The Intermediate Guide on the Fetal Pig

How to use this guide:

This guide is intended to guide the student through the dissection of the fetal pig in a step-by-step manner. Major organ systems are summarized in the middle portion of this guide. Illustrations are provided that will aid in the identification of structures with numbered lists. The figures are designed in a manner in which the answers to the numbered structures can be covered up for quiz purposes. Dissection instructions are in italics. A worksheet is located in the back of the guide along with an answer key. If needed, a more extensive guide, "The Taxonomy & Physiology of the Fetal Pig" is available from the Bio Company.

The fetal pig belongs to a group of animals called Class Mammalia. All mammals share certain characteristics including:

- Hair
- Specialized teeth
- Body plan of head, neck, trunk, and tail
- Bilateral symmetry
- Four-chambered heart
- Muscular diaphragm
- Paired limbs

All mammals have hair in varying degrees. Hair can be used for warmth, protection, camouflage, and to signal distress. Have you ever frightened a dog or a cat? It will make it's hair stand up to appear bigger and stronger.

A mammal has specialized teeth that reflect its diet. Carnivores generally eat meat. They have prominent canine teeth along with incisors, and molars that tear and chew the meat of their prey. Herbivores eat plants. They have high-crowned molars and incisors that are used to grind and crush plant matter. Omnivores eat both meat and plants. They have a combination of different types of teeth including incisors, canines, and high-crowned molars. Pigs and humans are considered omnivores. Look in the mouth of your pig. Do you see the beginnings of different types of teeth?

Mammals have a body plan of a head, neck, trunk, and tail (figure 2). The trunk is further divided into the thorax and abdomen. They all have paired limbs. These limbs may be legs, arms, wings, or fins. They also have an internal adaptation of a muscular diaphragm that serves to aid in negative-pressure breathing and divides the thoracic and abdominal cavities. During negative-pressure breathing, air is sucked down into the lungs when the diaphragm contracts. The result is inhalation. When the diaphragm relaxes and moves up, the air is pushed out of the lungs. The result is exhalation. You will get to see the diaphragm as part of your dissection.

Within the thoracic cavity is the four-chambered heart. That is, the heart is in four parts: the right atrium, the right ventricle, the left atrium, and the left ventricle. The left atrium and left ventricle pump blood to the lungs to get oxygen. The right atrium and right ventricle pump blood through the body.

figure 1 - Symmetry terms

All mammals exhibit bilateral symmetry, in which the animal can be divided into an equal mirror image. When referring to an animal that is bilateral, you should know the following terms in figure 1. Anterior refers to the head region, posterior refers to the tail region, dorsal refers to the back region, and ventral refers to the belly region.
The Dissection: External Features – figures 2 & 3

Materials
- Fetal pig
- Dissecting tray
- Protective gloves
- Scalpel
- T-pins
- Forceps
- Probe
- Ruler
- Apron
- String (not included)

1. Obtain a fetal pig, dissection tray, gloves and other items listed above.
2. Always wear gloves when handling the specimen.
3. Measure the body of your pig by taking the string from the tip of the snout to the base of the tail along the dorsal side.
4. Mark the length of your string and use your ruler to determine its length.
5. Determine the age of your pig by referring to the chart below.

<table>
<thead>
<tr>
<th>Age of the Fetus (in weeks)</th>
<th>Length of the Fetus</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1.1-1.3 cm</td>
</tr>
<tr>
<td>7</td>
<td>2.8-3.8 cm</td>
</tr>
<tr>
<td>14</td>
<td>22-23 cm</td>
</tr>
<tr>
<td>16-17 (full term)</td>
<td>~30 cm</td>
</tr>
</tbody>
</table>

6. Continue your observations of the external anatomy. Use figure 3 to assist in identification of structures.
7. Determine the gender of your pig and observe its structures. Use figure 3 to assist you.
8. Circle the gender of your fetal pig:
   - Male
   - Female

Figure 2 - External anatomy

1-external ears; 2-eyelid; 3-snout with nares (nostrils); 4-tongue; 5-wrist; 6-hoof; 7-elbow; 8-umbilical cord; 9-knee; 10-ankle; 11-tail
Some structures will be the same for both males and females. Under the tail, they both have an **anus**. They both have **mammary papillae**. In females, the mammary papillae function to nourish the young using milk produced by the mammary glands. In males, they never develop as in females.

If your pig is male, you will see the **urogenital opening** anterior to the **umbilical cord**. It is the passageway for urine and semen. The **scrotal sacs** are easier to see in late-term pigs. In younger fetal pigs, the testes have not yet descended into the scrotal sacs.

If your pig is female, you will see the **genital papilla**, a flap of skin ventral to the tail. At the base of this structure is the **urogenital opening**, which is the opening to the reproductive system releases urine.

**The Dissection: Internal Features** - figure 4

9. Depending on the gender of your pig, you will make incisions with your scalpel according to the graphic in figure 4. The cuts are numbered in order.

10. When initially cutting into the body, carefully score the skin. Repeat scoring, not cutting too deep, until you begin to see the organs below. Try not to cut into the liver or any other organs.

11. You will need to cut through the sternum in the center of the chest. It is still primarily composed of cartilage and should separate with minimal effort.

12. As you separate the sternum, you will notice many membranes covering the internal organs. Carefully remove them by grasping them with your forceps and cutting them away with your scissors or scalpel.

13. Try not to remove the diaphragm. It will appear as a dark brown layer in between the lungs and the liver. With your scalpel, cut the sides of the diaphragm away from the sides of the internal body wall.

14. As you go through your dissection, try not to remove any organs until absolutely necessary. Your dissection will make more sense if relatively intact.

15. Now go on to study and observe the organs of the fetal pig.
The following is a generalized summary of some of the organ systems of the fetal pig. This guide is intended to be an instructional manual on the dissection of the fetal pig and introduce some of its structures. To learn more on these systems refer to a biology or science text book.

**The Nervous System**

Many of the nerves of the fetal pig can be difficult to find. Nerves are a bundle of neurons bound together by connective tissue. They will appear as thin, white cords. Your fetal pig’s brain is too small to be studied. A sheep’s brain is usually used as a typical example of a mammalian brain. There is a separate guide available for the sheep’s brain.

**The Respiratory System**

The respiratory system is responsible for the inspiration of air and gas exchange in the body. Air contains oxygen, the gas that all mammals need in order to live. Air is inhaled through either the **mouth** or the **external nares** into the **nasopharynx**. It passes through the **larynx**, passes through the **trachea** and into the **lungs**. Once in the lungs, the air goes through a series of channels that progressively get smaller. The trachea divides into the **bronchii**, which then divide into smaller **bronchioles**. The bronchioles empty into the **alveoli**, small air cells. These converge with a network of **capillaries** that deliver oxygen via the blood to the rest of the circulatory system and return carbon dioxide to be exhaled.

![Figure 5 - Generalized circulation](image)

**The Circulatory System**

The circulatory system moves blood throughout the body. It supplies oxygen and nutrients to the cells and removes the waste gas, carbon dioxide. The heart is the major organ of the circulatory system. It has 4 parts: the left and right atria; the left and right ventricles. In general, the left side of the heart pumps blood to the lungs and the right side pumps it to the body.

Blood flows through a series of channels to transport oxygen and carbon dioxide throughout the body. In general, arteries and arterioles are thick-walled vessels that carry oxygen-rich blood away from the heart. Veins and venules are thin-walled vessels that carry oxygen-poor blood back towards the heart. The capillaries are the smallest channels where gases are exchanged with the cells.

**The Digestive System**

The digestive system is responsible for converting food into energy. Food enters the mouth and the chewing action of the teeth breaks it down. It moves through the **pharynx**, into the **esophagus**, and into the **stomach**. Within the stomach, the food is mixed with acidic gastric juices and is further broken down. From there it passes into the **small intestine**, through the **large intestine**, and out through the **anus**. The digestive glands associated with this process are the **liver** and the **pancreas**.

**The Urogenital System**

The urogenital system consists of the excretory system and the reproductive system. The excretory system removes liquid waste from the body in the form of urine. The reproductive system is responsible for producing young and differs between the male and female. The term, urogenital, is used for structures in both the excretory and reproductive systems.

**Note:** In order to see the reproductive structures you will need to cut through the pelvic girdle and spread it apart. Take care not to cut through any of the organs.

On the male pig: Depending on the age of your fetal pig, the testes may not be descended into the scrotal sac. If your pig is young, many reproductive organs may be underdeveloped and difficult to find. Have some patience and proceed in a methodical manner.
figure 6 - The body cavity - The structures in this illustration are listed on the following pages.

1-larynx; 2-trachea; 3-heart; 4-lung; 5-liver; 6-pancreas; 7-small intestine; 8-kidney; 9-large intestine; 10-spleen; 11-stomach; 12-diaphragm

note: The liver is reduced in this illustration to show some of the deeper organs
The Thoracic & Abdominal Cavities
The following structures and functions correspond with figure 6 (on the page 5).

1. Larynx – (respiratory system) The larynx is commonly called the “voice box” due to its function in producing sounds. The larynx is the connection between the nasopharynx and the trachea and provides a passageway for air. It contains the vocal cords (to see the vocal cords you may cut open the larynx with your scalpel).

2. Trachea – (respiratory system) This tube is the passageway for air that leads to the lungs. It is sometimes called the “windpipe”. The trachea lies ventral to the esophagus. It is composed of cartilage and is ribbed in appearance (in contrast to the esophagus that is smooth).

3. Heart – (circulatory system) The heart pumps blood throughout the body to provide nutrients and oxygen to the cells and remove the waste gas, carbon dioxide. The heart has four parts: the left and right atria (atrium = singular; atria = plural); the left and right ventricles. The left side of the heart pumps blood to the lungs and the right side pumps it to the body.

4. Lungs – (respiratory system) The lungs have a spongy texture and appearance. You will notice many lobes of the lungs. How many lobes does your fetal pig have?

Number of lobes in right lung: ____________

Number of lobes in left lung: ____________

(Humans have five lobes: three in the right lung and two in the left lung; your pig has seven: three on each side and one in the middle). The lungs function in respiration to add oxygen and remove carbon dioxide from the body.

5. Liver – (digestive gland) The liver is the most prominent organ of the body cavity. You will notice many lobes of the liver. The human liver has four lobes. How many lobes do you see? Use your blunt probe to carefully move aside the intestine to see all the lobes.

Number of liver lobes: ____________

The liver has many functions. It regulates the chemical composition in the blood. It contains cells called hepatocytes that detoxify poisons such as alcohol. The liver secretes a substance called bile, which is a solution of salts, cholesterol, and other components. Bile functions in the digestion and absorption of fats. The liver also stores and regulates sugar, iron, copper, and vitamins A, B12, D, E, and K. Old red and white blood cells are “eaten” in a process called phagocytosis.

6. Pancreas – (digestive gland) The pancreas secretes pancreatic (digestive) juices into the small intestine through the pancreatic duct. This duct is too small to be seen in the fetal pig. The pancreas also produces insulin, glucagon, and other hormones that are important in the regulation of sugar levels and the metabolism of fats and carbohydrates. The pancreas is located beneath the small intestine. You may need to push aside the small intestine to see it. This structure is cream in color and lumpy in texture.

7. Small intestine – (digestive system) The small intestine is the site of nutrient absorption and digestion. The length of the human small intestine is ~20 feet. In order to compare the human intestine and fetal pig intestine, cut away the small intestine and measure it. Make sure to convert your measurement into feet for a direct comparison.

Length of the small intestine: ____________
3. Kidney – (excretory system) The kidney removes substances such as ions, water, urea and other wastes.

9. Large intestine – (digestive system) The large intestine digests bacteria, reabsorbs water, and forms feces.

10. Spleen – The spleen is a dark brown flap to the left of the stomach. It is part of the system of macrophage cells. Macrophage cells "eat" and digest dead cells in a process called phagocytosis. The spleen's cells phagocytize old red blood cells, platelets, and bacteria. It removes iron and other useful components from blood cells. The spleen also helps the immune system.

11. Stomach – (digestive system) The stomach releases acids that break down food. It is divided into three regions: the cardiac end, the fundus, and the pyloric end. The cardiac region is attached to the esophagus in the anterior end of the stomach. The fundus makes up the body of the stomach. The pyloric region leads to the small intestine and is the posterior end of the stomach.

12. Diaphragm – (respiratory system) This muscular flap separates the thoracic and abdominal cavities and functions in negative pressure breathing. Air is pulled down into the lungs through the contraction of the diaphragm and results in inhalation. When the diaphragm relaxes and moves up, the lungs are restored to their smaller volume, which results in exhalation.

13. Esophagus (not pictured) – (digestive system) The esophagus delivers food from the mouth to the stomach. It lies dorsal to the trachea. Unlike the trachea, it is smooth and muscular in appearance.

The Urogenital Structures
The following structures correspond to figure 7 on page 8 (note: some structures that are listed are not part of the urogenital system: the arteries, veins, aorta, and vena cava.)

1. Renal arteries & veins – (circulatory system) These vessels supply blood to and from the kidneys.

2. Vena cava – (circulatory system) The vena cava extends into the upper and lower extremities of the body. It transports deoxygenated blood from the lower body to the right atrium.

3. Aorta – (circulatory system) The aorta supplies highly oxygenated blood into the lower extremities of the body.

4. Adrenal gland – (excretory system) The adrenal gland produces hormones, regulates salt balance in the body, and functions in the "flight or fight" stress response.

5. Kidney – (excretory system) The kidney functions in the excretion of substances such as ions, water, urea and other wastes.

6. Ureter – (excretory system) The ureter is an extension of the renal pelvis that transports urine to the urinary bladder.

7. Fetal urinary bladder – (excretory system) In fetal mammals the urinary bladder is also called the allantoic bladder. Waste is transferred from the fetus to the mother through the allantoic duct through the umbilical cord.

8. Umbilical arteries – (circulatory system) These vessels carry partially oxygenated blood from the mother through the umbilical cord to the fetus.

9. Urethra – (urogenital system) In a non-fetal animal, the urethra transports urine from the urinary bladder to the urogenital opening.

10. Ductus deferens – (reproductive system) The ductus deferens is sometimes called the vas deferens. This tube transports sperm from the testis to the urethra.
11. **Testis** – (reproductive system) The testis is the site of the production of sperm and the hormone testosterone. *In a young pig, the testes can be mistaken for the ovaries of the female due to their bean shape and location high in the abdominal cavity. As the fetal pig matures, the testes descend into the scrotal sacs. In older fetal pigs, the scrotal sac must be opened to view the testis.*

12. **Scrotal sac** – (reproductive system) The scrotal sac is also referred to as the scrotum. This sac houses the testis and related structures.

13. **Penis** – (urogenital system) The penis extends from the urethra. In adult animals, it is the passageway for both sperm and urine to the external environment.

14. **Ovary** - (reproductive system) The ovary is the site of oogenesis and production of the hormones progesterone and estrogen.

15. **Uterine horn** – (reproductive system) The arms of the "Y" that connect the uterus with the oviducts. It is in the uterine horn that the fetus develops.

16. **Uterus** – (reproductive system) The uterus is the site of menstruation in mature animals. It is where the fertilized egg implants and grows from an embryo to a fetus. In this stage it is often called a womb. The uterus is composed of three parts: the **uterine horn**, the **uterine body**, and the **cervix**, a small constriction between the uterus and the vagina.

17. **Vagina** – (reproductive system) The vagina receives the penis during copulation.
On a separate piece of paper, answer the following:

**Short answer:**
1) Name the four chambers of the heart.
2) Name the seven features of mammals listed in this guide.
3) Describe the differences between carnivores and herbivores. Include tooth structure in your answer.
4) Name the three regions of the stomach.
5) Name the two major glands of the digestive system.
6) Using your dissected specimen, find the following structures and name their functions:
   *(To check this section, the tester may use figure 8)*
   - Larynx
   - Liver
   - Spleen
   - Pancreas

**True or False** – if the answer is false, make a statement to make it true.
7) T F Humans are herbivores.
8) T F The ureter transports urine from the kidney to the urinary bladder.
9) T F A male pig has genital papilla.

**Matching** – Match the structure with its appropriate system.
10) _______ Ureter
11) _______ Trachea
12) _______ Esophagus
13) _______ Vena Cava
14) _______ Ductus deferens
15) _______ Uterus

- a) Respiratory
- b) Reproductive (male)
- c) Circulatory
- d) Reproductive (female)
- e) Digestive
- f) Excretory