig will also have a *scrotum* that can be felt as two patches of thin skin between the hind limbs. What is the sex of your pig? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Visit other class pigs to be certain to see the external anatomy of both sexes. Label the structures on your photograph that enabled the identification of the sex of your pig.

**B. Further preparation**

1. Collect two pieces of twine/string. Place the pig on its back in the dissecting tray and tie one piece of string to the wrist of one forelimb. Pass the string beneath the tray and tie the other end of the string to the opposite forelimb wrist making the string as taut as possible. Do the same procedure with the hind limbs securing the pig tightly.
2. Remember that when making cuts with both scissors and the scalpel, cut away from your body. Pull gently upward on the umbilical cord and while the umbilical cord is being pulled, gently use the scalpel to make a small incision through the skin and muscles immediately anterior to the umbilical cord (cut 1). This incision should be about a half of a centimeter in length and extend just through to the abdominal cavity. Be careful not to damage any of the organs within the abdominal cavity. Call the teacher over before going any further.
3. When instructed to continue, use the scissors to extend the incision laterally in both directions until the area of the frontal plane. Make two incisions posterior to the first, one on each side of the umbilical cord as shown in the diagram (cuts 2 & 3).

Reference diagram for incisions



 **C. Digestive System**

1. Begin in the mouth where digestion begins. Open the mouth. Insert scissors into one of the corners of the mouth and cut through the skin muscles and bones. Repeat on the other corner of the mouth. Pull open the jaw so you can examine the mouth structures.
2. Rub a gloved finger along the surface of the pig’s gums. Young pigs have 32 milk *teeth*; how many teeth have broken through the gums of your pig? \_\_\_\_\_\_\_\_
3. Are all of the erupted milk teeth the same shape? \_\_\_\_\_ Why would this be? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. There are ridges along the *hard palate* of the roof of your pig’s mouth. This provides a surface upon which food can be rolled into a ball that is easily swallowed. Do you have these ridges? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Behind this hard palate is the *soft palate*. Look at a lab mate’s soft palate or your own in a mirror. What is a noticeable difference between the pig’s soft palate and your own? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Observe the pig’s *tongue* and a human’s tongue. What differences do you notice?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. At the rear of the mouth you will find the *esophagus*. Feel the muscular walls of the esophagus with your finger. These muscles push food down to the stomach.
2. Return your focus to the abdominal cavity where the esophagus enters the large sack-like *stomach* that is beneath the large three lobed *liver* on the left side of the pig’s body. Are there three lobes in the human liver? \_\_\_\_\_\_\_\_\_\_\_\_\_ Glands in the stomach will secrete enzymes to aid in protein digestion.
3. Find the coiled, narrow *small intestine* that leads from the posterior end of the stomach. Digestion is completed in the small intestine. The liver contributes bile, a greenish liquid that breaks large fat drops into smaller droplets. Lift the right central lobe of the liver to find the transparent bile storage sac called the *gall bladder*. The green hue of the gall bladder is due to the green colored bile that it stores. Find the duct that leads from the liver and gall bladder to the small intestine. This thin tube is called the *bile duct*.
4. Locate the bumpy, light colored *pancreas* behind the stomach. This glandular organ secretes digestive enzymes into the top portion of the small intestine. What do these enzymes do?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. The fetal pig obtains its nutrients from its mother’s blood. The nutrients diffuse across the placenta into the fetus’s blood. What structure facilitates this movement of blood and nutrients from the placenta to the fetus? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ After birth, digested food is absorbed through the walls of the small intestine. The small intestine leads into the thicker, tightly coiled *large intestine*. Follow the small intestine to the large intestine and find the small pouch/projection that fork off of the small intestine at the junction with the large intestine. This pouch is called the *cecum*. What is the analogous structure called in a human? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. The large intestine spirals through the abdominal cavity, loops through the upper portion of the small intestine and then forms a straight tube called the *rectum*. The rectum leads to the *anus* – the outside opening of the pig’s body. Look up a diagram of the human large intestine to compare.
7. Carefully remove the digestive organs of the pig’s body as follows. Cut through the lower end of the esophagus and the lower end of the rectum. Move all of the organs off to one side and use the scalpel to carefully remove the connective tissue. Move the organs to the other side and continue separating the connective tissue until the digestive system can be removed. Separate the small intestine to get a sense of its length. Make an incision and examine the inner lining of the small intestine.
8. Examine the stomach further by making a slit in its wall. Notice the folds of the inner walls of the stomach, they unfold to allow the stomach to stretch when full of food. Sever the uppermost end of the stomach from the esophagus and cut the lowermost end from the small intestine. Find the rings of muscle, or sphincters, which close off the entrance and exit to the stomach. The cardiac sphincter allows food from the esophagus to pass into the stomach and the pyloric sphincter squirts food from the stomach into the small intestine. If necessary, extend the longitudinal cut in the stomach so the contents can be emptied. Notice the greenish color of the contents due to the bile pigments. Are there any food particles present in the stomach of your fetal pig? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 **D. Circulatory System**

1. Continue to further open the chest cavity by extending your midsagittal ventral cut anterior towards the throat (cut 7, 8 & 6). This cut will need to be made using scissors to cut through the sternum and rib bones. Be sure to aim the scissors upwards so as to avoid damaging the heart and lungs. You will need to clip the diaphragm around the edges and pull it down over the liver to fully expose the lungs.
2. Locate the heart in the middle of the chest cavity. You should see a sheer membrane surrounding the heart called the *pericardium*. You may also see portions of the *thymus gland* obscuring part of the heart. This gland is dull white in color and might appear like a mass of fatty tissue. Remove any thymus gland and the pericardium to clearly see the heart.
3. You have read that mammalian hearts are divided into four chambers: the two top chambers called atria and the two lower chambers called ventricles.

What is the function of the atria? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is the function of the ventricles? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. The outer surfaces of the atria are covered with connective tissue and the more muscular ventricles compose the triangular region, *apex*, of the heart. Locate the *coronary blood vessels* that run down the central surface of the heart. The coronary artery runs just above the septum which partitions the two ventricles. Blood from this coronary artery feeds the muscles of the ventricles.
2. Locate the blood vessels leading to and from the heart, the *anterior vena cava* and *posterior vena cav*a enter the right atrium. Lift the heart gently and slightly turn it so as to see these vessels. Find the *pulmonary artery* that leads from the right ventricle to the lungs. Also find the *pulmonary veins* that lead from the lungs into the left atrium. The *aorta* is located under the pulmonary artery carries the blood from the left ventricle to the rest of the body. Try to locate the branches of the aorta. If dissecting the fetal pig very carefully you may find the a blood vessel connecting the pulmonary artery and the aorta. This connecting vessel is called the *ductus arteriosus*. How does this vessel affect the flow of blood through the fetal heart? Why would it be necessary in a fetus? Why would it be life threatening after birth? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Be sure to have taken the necessary photos of the heart in situ as you will now remove it from the chest cavity. To accomplish this, gently lift the heart and carefully remove the connective tissue underneath. Lift the heart out of the chest cavity. Make a longitudinal cut through the heart, starting at the apex through the atria following the instructor’s directions. Identify the *right and left atria*, the *right and left ventricles*, *septum, aorta, venae cavae, pulmonary artery* and *pulmonary veins*.
4. Move your focus to the umbilical cord. Locate the blood vessels in the umbilical cord. The *umbilical vein* supplies blood rich in oxygen and nutrients from the placenta to the fetus. The *umbilical arteries* carry away waste products from the fetal pig’s body. Trace these umbilical blood vessels to the heart.

**E. Respiratory System**

1. Trace the path of air through your fetal pig’s respiratory system. Open the mouth of you pig and use a probe to trace the path of air through the nares. Does the pig breathe through its nose, mouth or both? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Move your focus to the chest cavity and find (or find again) the thymus gland that extends from the heart area to the anterior of the neck in your fetal pig. Remove this gland. You will now clearly see the *trachea*. Find yellowish *lymph nodes* and the reddish pebble-like *thyroid* gland that lie over the trachea.
3. Use the probe to follow the airway down the back of the mouth, called the *pharynx* into the *glottis*. Find the *epiglottis*, noticing how it covers the entrance of the glottis preventing food from entering the lungs.
4. As you follow the trachea towards the lungs, just posterior to the glottis, you will find the *larynx* which contains the pig’s vocal cords. The larynx is covered with cartilage; carefully make a slit in this cartilage and the wall of the larynx to try to view the thin membranous vocal cords.
5. Find the rings of cartilage around the trachea below the larynx. These give support to the trachea, preventing it from collapsing as the pig breathes. Follow the trachea as it divides into two tubes, the *bronchi* that enter the *lungs*. It may be necessary to lift/shift the lungs to view the bronchi.
6. The lungs themselves are covered with a protective lining called the pleura. The lungs are divided into *lobes*. The right lung has four lobes and the left lung has three lobes. Why is there a difference? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

How many lobes in human lungs? \_\_\_\_\_\_\_\_\_\_\_\_

1. Peel away the pleura and feel the texture of the lung surface. The preservative can make the lungs hard, but in a living pig, the tissues of the lung are made of tiny air sacs called alveoli. The alveoli are the sites of gas exchange.
2. Revisit the now clipped diaphragm and recall the seamless, airtight seal it made below the lungs. This allows the diaphragm to pull air into and push air out of the lungs.

**F. Excretory System**

1. Shift your focus to the lower abdominal cavity, more specifically to the dark red bean-shaped *kidneys* along the opposite sides of the dorsal body wall. They are covered with the thin membrane called the *peritoneum* that lines the abdominal cavity. There may also be some fat tissue. Remove the peritoneum and any fatty tissue to obtain a clear view of the kidneys. Notice the small, whitish glands on the anterior portion of the kidney. These are the *adrenal glands*, responsible for secreting adrenalin. They are part of endocrine system, not the excretory. What does adrenalin do in a mammal? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Find the *renal arteries* and the *renal veins* that enter and exit from the concave sides of both kidneys. Which main *blood vessel* is the origin for the renal arteries? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Which main *blood vessel* is the sink for the renal veins? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The kidneys filter wastes from the blood. How would the blood in the renal arteries differ from the blood in the renal veins? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Find the thin white tube called the *ureter* extending from the kidney to the urinary bladder. The ureter carries urine away from the kidney. Trace the ureter from the concave side of each kidney to the *urinary bladder* which will be found on the inside of the ventral flap containing the umbilical cord. In this fetal pig, you may notice the allantoic duct which carries the urine through the umbilical cord until birth.
2. After birth the urine will exit the bladder through the *urethra*. Find the urethra by spreading the hind legs apart as far as possible and use the scalpel to make a small incision in the tissue a little to one side of the mid-ventral line. You will be able to feel the cartilage of the pelvic bone with your finger; cut through this cartilage to expose the urethra. The urethra will likely be much easier to view after dissecting the reproductive system. Feel free to come back to it then. The urethra will lead to the *urogenital opening* which allows the urine to exit the body.
3. Now you will remove a kidney to examine it more fully. Use your scalpel to carefully cut the connective tissue surrounding the kidney and holding it in place. Cut through the connecting blood vessels and ureter and lift out the kidney. Make a longitudinal cut through the kidney from the lateral to medial sides. Ask if unsure of cut! You should clearly see three portions of the kidney: the lighter-colored outer section called the *cortex*, the darker-colored middle section called the *medulla* which is made of many small tubules and the final drainage area for the tubules called the *renal pelvis*.

**G. Reproductive Systems – follow the dissection protocols for your pig, but observe a pig of the other sex and obtain appropriate unlabeled photos (you should label on your own).**

**Female**:

1. You may need to further loosen the flap holding the umbilical cord to clear your field of view. Go back to the cut through the pelvis that was made in examining the excretory system. On the dorsal side, posterior to the kidneys, locate the small whitish almond-shaped *ovaries*. They are quite small.

What are made in the ovaries? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Use the dull probe to follow the thread-like *oviducts* from the ovaries (loops behind them) to the *horns of the uterus*. These oviducts have tiny cilia that will sweep the eggs from the ovary to the uterus for possible fertilization. Pigs often have multiple births whereas humans do not. How does this forked uterus better enable multiple births? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. The forked horns of the uterus connect in the *body of the uterus*. The narrow *cervix* can be found just posterior to the body of the uterus and just posterior to the cervix is the *vagina*.
3. Notice that the urethra merges with the vagina very close to the *urogenital opening* in a common tube called the *urogenital sinus*.

 **Male**:

1. Locate the *scrotum* on either side of the anus. Carefully continue cuts 4&5 with the scalpel through the scrotum. You may need to merge (or newly cut) with the cut through the pelvis. Cut through the lining of the scrotum to find a small, hard ovular mass called the *testis*. A male will have two testes, but in the fetus they may not have yet descended into the scrotal sac from the abdominal cavity. What are made in the testes? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Find a coiled mass of tiny tubes, the *epididymis*, along the side of the testis. The epididymis leads into the *vas deferens*, a tube that passes through the *inguinal canal*, loops over the ureters and joins the urethra near the entrance to the urinary bladder. From this point on the reproductive system of the male shares the passageway with the excretory system.
3. Trace the urethra posteriorly until it enters the cordlike cylinder under the skin and posterior to the umbilical cord, which becomes the penis. You will find the *urogenital opening* just posterior to the umbilical cord.
4. There are three sets of glands that secrete fluids which aid the movement of the sperm through the reproductive tract. The *bulbourethral glands* are relatively easy to see; they are oblong and lie on either side of the urethra just anterior to the penis. The prostate gland lies behind the urethra just posterior to the entrance of the vas deferens. This gland is usually too small to see in a fetus. The third set of glands are the *seminal vesicles* and lie on either side of the prostate. The seminal vesicles secrete fluid into the each vas deferens anterior to the urethra.

These directions are derived from Scott, Foresman and Company *Biology Laboratory Manual*, Dissecting a Mammal – the Fetal Pig.