Name Date

LABORATORY

Dissecting a Mammal—the Fetal Pig

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BACKGROUND

Mammals share many common characteristics. Body hair, mammary glands, and specialized teeth are external traits shared by most mammal species. Internal features shared by all mammal species include a diaphragm, a four-chambered heart, and similar digestive, respiratory, circulatory, excretory, and reproductive systems. By examining the external and internal anatomy of a fetal pig, you can learn about the common body traits shared by mammals. You will also study some unique anatomical features common to all developing placental mammals. In this laboratory you will observe and dissect a fetal pig and compare the fetal pig's anatomy with that of other vertebrates.

OBJECTIVES

- Examine the external anatomy of the fetal pig.
- Dissect the digestive, respiratory, circulatory, excretory, and reproductive systems of the fetal pig.
- Identify differences between the digestive, respiratory, circulatory, and excretory systems of the fetal and newborn pig.
- Compare features of fetal pig anatomy with features of the anatomy of amphibians, reptiles, birds, and other mammals.

MATERIALS

Preserved fetal pig
Dissecting tray
2 pieces of string or twine, 40-cm long
Label or paper to make a name tag
Dissecting scissors
Dissecting pins
Probe
Forceps
Hand lens or stereoscopic microscope
Optional: Rubber gloves or hand cream
Mirror

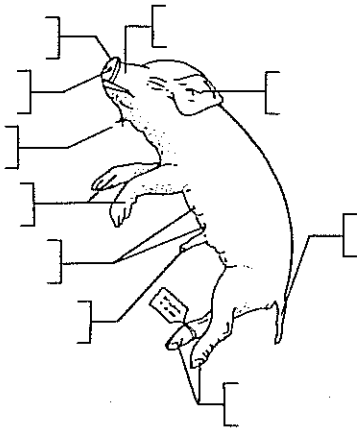
PROCEDURE A

EXTERNAL ANATOMY

1. Rinse your pig with tap water to remove excess preservative. Place a tag or label with your name on it around the ankle of your pig.

2. Place the pig in a dissecting tray. Locate the *snout, nostrils*—or *nares, hairs* on the head and snout, *rooter*—or foremost rim of tough tissue on the snout, and *ear flaps* on the head of your pig. After you examine these structures, label them on **a.** Gently examine the inside of the ear with a probe. Locate the eardrum.

a. External anatomy



3. Feel the pig's thick neck muscles on the dorsal side. These muscles help the pig root—or dig for food with its snout.

4. Locate the following structures on the pig's body, and then label them on **a:** *umbilical cord, tail, hind limbs,* and *forelimbs.* What is the orientation of the limbs (ventral or lateral) and the number of digits on each limb?

(a) _____

5. Find the double row of nipples on the pig's ventral surface, and label them on **a.** Examine the fetal pigs of your classmates. Can you determine the sex of a fetal pig by observing these structures? Explain.

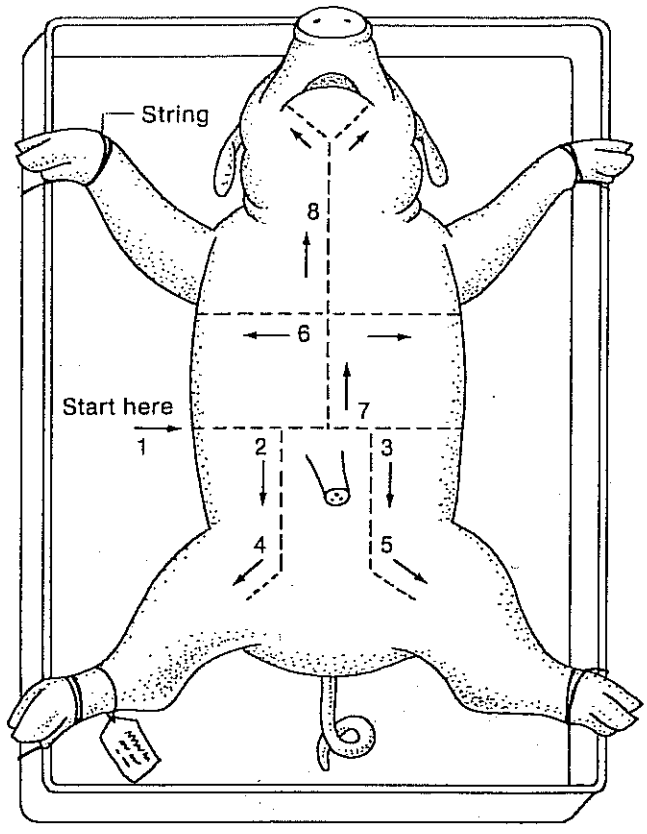
(b) _____

6. One way you can determine the sex of your pig is by locating the urogenital opening of your pig. A female has a urogenital opening ventral to the anus under the tail. Notice also a small, pointed projection—the *genital papilla*—below the urogenital opening. The male's urogenital opening is located posterior to the umbilical cord. Below the male's tail, only the anal opening is found. The male's *scrotum* can be felt as two patches of thin skin between the hind limbs. Record the sex of your pig on the line below. On **a,** draw the structures that allowed you to determine the sex of your pig.

(c) _____

PROCEDURE B PREPARING FOR THE DISSECTION

1. Place the pig on its back in the dissecting tray. Tie a piece of string or twine around the wrist of one forelimb. Then, pass the string under the tray, and tie it to the other wrist, as shown in **b.** Tie and spread apart the fetal pig's hind legs as you did the forelimbs. Your pig will be anchored for dissection.



b. Preparing for dissection

2. *CAUTION: Always cut away from yourself when you use dissecting scissors or a scalpel.* Use dissecting scissors to cut through the skin and muscles along the lines indicated in **b.** (NOTE: You can avoid cutting into the underlying organs by pulling up the umbilical cord as you make the incisions.) The flap formed by incisions 1–5 will remain attached to the main part of the pig's body. To free this flap of tissue, cut the vein leading from the abdominal cavity into the umbilical cord. Make incision 6, and then connect incisions 1 and 6 by making incision 7. Open the flaps, pinning them down with dissecting pins. Rinse the abdominal cavity with running water to remove the excess preservative.

3. Identify the abdominal tissues and main organs that you can see. Notice the *peritoneum* that lines the abdominal cavity and supports the abdominal organs. Peel away this tissue if necessary. Identify the *diaphragm*, the thin sheet of muscle that separates the abdominal and chest cavities. Locate the large, dark brown, five-lobed *liver*, posterior to the diaphragm. Find the *small intestine*—the thin, coiled tube. The coiled mass of thicker tubing below the small intestine is the *large intestine*. (NOTE: As you proceed through the dissection, do not remove any organs unless you are directed to do so.)

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PROCEDURE C DIGESTIVE SYSTEM

1. Begin your study of the digestive system by examining structures in the mouth of the fetal pig. First, pry open the mouth. Then, insert your scissors into one of the corners of the mouth and cut through the skin, muscles, and bones. Repeat this procedure with the other corner of the pig's mouth. The lower jaw can now be pulled open easily so that you can examine the inside of the mouth.

2. Rub your finger along the surface of the pig's gums. Young pigs have 32 milk teeth. How many teeth have already broken through the gums?

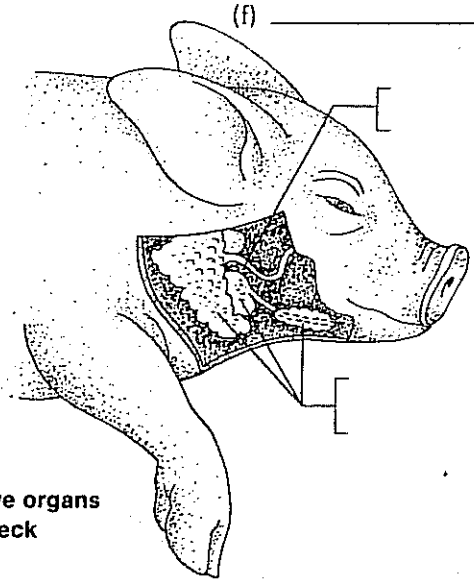
   (d) _____

3. Notice the ridges on the *hard palate* on the roof of the pig's mouth. Food is rolled against this hard surface and formed into a ball that is easily swallowed. Behind the hard palate is the *soft palate*. Use a mirror to look at your own soft palate. What differences do you observe between your soft palate and the pig's soft palate?

   (e) _____

4. Feel the surface of the pig's tongue. Compare the tongue's surface to your tongue's surface. Describe the differences you observe.

   (f) _____



c. Digestive organs in the neck

5. Turn the pig's head to the side, and remove the skin above the neck region shown in **c.** The three masses of globular tissue are *salivary glands*. Saliva contains an enzyme that helps digest the pig's food. Note that each gland secretes saliva into a duct. Use your probe to trace a duct to its opening in the mouth. Identify and label the salivary glands and duct in **c.**

6. Return the pig's head to its original position shown in **b.** Use a probe to locate the *epiglottis*, a cartilaginous projection directly posterior to the base of the pig's tongue. Note how the epiglottis can lower to cover the *glottis*—or opening to the respiratory tract—as the pig swallows. Thus, the epiglottis prevents food from entering the lungs.

7. At the rear of the mouth, locate the entrance to the *esophagus*. Feel the muscular walls of the esophagus with your finger. The esophagus muscles push food down the length of this tube toward the stomach.

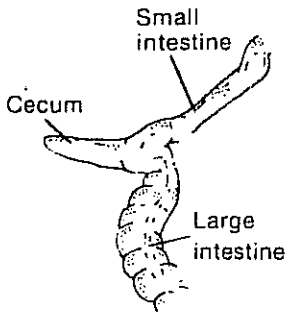
8. Continue your study of the digestive system by examining the abdominal cavity. The esophagus leads into the large, slack, J-shaped *stomach* on the left side of the pig's body. Lift up lobes of the liver to locate this organ. Enzymes secreted by glands in the stomach aid protein digestion.

9. Notice that the coiled, narrow *small intestine* 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—the *gall bladder*. The green color of the gall bladder is due to the green-colored bile stored in the gall bladder. Locate the duct that leads from the liver and gall bladder to the small intestine. This thin tube is called the *bile duct*.

10. Locate the coarse, light-colored *pancreas* behind and slightly posterior to the stomach. This glandular organ secretes digestive enzymes into the top portion of the small intestine.

11. A fetal pig gets its nutrients from its mother's blood. The nutrients diffuse across the placenta into the fetus's blood. After birth, digested food is absorbed through the walls of the small intestine. Make a 3-cm incision in the wall of the upper portion of the small intestine. Examine the inner lining of the small intestine. Describe its texture.

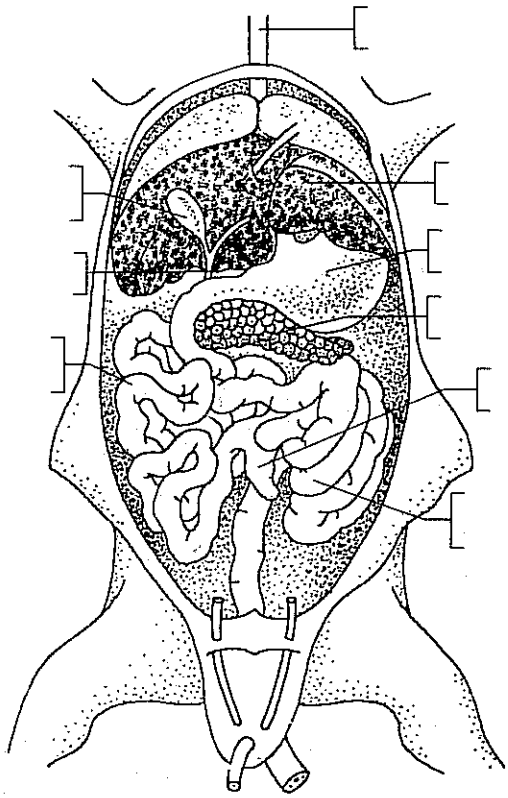
(g) _____



d. Cecum

12. The small intestine leads into the thicker, tightly-coiled large intestine. Find the small pouch—the *cecum*—that forks off the small intestine at the junction with the large intestine, as shown in **d.** Notice how the large intestine spirals through the abdominal cavity, loops through the upper portion of the small intestine, and then forms a straight tube, the *rectum*. The rectum leads to the *anus*—the outside opening of the pig's body.

13. Review the abdominal organs of the digestive system by labeling the organs in **e.**



e. Digestive system

14. Remove the liver, gall bladder, stomach, pancreas, small intestine, and large intestine by cutting through the lower end of the esophagus and the lower end of the rectum.

15. Examine the stomach in more detail by making a longitudinal slit in the wall of the stomach. Notice the folds of the inner walls of the stomach. These surfaces unfold allowing the stomach to stretch and expand when it is 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*, that close off the entrance and exit to the stomach. The *cardiac sphincter* allows food from the esophagus to pass into the stomach; the *pyloric sphincter* squirts food from the stomach into the small intestine. Extend the longitudinal cut in the wall of the stomach so that you can empty its contents. The greenish color of materials you may notice are due to bile pigments. Record if any food materials are present in the stomach.

(h) _____

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PROCEDURE D

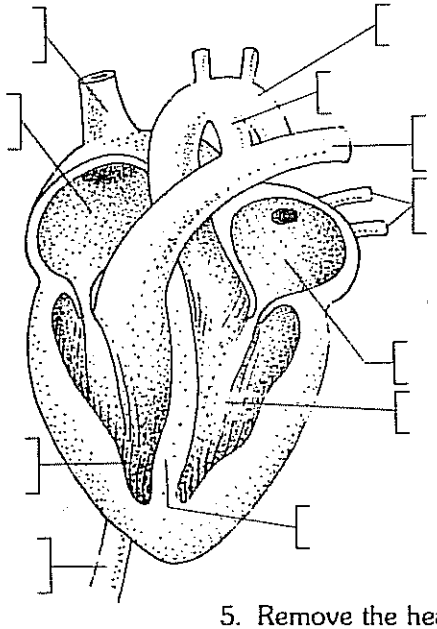
CIRCULATORY SYSTEM

1. Continue the dissection by opening the chest cavity as described below. Make incision 8 as shown in **b.** First use your scalpel to make a shallow cut through the skin. Then, use your dissecting scissors to cut through the ribs, breastbone, and collarbone. (NOTE: Keep the lower edge of your scissors tightly pressed against the inner sides of the bones to avoid puncturing the delicate lung and heart tissues and other structures just under these bones.) Pin back the flaps of skin with dissecting pins. Free the diaphragm from the body wall by clipping the diaphragm around the edges where it joins the ribcage. Pull the diaphragm down so it covers the liver.

2. Locate the heart in the middle of the chest cavity between the lungs. Note that the heart is enclosed in a transparent membrane, the *pericardium*. The heart may be partially covered by a portion of the *thymus gland*. This gland is a dull white color and may resemble a mass of fatty tissue. Remove any portion of the thymus gland that obstructs your examination of the heart. Also remove the pericardium.

3. Mammalian hearts are divided into four chambers. The top chambers—the *atria*—collect blood as it comes into the heart. The bottom chambers—the *ventricles*—pump blood to the lungs and body. The outer surfaces of the atria are covered with light-colored connective tissue. The more massive ventricles compose the triangular region, or apex, of the heart. Notice the *coronary blood vessels* that run down the central surface of the heart. The coronary artery runs just above the *septum*, the partition separating the two ventricles. Blood from the coronary artery feeds muscles of the ventricles.

f. Fetal heart



4. Notice the blood vessels leading to and from the heart. the *anterior* and *posterior venae cavae* enter the right atrium. Lift the heart and rotate it to your right to locate these blood vessels. Find the *pulmonary artery* that leads from the right ventricle to the lungs. The *pulmonary veins* lead from the lungs into the left atrium. The *aorta*, located underneath the pulmonary artery, carries the blood from the left ventricle to the rest of the body. Locate the branches of the aorta. If you dissect the fetal heart carefully, you will notice a blood vessel connecting the pulmonary artery and the aorta. This blood vessel is called the *ductus arteriosus*. How does the ductus arteriosus affect the path of blood through the fetal heart?

   (i) _____

5. Remove the heart from the chest cavity. Make a longitudinal section of the heart along the midline from top to bottom of the heart. You will have two sections: a dorsal section and a ventral section. Examine the ventral section under a stereoscopic microscope. Note the path the blood would flow through a fully-functioning heart.

6. Review the structure of the heart by labeling **f.**

7. Trace some of the larger veins that lead to the anterior vena cava and some of the larger arteries that lead from the aorta. (NOTE: These blood vessels may have been injected with colored latex. Red latex fills the arteries; blue latex fills the veins.) Cut an artery and a vein and look at the cross sections. Aside from the color of the latex, how do the arteries and veins differ in structure?

(j) _____

8. 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. Use a probe to trace the umbilical arteries and vein to and from the heart.

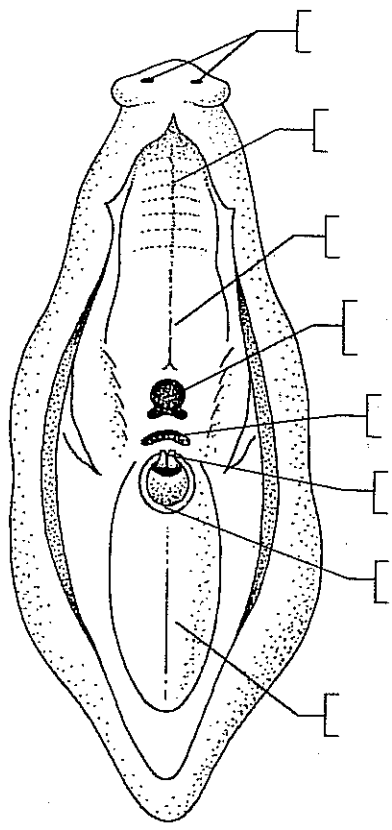
PROCEDURE E RESPIRATORY SYSTEM

1. Trace the path air would follow through the respiratory system of your fetal pig. Use the following instructions as your guide. Open the mouth of your fetal pig. Use a probe or your finger to trace the path air would follow through the nares. Can the pig breathe through its nose, its mouth, or both? Explain.

(k) _____

_____

2. Use your probe to follow the air pathway down the back of the mouth, or *pharynx*, into the *glottis*. Notice how the respiratory tract passes in front of the esophagus of the digestive tract. Use your forceps to bend the epiglottis. Note how it covers the entrance of the glottis, preventing food from entering the lungs.



g. Structures of the mouth

3. Label the structures of the mouth in **g.**

4. Observe the upper chest cavity as shown in **h.** Notice the thymus gland that extends from the heart region to the anterior of the neck in your fetal pig. Remove this glandular tissue. The windpipe—or *trachea*—will now be clearly visible. Locate yellowish *lymph nodes* and the reddish *thyroid gland* that lie over the trachea.

5. Find the enlarged region of the respiratory tract just posterior to the glottis. This region is the *larynx*, which contains the pig's *vocal cords*. Note that the larynx is covered with a cartilage shield. Make a slit through the cartilage and larynx wall, and try to observe the vocal cords with a hand lens. These structures are thin, whitish membranes connected to the lateral walls of the larynx.

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6. Notice the rings of cartilage attached to the trachea below the larynx. Cartilage rings support the trachea, preventing it from collapsing when the pig respires. Follow the path of the trachea as it divides into two tubes—the *bronchi*—that enter the lungs. You may need to lift or move the lungs to the side to observe the entrance of the bronchi.

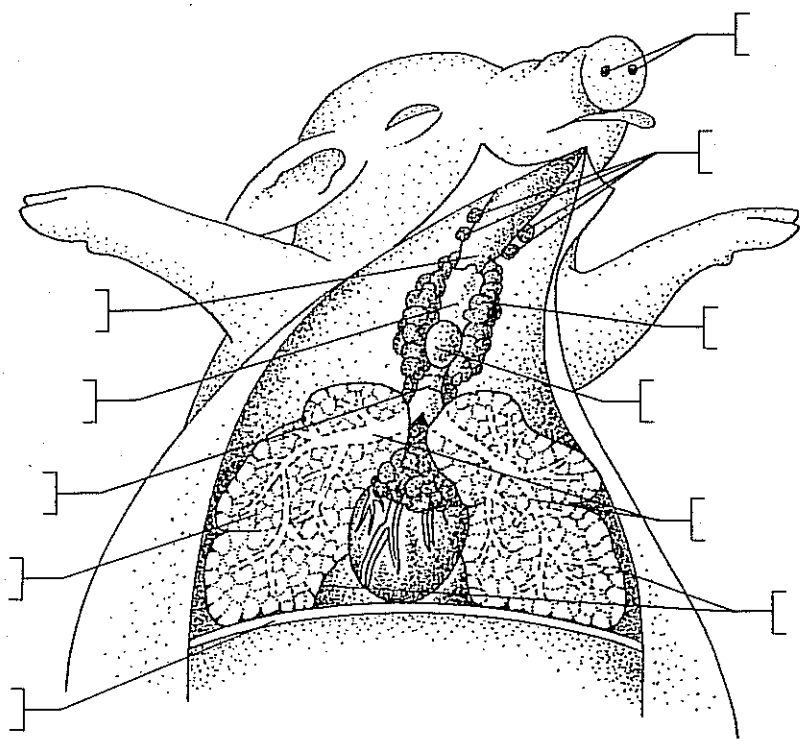
7. Notice the outer linings of the lungs—the *pleura*. These membranes protect the surfaces of the delicate lung tissues as the lungs expand and contract. Notice that the lungs are divided into lobes. The right lung has four lobes; the left lung has three lobes. Give a reason for this difference. (HINT: Note the location of the heart in the chest cavity.)

   (l) _____

8. Peel away the pleural membranes. Feel the texture of the surface of the lungs. The hardness and compactness of the lung tissue is due to preservatives. In a living pig the lung tissues are made up of tiny, resilient air sacs called *alveoli*. Gas exchange occurs in the alveoli.

9. Before you clipped the diaphragm from the body cavity, it formed an airtight seal between the chest cavity and the abdominal cavity. The movement of the diaphragm causes air to flow in and out of the lungs.

10. Review the respiratory system by labeling **h** below.



h. Respiratory system

PROCEDURE F EXCRETORY SYSTEM

1. Locate the dark red, bean-shaped *kidneys* along opposite sides of the dorsal body wall. You may need to remove the *peritoneum*, the thin membrane that lines the abdominal cavity, and fat tissue to get a better view of the ventral sides of the kidneys. Notice the whitish, crescent-shaped organs attached to the anterior edge of each of the kidneys. This pair of *adrenal glands* is not part of the excretory system, but the endocrine system. The adrenal glands produce hormones that affect the behavior and metabolism of the animal.

2. Trace the *renal arteries* and *renal veins* that lead from the concave sides of both kidneys. From which blood vessel do the renal arteries originate?

   (m) _____

   Into which blood vessels do the renal veins empty?

   (n) _____

   The kidneys filter wastes from the blood. How do you think blood from the renal veins differs from blood in the renal arteries? Explain.

   (o) _____

   _____

3. Each kidney connects to a *ureter*—a white tube that carries the urine from the kidney to the *urinary bladder*. Locate a ureter on the concave side of one of the kidneys just below the renal artery and vein. Trace the ureters to the urinary bladder, which you will find on the inside of the ventral flap that contains the umbilical cord. Notice in the fetus, a tiny tube, the *allantoic duct*, carries urine from the bladder through the umbilical cord.

4. After birth urine leaves the bladder through the *urethra*. To locate the urethra, spread the hind legs as far apart as you can. Then, use your scissors to make a small incision in the tissue a little to one side of the mid-ventral line. Probe with your finger until you find the cartilage that makes up the pelvic bone. Cut through the cartilage and expose the urethra. The urethra leads to the *urogenital opening* through which urine passes out of the body.

5. Identify and label the excretory organs in **i** on page 193.

6. Use your scalpel to cut the connective tissue holding a kidney to the body wall. Then, sever the blood vessels and ureter that lead from this kidney and remove the kidney. Slice through the adrenal gland, and note the light-colored *adrenal cortex* and darker *adrenal medulla*. Then, cut the kidney longitudinally from the lateral to the medial surface. Notice that the kidney is divided into three sections. The light-colored *cortex* is the outer section of the kidney. The *medulla* is darker in color and is made of many tiny tubules that project into the *renal pelvis*. The renal pelvis drains the incoming and outgoing fluids.

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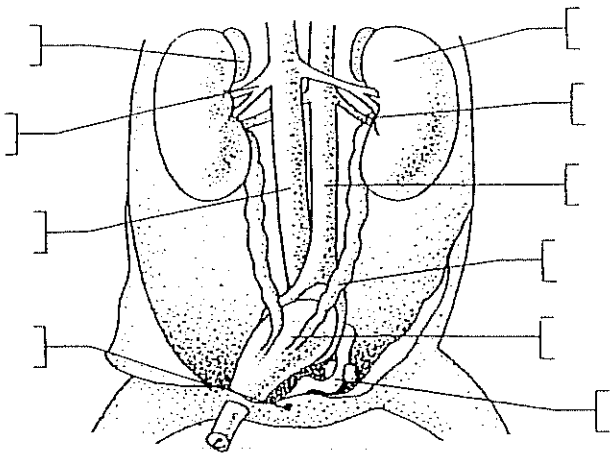
I. Excretory system



ANALYSIS

1. List five mammalian traits you observed in your dissection of the fetal pig.

2. How is digestion different in a fetal pig from that in a newborn or adult pig? Give evidence from the lab to explain your answer.

3. Trace the path that food would take through the pig's digestive system.

ANALYSIS (Continued)

4. What is the role of the respiratory system in the healthy functioning of the fetal pig? Explain how the fetal pig exchanges oxygen and carbon dioxide with its environment.

5. Trace the path of inhaled air through the respiratory system of a pig.

6. From your laboratory observations, describe how the structure of the fetal pig's heart would differ fom the heart of a newborn or adult pig. If this structural difference persisted after birth, how would it be harmful to the pig?

7. Chart the course blood would take through the four-chambered heart of a pig.

8. Trace the path of wastes from the blood through a newborn or adult pig's excretory system and out of the body. How is this different from the path these wastes would take out of the fetal pig's body?

Terminology and Techniques for Dissection

Orientation Terminology

Orientation terminology used with quadrupeds (four-legged animals such as the fetal pig) differs from terminology used with bipeds (such as humans). Become familiar with the following terms, which refer to quadrupeds (Figure C.1).

Right/left: Always refer to the animal's right or left, not yours.
Anterior, cranial: Toward the head.
Posterior, caudal: Toward the tail.
Dorsal: Backside; from the Latin *dorsum*, meaning "back."
Ventral: Bellyside; from the Latin *venter*, meaning "belly."

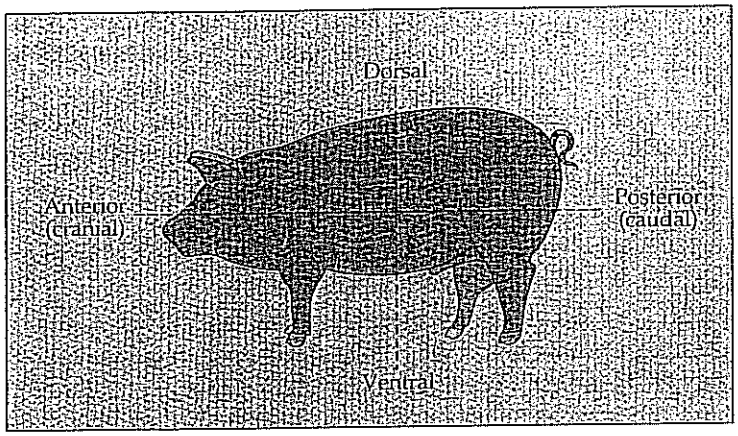


Figure C.1.
Orientation terminology for quadrupeds.

Terms Relating to Position in the Body

Proximal: Near the trunk, attached portion, or point of reference; for example, "The pig's elbow is *proximal* to its wrist."
Distal: Farther from the trunk, attached portion, or point of reference; for example, "The toes are *distal* to the ankle."
Superficial: Lying on top or near the body surface.
Deep: Lying under or below.

Dissection Techniques

When studying the anatomy of an organism, the term **dissection** is perhaps a misnomer. Dissection literally means to cut apart piece by piece. In lab, however, it is usually more appropriate to *expose* structures rather than *dissect* them. Initial incisions do require that you cut into the body, but after body cavities are opened, you will usually only separate and expose body parts, using dissection rarely. Accordingly, you will use the scalpel when you make initial incisions into the body wall of large animals, but seldom when studying small animals or organs of large animals.

Scissors are used to deepen initial cuts made by the scalpel in large animals and to cut into the body of smaller animals. When using scissors, direct the tips upward to prevent gouging deeper organs. Once the animal's body is open, use forceps and the blunt probe to carefully separate organs and to pick away connective tissue obstructing and binding organs and ducts. Needle probes are only minimally useful. Never cut away an organ or cut through a blood vessel, nerve, or duct unless given specific instructions to do so.

Producing a good dissection takes time and cannot be rushed. As you study the anatomy of animals, your goal should be to expose all parts so that they may be easily studied and demonstrated to your lab partner or instructor.

Dissecting a Mammal- the Fetal Pig

Key Terms for Diagrams

Diagram A:

- ear flaps
- forelimbs
- hair
- hindlimbs
- nares
- nipples
- rooter
- snout
- tail
- umbilical cord

Diagram C: #5 on pg. 187

Diagram E:

- bile duct
- cecum
- esophagus
- gall bladder
- large intestine
- liver
- pancreas
- small intestine
- stomach

Diagram F:

- anterior vena cava
- aorta
- ductus arteriosus
- left atrium
- left ventricle
- posterior vena cava
- pulmonary artery
- pulmonary vein
- right atrium
- right ventricle
- septum

Diagram G:

- epiglottis
- esophagus
- hard palette
- nare
- pharynx
- soft palette
- tongue
- trachea

Diagram H:

- alveoli bronchi
- cartilage rings
- diaphragm
- larynx
- lymph nodes
- nare
- pleura
- thymus
- thyroid
- trachea

Diagram I:

- adrenal glands
- aorta
- kidney
- renal artery
- renal vein
- ureter
- urethra
- urinary bladder
- urogenital opening
- vena cava