Fetal Pig Dissection Unit

Objectives:
- Identify important external structures of the fetal pig.
- Identify major structures associated with a fetal pig’s integumentary, skeletal, digestive, respiratory, circulatory, urogenital, & nervous systems.
- Compare the functions of certain organs in a fetal mammal with those of an adult mammal.

Materials: preserved fetal pig, dissecting pan, dissecting tools, dissecting T-pins, plastic bag, metric ruler, paper towels, latex gloves, string

General Dissection Information:
The term "dissection" means more than merely cutting your specimen apart. It is a method of seeking, exposing, identifying and studying the internal anatomy. It also helps to bring into view many structures not readily seen under normal circumstances.

Remember the dissection tools are sharp and are to be handled with caution and care. Always clean these tools after using them.

Use your scissors to do the cuts. Rely mostly on the probes for looking at and pushing aside internal structures. When studying a system or organ, always look at the diagram, making sure of the name and location of the body part. Greater caution must be taken in dissecting a fetal animal than an adult animal. The organs and tissues are not yet fully developed. They are, therefore, smaller, differently shaped, and more delicate than those of the adult. It will mean using greater care in cutting the soft, thin skin. A careless movement of finger, scissor, or probe may tear, cut, or destroy important structures.

At the end of each class period, wrap the fetal pig in wet paper toweling, wet it and put it in the plastic bag. Do not allow for much air in the bag, for this may cause the fetal pig to decay prematurely. Remember to line your dissection pan with paper toweling before placing the specimen on it. This will help your clean up!

When all supplies are cleaned and properly put away, wash your hands with soap and water.
Background Information:
The fetal pig (Sus scrofa) belongs to the class “Mammalia”, the same class to which man belongs. The gestation period of the pig is about 115 days and the fetal pigs are approximately 30 cm in length at the end of this period.

Mammals are vertebrates having hair on their body and mammary glands to nourish their young. The majority are placental mammals in which the developing young, or fetus, grows inside the female’s uterus while attached to a membrane called the placenta. The placenta is a source of food and oxygen for the fetus, and it also serves to get rid of fetal wastes.

The dissection of the fetal pig in the laboratory is important because pigs and humans have the same level of metabolism and have similar organs and systems.

External Anatomy

1. Obtain a fetal pig and rinse off the excess preservative by holding it under running water. Lay the pig on its side in the dissecting pan and locate the dorsal (back surface), ventral (belly surface), anterior (toward the head), and posterior (toward the tail end) surfaces.

2. A fetal pig has not been born yet, but its approximate age since conception can be estimated by measuring its length. Measure your pig’s length from the tip of its snout to the base (start) of its tail, using string. **Do not measure the tail itself.** **Use the length/age chart below to determine the age of your fetal pig and record this on your hand-in for day 1.**

<table>
<thead>
<tr>
<th>Length of Fetus</th>
<th>Gestation Days</th>
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<tr>
<td>2 cm</td>
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External Structures

a. **Snout** - The snout of the pig has a blunt tip composed of cartilage and strengthened by bone. This permits the pig to use the snout to push, lift weights, and dig.

b. **Nares** - These are the nostrils of the snout. They open into the nasal cavity. Here the inhaled air is warmed, filtered, and moistened.

c. **Pinna** - This is the flap-like external ear. They are composed of cartilage, just as the human ear is composed. Its function is to collect sound waves.

d. **Eyes** - Note the upper and lower eyelids. In addition, there is a third eyelid, the *nictitating membrane*, which covers the anterior portion of the eye and helps to clean it. **You need to make a small incision and open the other two lids to see this.

e. **Appendages** - Note the positions of the knee, the elbow, the ankle, and the wrist.

f. **Digit** - (on the foot) - The pig walks on the digits, or toes. **Count and record the number of digits of the fetal pig.

g. **Umbilical cord** - This extends from the abdomen of the fetus to the placenta of the mother. It functions in the bringing of food and oxygen to the fetus and the removal of wastes. Substances diffuse from one blood system to the other. **With scissors, cut across the cord about 1 cm from the body.** Examine the 3 openings in the umbilical cord. The largest is the *umbilical vein*, which carries blood from the placenta to the fetus. The two smaller openings are the *umbilical arteries* which carry blood from the fetus to the placenta.

h. **Anus** - Lift the pig’s tail to find the anus. Study the ventral surface of the pig and note the tiny bumps called *mammary papillary*. These are present in both sexes. In the female these structures connect to the mammary glands.

i. **Urogenital Opening** - Determine the sex of your pig by locating the urogenital opening through which liquid wastes and reproductive cells pass. In the male, the opening is on the ventral surface of the pig, just posterior to the umbilical cord. In the female, the opening is ventral (just below) to the anus. **Record the sex of your pig.**
The Skeleton

The skeleton of the fetal pig has not yet fully hardened to bone. Much of the skeleton is composed of cartilage.

Skeletal Structures:

a. **Feet** - Observe the position of the feet in the diagram of the adult pig. While man walks on the sole of the foot, the pig walks on his toes. The feet are narrow and foot bones are separate. The 1st digit of the pig is absent. The middle two are flattened and have hooves. These are the 3rd and 4th digits. The side toes are the 2nd and 5th digits.

b. **Teeth** - The pig and human are omnivorous, which means the diet consists of both plant and animal matter. Both have sharp pointed incisors and grinding molars. The total number of teeth in adult pigs is 44, and 32 in man.

c. **Skull** - The skull consists of the cranium, the bone protecting the brain, and the facial bones. Both the pig and humans have 8 cranial bones. The pig has 19 facial bones and man has only 14.

d. **Vertebral Column** - The vertebra serves as an attachment for the muscles of the back and its support. It also protects the spinal column, which is the core of the nerve network. The vertebra of the pig is composed of 51-56 bones; that of man only 33.

e. **Forelimbs** - In man, each forelimb is composed of the humerus, ulna, radius, eight carpals, five metacarpals, and 14 phalanges. In the pig, the humerus, ulna and radius are smaller. There are eight carpals, 4 metacarpals, and 12 phalanges.

f. **Hindlimbs** - In man, each hind limb is composed of the femur, patella, tibia, fibula, 7 tarsals, 5 metatarsals, and 14 phalanges. In the pig, the femur, patella, tibia and fibula are smaller. There are 7 tarsals, 5 metatarsals, and 12 phalanges.

g. **Ribs** - In man, there are 12 pair of ribs; the pig has 14 to 15 pair.
The Integumentary System

- Comprised of skin, and appendages of skin: hair, nails, skin pores, and sweat and oil glands
- Integument means covering, and the average adult has approximately 3,000 square inches of skin
- Skin weighs about 6 pounds, nearly twice the weight of the liver or brain
- Skin is flexible and rugged, mostly waterproof, and can usually regenerate itself
- Skin protects us from the sun and most harmful elements
- Skin varies in thickness. Thinnest skin is on the eyelids; thickest skin is on the soles and palms.

Nerves of the Skin

- Motor nerve fibers: distributed to muscles attached to the hair follicles. These muscles can cause goose bumps when someone is frightened or cold.
- Sensory nerve fibers: react to heat, cold, touch, pressure, and pain. These sensory receptors send messages to the brain.
- Secretory nerve fibers: distributed to the sweat and oil glands of the skin. They regulate the excretion of perspiration from the sweat glands and oil from the oil glands to the surface of the skin.

Sudoriferous (Sweat) Glands

- Excrete sweat from the skin
- Almost all parts of the body have sweat glands
- More numerous on the palms (we have about 3,000 sweat glands per square inch on our palms), soles, forehead, and armpits
- Regulate body temperature and help to eliminate waste products from the body
- Normally, one to two pints of liquids containing salts are eliminated daily through sweat pores in the skin

Sebaceous (Oil) Glands

- Connected to the hair follicles
- The glands secrete oil that lubricates the skin and preserves the softness of the hair
- Found on all parts of the body except the palms and soles
- Larger glands are located in the face and scalp
- Normally, sebum flows through the oil ducts to the hair follicles. When the sebum hardens, the duct becomes clogged and forms a blackhead

Protection

- Skin protects the body from injury and bacteria
- The outermost layer is waterproof, and is resistant to temperature, minor injuries, chemically active substances, and many forms of bacteria

Heat Regulation

- The skin protects the body from the environment and helps maintain a 98.6° temperature
- When the body is cold, the skin pores will tighten, causing goose bumps
- When the body is hot, perspiration will cool
The Oral Cavity

1. Carefully lay the pig on one side in your dissecting pan and cut away the skin from the side of the face and upper neck to expose the masseter muscle that works the jaw, lymph nodes, which filter the blood, and salivary glands, which keep the mouth moist and break down starches. Label these on your hand-in.

2. With scissors, make a 3-cm incision in each corner of the pig's mouth. Your incision should extend posteriorly through the jaw.

3. Spread the jaws open and examine the tongue.

4. Observe the palate on the roof of the mouth. The anterior part of the palate is the hard palate, which is composed of bone and is rigid, while the posterior part is the soft palate. In man, there is a finger-like structure, the uvula, which hangs down from its center. It is absent in the pig.

5. Locate the epiglottis, a cone-shaped structure at the back of the mouth which is the opening into the trachea which leads to the lungs. This cavity carries air from the nostrils to the trachea, a large tube in the thoracic cavity which supplies air to the lungs.

6. Dorsal to the glottis, find the opening to the esophagus, the tube leading to the stomach. Examine the tongue and note tiny projections called sensory papillae, also known as taste buds.

7. Examine the teeth of the pig. Canine teeth are longer for tearing food, while incisors are shorter and used for biting. Pigs are omnivores, eating plants and animals.

8. Label the drawing of the inside of the pig’s mouth.

9. Clean up your materials and work area.

FIGURE 5.3. Interior of mouth.
The Incision

1. Place the fetal pig ventral side up in the dissecting tray.
2. Tie a string securely around a front limb. Run the string under the tray, pull it tight, and tie it to the other front limb. Repeat this procedure with the hind limbs to hold the legs apart so you can examine internal structures.
3. With your fingertips, locate the lower edges of the ribs.
4. Refer to the diagram below, which illustrates the order number of incisions you will make.
5. Make the cuts in the order of the numbers, beginning with number 1 and stopping with number 4.
6. With scissors, make the incisions in order, beginning with 1. Be sure to keep the tips of your scissors pointed upward because a deep cut will destroy the organs below.
7. Continue with incision number 2. This will bring you just above the umbilical cord. Cut around the cord (incision number 3) to avoid injury to other structures.
8. Extend incision number 4 to the rear body wall.
9. After you have made your incisions through the body wall, you will see the peritoneum, a thin layer of tissue that lines the body cavity. Cut through the peritoneum along the incision lines.
10. Spread the flaps of the body wall apart. Cut the umbilical vein which extends through the liver.
11. Once the vein is cut, carefully pull the flap of skin, including the end of the umbilical cord between the hind legs. You are now able to see the organs of the abdominal cavity.
12. Some specimens may contain excess preservative fluid and clotted blood. If so, rinse the abdominal cavity gently under running water. Dab lightly with paper towels to soak up excess water.
The Digestive System

The digestive system of the fetal pig, like that of humans, consists of the alimentary (digestive) canal and accessory organs. The alimentary canal is a “tube-within-a-tube.” It is made up of the mouth, esophagus, stomach, and intestines. There are several accessory organs secreting products that assist in digestion. These organs are the salivary glands, liver, pancreas, and gall bladder.

1. Locate the diaphragm, a sheet of muscle that separates the abdominal cavity from the thoracic cavity. Find the most obvious structure in the abdominal cavity, the brownish-colored liver. Count the number of lobes.

2. Find the tube-like esophagus which joins the mouth and the stomach. Food moves down the esophagus by muscular contractions called peristalsis after being softened by saliva in the mouth. Follow the esophagus and locate the soft, sac-like stomach beneath the liver.

3. With scissors, cut along the outer curve of the stomach. Open the stomach and note the texture of its inner walls. These ridges inside the stomach are called rugae and increase the area for the release of digestive enzymes. The stomach may not be empty because fetal pigs swallow amniotic fluid. Rinse out the stomach contents.

4. The pig has a digestive system which is classified as monogastric or nonruminant. Humans also have this type of digestive system. They have one stomach (mono=one, gastric=stomach). Locate the entrance to the stomach or esophageal area, the cardiac region which is largest, and the pyloric region where the stomach narrows to join to the small intestine.

5. At the end of the stomach, there is a sphincter, or ring-shaped muscle to control food leaving the stomach and entering the duodenum. Locate the cardiac sphincter at the junction of the stomach and esophagus, and the pyloric sphincter at the junction of the stomach and small intestine. Fetal pigs receive their nourishment from their mother through the umbilical cord.

6. Identify the first part of the small intestine, the U-shaped duodenum, which connects to the lower end of the stomach. Pancreatic juices, made by the pancreas, and bile, made by the liver and stored in the gall bladder, are added to food here to continue digestion.

7. Study the rest of the small intestine. Notice that it is a coiled, narrow tube, held together by tissue called mesentery. The soupy, partly digested food that enters the small intestine from the stomach is called chyme.

8. Carefully cut through the mesentery and uncoil the small intestine. Note and record its length in centimeters. The mid-section is called the jejunum, while the last section is called the ileum.

9. With scissors, remove a 3-cm piece of the lower small intestine. Cut it open and rinse it out.

10. Observe the inner surface of the small intestine. Run your finger along it and note its texture. Using a magnifying glass, examine the villi, the tiny projections that line the small intestine and increase the surface area for absorption of nutrients.

11. Follow the small intestine until it reaches the wider, looped large intestine. Cut the mesentery and unwind the large intestine or colon. Measure and record its length in centimeters.

12. At the junction of the large and small intestine, locate a blind pouch called the caecum. The caecum has no known function in the pig. It is a vestigial organ, like the appendix in humans.

13. Notice that the large intestine leads into the rectum, a tube that runs posteriorly along the dorsal body wall. The rectum carries wastes to the opening called the anus where they are eliminated.

14. Locate the thin, white pancreas beneath the stomach and duodenum. Pancreatic juice flows through pancreatic ducts to the duodenum.

15. Between the lobes of the liver, find the small, greenish-brown gall bladder. Locate the hepatic duct which carries bile from the liver to the gall bladder.

16. Find the spleen, a long, reddish-brown organ wrapped around the stomach. The spleen filters out old red blood cells and produces new ones for the fetus.
**Digestive System Structures**

**Liver** - This dark brown organ dominates the upper abdomen. Five lobes, or parts, of the liver can be seen. The liver produces bile, a digestive enzyme which breaks down fats.

**Gall bladder** - Lift the right central lobe of the liver to expose the gall bladder. This sac-like structure stores bile excreted by the liver and releases it into the small intestine.

**Stomach** - This muscular pouch lies on the left side in the upper abdomen. It is the continuation of the esophagus. Find the esophagus and locate where it pierces the diaphragm to join the stomach. Open the stomach with your scissors by cutting along the greater curvature of the stomach on the left side. Wash out the contents of the stomach. Look along the inner walls of the stomach and notice the folds (rugae) which help to churn and mix the food with digestive juices.

**Small Intestine** - The first portion of the small intestine is the duodenum, which is a short U-shaped tube about one centimeter in length. Villi line the walls of the small intestine, where nutrients are diffused into the blood stream to other body cells.

**Large Intestine** - At the end of the small intestine is the large intestine, which absorbs excess water. The spiral colon is the major part of the large intestine. It is shorter, darker, and thicker than the small intestine. The posterior portion of the large intestine is the rectum, which leads to the anus, where feces are excreted from the body.

**Pancreas** - Lift the main portion of the small intestine, the duodenum. Expose where the duodenum is attached to the stomach. Observe the pancreas, a glandular structure lighter in color than the neighboring intestines. Its main portion lies in the loop of the duodenum. The pancreas serves two main functions. One is to produce enzymes that digest carbohydrates, proteins, and fats. The other is to secrete hormones such as insulin. When blood glucose levels are low, glucagen is released from the pancreas. An elongated portion of the pancreas extends toward the stomach and spleen.

**Spleen** - This dark-colored organ can be seen in the left side of the abdominal cavity without moving any other organs. It lies to the left of the stomach and extends to the left. The spleen stores blood and destroys damaged red blood cells. (not in the digestive system)
The Respiratory System

Cells obtain cellular energy (ATP) from organic molecules (food) which have been ingested and digested. For this to happen, the life function of respiration is carried out. For respiration to completely occur, oxygen is necessary. Cells must therefore have a continuous supply of oxygen and means of releasing the carbon dioxide waste. Lungs accomplish this job of gas exchange. You will now dissect into the thoracic cavity, the area above the diaphragm.

1. Examine the diaphragm, a sheet of muscle that stretches across the abdominal cavity and separates it from the thoracic cavity where the lungs are located. The diaphragm isn’t used by the fetal pig because gas exchange occurs through the umbilical cord. The diaphragm in adult pigs moves up and down changing air pressure in the chest cavity causing air to move into and out of the lungs. Spasms of this muscle result in hiccups!

2. In order to see the upper part of the respiratory system, you will need to extend cut #5 up under the pig’s throat and make more lateral incisions in order to fold back the flaps of skin covering the throat. (cut #6)

3. Locate the two, spongy lungs that surround the heart. The tissue that covers and protects the lungs is called pleura. The lungs haven’t been used by the fetus so they have never contained air.

4. Find the trachea, a large air tube that lies anterior to the lungs. The trachea is easy to identify because of the cartilaginous rings that help keep it from collapsing as the animal inhales and exhales. The tube in back of the trachea is the esophagus, which carries food from the mouth to the stomach.

5. You already located the epiglottis at the top of the trachea. This flap of skin closes over the trachea whenever you swallow, so that food or water does not enter the trachea. You already located the area called the pharynx at the back of the nasal cavity. Air enters an adult pig through the mouth or nose (external nares) before passing through the pharynx and down the trachea to the lungs.

6. Notice that the trachea branches into each lung. These two tubes are called bronchial tubes. Inside the lungs these branch into smaller bronchioles that end with a grape-like cluster of air sacs or alveoli where oxygen and carbon dioxide are exchanged with capillaries.

7. Lying ventral to the trachea or windpipe, locate the pinkish-brown, oval-shaped structure called the thyroid gland. This gland secretes hormones that control metabolism.

8. At the top, anterior end of the trachea, find the hard, light-colored larynx or voice box. This organ contains the vocal cords that enable the animal to produce sound. (grunts and oinks)
The Circulatory System

1. Locate the heart. It is covered by a thin tissue called the **pericardium**. Remove this membrane to study the heart.

2. Pigs, like all mammals, have four-chambered hearts. The **right side** of the heart pumps blood to the **lungs**, while the **left side** of the heart pumps blood to all **other parts of the body**. Locate the right and left sides of the heart. **Veins** carry blood to the heart, while **arteries** carry blood away from the heart.

3. Each side of the heart has an upper and a lower chamber. Upper chambers are called **atria**, or **auricles**, and receive blood, while lower chambers are called **ventricles** and pump blood out of the heart. Locate the right and left atria and ventricle.

4. Notice that the surface of the heart is covered with blood vessels. These are part of the **coronary circulation**, a set of arteries and veins whose only job is to nourish the heart tissue. Blockage in these vessels causes heart attacks.

5. Anterior to the heart, locate another large vein that enters the right atrium. This vein, the **superior (anterior) vena cava**, brings blood to the right atrium from the anterior part of the body.

6. Now lift the heart to view its dorsal surface. Observe the **inferior (posterior) vena cava** that carries blood from the posterior part of the body and empties it into the right atrium.

7. **Find the pulmonary artery** which leaves the right ventricle. After birth, this vessel carries blood to the lungs. However, in a fetus, a shunt called the **ductus arteriosus** allows fetal blood to bypass the lungs and go directly to the aorta, the largest artery of the body.

8. **Locate the pulmonary veins** that enter the left atrium. After birth, these vessels carry oxygenated blood from the lungs to the heart.

9. **Identify the aorta**, a large artery that transports blood from the left ventricle. Many arteries that carry blood throughout the body branch off of the aorta.

10. **Remove the heart by severing the blood vessels attached to it.**

11. **Hold the dorsal and ventral surfaces of the heart with your thumb and forefinger and rest the ventricles on your dissecting tray.** With a scalpel, cut the heart into dorsal and ventral halves. **Caution:** The scalpel is very sharp. Use it carefully and always cut away from yourself.

12. **Remove any material inside the heart and expose the walls of the atria and the ventricles.**

13. **Study the internal features of these chambers and note where vessels leave or enter each chamber.** Locate the valves between each atrium and ventricle. These structures prevent blood from flowing backward in the heart.
Fact: The human heart beats 100,000 times a day.