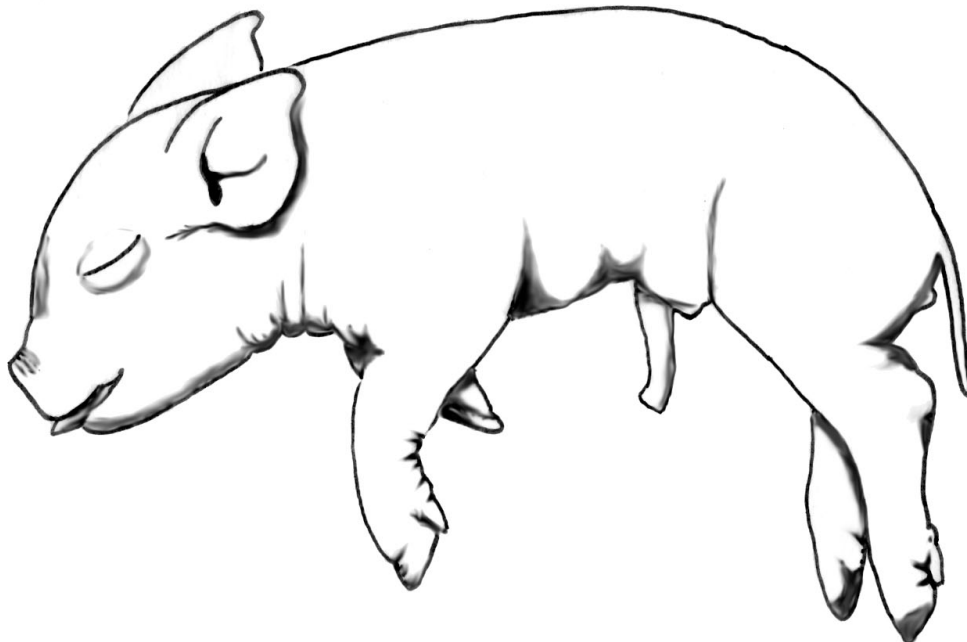


Biology 2108
Laboratory Exercises: Variation in Natural Systems

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LABORATORY 5
Anatomy: Fetal Pig Dissection



OVERVIEW OF LAB

Like cells and ecosystems, organisms are units composed of many parts that interact and function together. The organism as a whole is composed of organ systems, such as the nervous system, and the circulatory system. Organ systems are composed of organs (such as the brain and the heart), and these, in turn, are made up of tissues. The small intestine, for example, is made up of epithelial, connective, and muscle tissues arranged in concentric circles.

In this lab, you will dissect a fetal pig, examining the general anatomy of a vertebrate. In addition to the dissection, you will look up the functions of specific organs in order to understand how they work with one another. Learning skills is an important component of most lab courses. So far, for example, you have had practice in designing experiments, taking accurate measurements, and using statistics. In this lab you will learn how to dissect and how to use a microscope.

Carefully read and follow the directions given. You will receive two grades for this lab. The first will be an evaluation of your dissection based on the thoroughness and correctness of your work. The second will be your score on a lab practical.

REMEMBER: You will be denied access to the laboratory if you are not appropriately dressed. Shorts, short skirts and open-toed shoes **are not** allowed. You must wear safety glasses and gloves (provided in lab). **Students may wish to purchase their own gloves and dissecting tools. Safety glasses will be provided.**

DISSECTION OF THE FETAL PIG

Dissection Tools – scissors, forceps, blunt probe. The following is a list of structures which you must locate. You are also responsible for the function of structures with an asterisk. These functions can be found in your text and in the supplemental laboratory manuals in the lab.

<u>Structure</u>	<u>Function or Special Features</u>
A.	External Anatomy
	head
	neck
	trunk
	appendages
	tail mouth
	lips
	cheeks
	external nares
	eyes
	eyelids
	auricle
	external acoustic meatus
	thorax
	abdomen
	umbilical cord
	prepuce orifice
	scrotum
	anus
	labia
	genital papillae
	vulva
	mammary papillae
	hooves
	wrist
	ankle
	elbow
	knee

Structure**Function or Special Features****B.****Internal Anatomy****Digestive and Respiratory Systems**

masseter
parotid gland
epiglottis*
teeth
tongue
papillae of tongue
hard palate
soft palate
oral cavity
nares (nasal cavities)
nasal septum
pharynx
larynx*
thymus*
vocal cords
trachea
glottis
thyroid*
esophagus
diaphragm*
coelom
pleural cavities
lungs*
pericardial sac
parietal pleura
visceral pleura
parietal pericardium
visceral pericardium
visceral peritoneum
mesenteries
liver*
umbilical vein*
umbilical arteries*
gall bladder*
stomach*
lesser curvature
greater curvature
greater omentum
spleen*
pyloric valve*
duodenum*
jejuno-illum*
pancreas*
colon*
caecum
rectum*
anus

Structure **Function or Special Features**

C. Heart and Great Vessels

coronary arteries and veins*
right and left atria*
right and left ventricles*
cranial and caudal vena cava*
pulmonary trunk*
pulmonary artery
pulmonary vein
aorta*

D. Excretory System

kidneys*
adrenal gland*
ureter*
urinary bladder*
urethra*

E. Reproductive System

scrotum*
testes*
inguinal canal
epididymis*
ductus deferens*
spermatic cord
glans penis
prepuce
ovaries*
uterine tube*
horn of the uterus
body of the uterus*
vagina
vestibule

INTRODUCTION

As you begin to dissect the fetal pig, you must keep in mind the purpose of a dissection. In a dissection, you expose important structures in order to see their relationship to each other. It is, therefore, important not to destroy or remove organs and to accomplish the dissection so carefully that another student would be able to locate all of the structures in their appropriate location.

You will only use scissors to make the initial incisions. Most of the rest of the dissection can be completed using the blunt probe and forceps.

During the reading of the instructions, you will find several terms to be useful. They are defined below:

superficial fascia -	the loose connective tissue beneath the skin and surrounding organs. This material can be picked away with forceps.
adipose tissue -	fat beneath the skin
right and left -	the pig's right and left
medial -	the midline of the body or toward the midline of the body
lateral -	toward the sides of away from the midline of the body
superficial -	close to the surface of the body
deep -	further from the surface of the body
anterior (cranial) -	toward the head
posterior (caudal) -	towards the tail
ventral -	belly surface
dorsal -	back surface
distal -	point of a structure, usually on a limb, farthest from the midline
proximal -	point of a structure closest to the midline

EXTERNAL ANATOMY

Examine the body of the pig and note that it consists of 4 basic sections; the head, neck, trunk, and tail. Two pairs of appendages are attached to the trunk.

Look at the head and locate the mouth surrounded by lips and cheeks which help the young to nurse. At the end of the snout are the **nares**, and cranial and lateral to them are the eyes with eyelids. Make a small incision in the medial corner of the eye and by pulling the eyelids apart, locate the **nictitating membrane** which helps to keep the eyeball clean. Lateral on the head opposite the **auricle** which helps to gather sound waves and the opening of the ear, the **external acoustic meatus**.

The trunk of the pig consists of a cranial **thorax**, a caudal **abdomen**, and a dorsal **lumbar region**. On the ventral surface of the fetal pig, locate the **umbilical cord** which connects to the placenta.

The male pig has a **prepuce orifice** of the **penis** and the **scrotum** both caudal to the umbilical cord. The **female** pig has a common opening to the urinary track and **vagina** located between the folds or **labia**. The labia come together ventrally to form the **genital papilla**. The external genitals of the female are called the vulva. In both sexes locate the end of the digestive track, the **anus**, and the five or six pairs of **mammary papillae**.

Observe the appendages attached to the trunk. The pig is called an ungulate because it walks on the tips of its toes. Notice the elongation of the feet and how the wrist and ankle are carried off the ground. They are easily confused with the elbow and knee.

INTERNAL ANATOMY

A. Digestive and Respiratory Systems

Systems consist of organs which are grouped together to perform a specific function. The digestive system is responsible for the mechanical and chemical hydrolysis (digestion) of the food we eat and for the absorption of nutrients. Gases are exchanged by the respiratory system. The oxygen is needed by the body to help produce energy and the carbon dioxide is a waste product of this energy production.

Carefully remove the skin from one side of the head and neck in order to expose the **salivary glands**, often confused with the muscles. Glandular tissue has a lumpy appearance while muscle tissue can be recognized by parallel stripes caused by the arrangement of the muscle cells into bundles. You may first notice the large **masseter muscle** at the angle of the lower jaw. There are several different salivary glands but the one easiest to locate is the **parotid gland** located just caudal to the masseter muscle.

Insert your scissors into the angle of the lips on the side of the head not yet dissected. Make an incision following the curvature of the **tongue** being careful not to cut into the roof of the mouth. You may need to cut through the other cheek in order to open the mouth enough to expose all of the structures. Continue cutting until you locate the **epiglottis**, a small flap of tissue extending dorsally from the floor of the mouth.

Continue your incision until the floor of the mouth and pharynx swings open. In the mouth locate the teeth and tongue. On the tongue surface observe the variously shaped **papillae**. The roof of the mouth is formed by a cranial **hard palate** and a caudal **soft palate**.

Ventral to the hard palate is the oral cavity. Dorsal to the hard palate are the paired **nasal cavities** separated by a vertical **nasal septum**. A common passageway for both the respiratory and digestive systems is the **pharynx** (pronounced “fair inks”). Caudal to the pharynx, two openings can be observed. The more ventral opening is the **larynx** (pronounced “lair inks”), passageway for air. The more dorsal opening is the **esophagus**, passageway for food. To expose this area, make a midventral incision from the chin to the front of the sternum or breastbone. Carefully remove the skin and muscle tissue from the incision area and the one you made to open the mouth and pharynx. As you perform this dissection, you will expose the **thymus**, a large gland on each side of the neck.

Once you have completed the above dissection, observe the larynx again and locate the cartilages supporting it. Again, locate the epiglottis, the flap of tissue at the entrance to the larynx. Cut open the larynx by making a longitudinal, midventral incision. Spread the larynx open and locate the pair of small white folds on the lateral walls. These are the **vocal cords**. The passage between the vocal cords is called the **glottis**. Caudal to the larynx is the windpipe or **trachea**.

Covering the trachea is the small, dark **thyroid gland**.

In order to observe the other respiratory and digestive system organs, you will next open the body cavity.

Observe the diagram “Opening the Body Cavity” to see where to make the incisions on the pig. The arrows indicate the direction in which your cuts should be made. First, make a shallow outline of the incision path; then, use your scissors and make the incisions. After you have completed incision 1, make incision 2 just in front of the umbilical cord. Extend them caudolaterally to the mammary papillae. Lying between these two incisions is a midventral strip of tissue that contains the umbilical arteries, the urinary bladder and, if your pig is a male, the penis. Turn this strip of tissue back by cutting the umbilical vein which is located cranial to the umbilical cord and extends to the liver. The vein should be cut near the umbilical cord which will leave a long stump attached to the liver. Incision 3 is a short cut which extends from the cranial end of the umbilical cord to the caudal end of the sternum. Now you can examine part of the body cavity and locate the **diaphragm**. The diaphragm forms a partition between the abdominal and thoracic cavities. Feel the attachment of the diaphragm to the **rib cage**. Make lateral incision 4 just caudal to where the diaphragm attaches to the rib cage and continue the incision to the back muscles. If this incision has not disconnected the diaphragm from the body wall, disconnect it now by carefully cutting the attachment close to the body wall on both sides of the body. Make incision 5 just lateral to the **sternum** and pull open the thoracic cavity by carefully cutting the membranes that hold the thoracic organs to the ventral thoracic wall. Bend back the flaps of the body wall, and if necessary, wash out the coagulated blood.

The body cavity or **coelom** is now exposed and contains the thoracic and abdominal organs which you will be examining. Cranial to the diaphragm and on either side of the thoracic cavity are the two lateral **pleural cavities** containing the **lungs**. Between these two cavities is a **pericardial cavity** which contains the **heart**. You will need to cut open the pericardial cavity to expose the heart. Next note that the coelom is lined with a shiny tissue and that this tissue also covers the organs. This is epithelial tissue which covers and lines all parts of the body. Skin is another example of epithelial tissue. Epithelial tissue is important for protection of body parts and also can produce some secretions. It has different names depending on its location. The epithelial tissue which lines a body cavity is called parietal while that covering body organs is called visceral. The epithelial tissue in the thoracic cavity is called pleura, in the pericardial cavity is called pericardium and in the abdominal cavity peritoneum.

Use this terminology and write the names of the epithelial tissues listed below:

Lining the pleural cavities -

Covering the lungs -

Lining the pericardial sac -

Covering the heart -

Lining the abdominal cavity -

Covering abdominal organs -

You will also note that the organs are somewhat connected to each other by thin membranes called **mesenteries**. Each mesentery is composed of a double layer of peritoneum between which are located blood vessels and nerves.

Return to the trachea and note that it extends caudally and then divides into two branches, the **bronchi** each extending to a **lung**. The bronchi cannot be observed easily and you will have to lift the heart in order to see them. Note how each lung is divided into lobes. Count to see how many each has.

You will next observe organs in the abdominal cavity. The large organ which fits under the diaphragm is the **liver**. Note the large **umbilical vein** running from the body wall into the liver. The **gall bladder** is imbedded in the liver. If you pull the liver cranially, you will be able to see the **stomach**. The short border of the stomach on the right side is called the **lesser curvature** while the long border on the left side is called the **greater curvature**. Attached to the greater curvature is a large mesentery called the **greater omentum**. Lying in a part of this greater omentum to the left of the stomach you will find an elongated body called the **spleen**. Cut open the stomach and wash it out. Just cranial to where the stomach and intestine join, locate the **pyloric valve**.

The first part of the **small intestines** is the **duodenum**. It extends caudally, crosses to the left side of the body, ascends toward the stomach and next turns caudally. The **jejunum-ileum** begins where the small intestine begins this caudal turn. Locate the **pancreas** in the loop of the duodenum. Eventually the small intestine joins with the **large intestine** or **colon**. At the junction of the small and large intestines find a short blind sac, the **caecum** (pronounced "see kum"). The terminal portion of the large intestine is called the **rectum** which terminates on the body surface and the **anus**.

You have now observed all of the major organs of the respiratory and digestive systems. In order to better understand the relationship of the organs to each other, complete the following:

Starting with nares, list in order the parts of the respiratory system through which air passes.

Starting with the mouth, list in order the parts of the digestive system through which food passes. This food tube is also called the alimentary canal.

Various organs and structures assist in the digestion of food. Make a list of these accessory parts:

B. Heart and Great Vessels

The heart functions to pump blood to the various parts of the body. In the adult the right side of the heart receives deoxygenated blood from the body and pumps it to the lungs where it is oxygenated. The left side of the heart receives this oxygenated blood and pumps it to the rest of the body.

Carefully remove the thymus from the heart and cut away the pericardial sac. The heart consists of a right and a left side. On the ventral surface of the heart is a groove containing the coronary arteries and veins. On the left side of this groove is the left ventricle and on the right side is the right ventricle. Cranial to the ventricles are the right and left atria whose ear-shaped, dark auricles are easily located. The cranial vena cava is the large vein which enters the right atrium. The caudal vena cava perforates the diaphragm and also enters the right atrium. The pulmonary trunk leaves the cranial end of the right ventricle and curves dorsally between the auricles. Dorsal to the pulmonary trunk, locate the aorta. Note that the aorta leaves the left ventricle.

Using the information provided above, trace the flow of blood from the cranial and caudal vena cavae to the aorta:

In a fetus, the pulmonary trunk is connected to the aorta and blood bypasses the lungs. Why is it not necessary for blood to flow to the fetal lungs?

C. Excretory Systems

The excretory system is important in maintaining homeostasis for the organism. Nitrogenous wastes are removed while water, salt, pH and many important parameters are regulated by the excretory system.

Along the ventral surface of the back muscles locate the pair of **kidneys**. They actually lie dorsal to the peritoneal cavity. Just adjacent to the craniomedial border of each kidney, locate the band-like adrenal gland. A **ureter** is attached to each kidney in the indented medial border. Trace the ureter caudally to where it joins with the **urinary bladder**. The **umbilical arteries** are located along the lateral boundaries of the urinary bladder. The caudal end of the urinary bladder narrows to form the **urethra**.

D. Reproductive Systems

The reproductive system is responsible for the production of hormones important in the male and female, and of gametes (egg and sperm). It also contains organs for copulation, and in the female, organs for the protection of the developing organism and its eventual birth.

** You are responsible for the structure of both sexes. We suggest that after you have carefully dissected your specimen, you share your dissection with a member of the class who has dissected the opposite sex.

Male:

Ventral to the anus, locate the external pouch, or **scrotum**, which contains the testes. In the fetal pig, the testes may not have descended into the scrotum. During the development, the testes begin their descent from their position caudal to the kidneys and migrate through an opening, the **inguinal canal**. Locate a testes either in the scrotum or in the abdominal cavity and cut through its covering to expose and trace it caudally to where it joins with the **ductus deferens**. Trace the ductus deferens to where it disappears behind the bladder. The ductus deferens, testicular blood vessels and nerves form a bundle between the testis and inguinal canal known as the **spermatic cord**. In the midventral strip of body wall that contains the urinary bladder, locate the **penis**. Cut open the preputial orifice and on the distal end of the penis locate the glans penis.

Female:

Caudal to the kidneys locate a pair of small nodule-like organs, the **ovaries**. At the caudal end of the ovary, find the small and highly convoluted uterine tube. As you trace the uterine tube caudally, it joins with the **uterine horns**. The uterine horns from each side of the body join caudally to form the body of the **uterus**, which lies dorsal to the urethra. You must now open the pelvic cavity to see the rest of the system. Cut vertically down along the midventral line through the pelvic muscles and girdle. Spread the legs apart and open the pelvic cavity. Separate the **urethra** from the body of the uterus. You will be able to see the vagina into which the uterus leads. The **vagina** and the urethra unite to form a common passageway, the **vestibule**.

Figure 1 - External anatomy (lateral view)

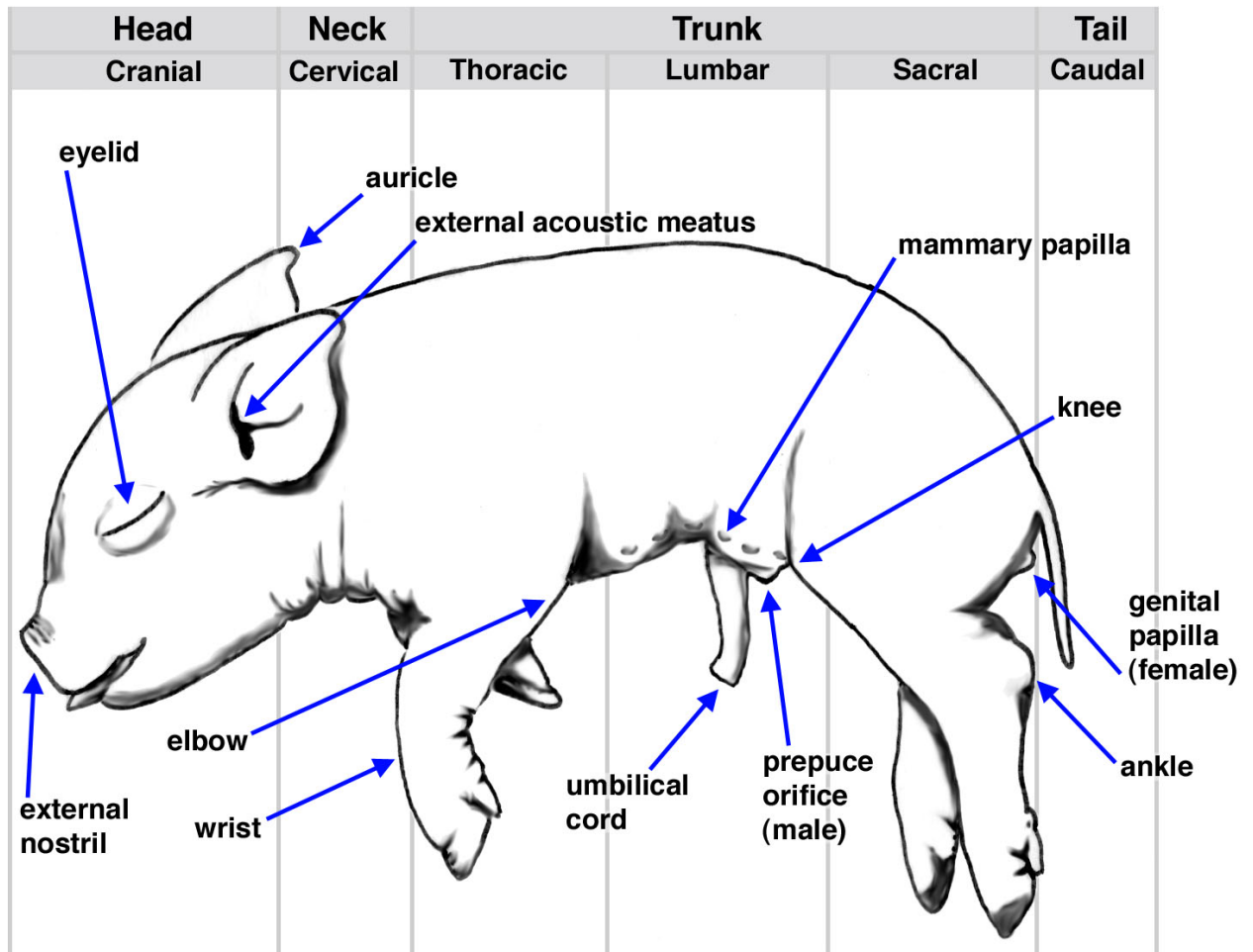


Figure 2 - Salivary glands (lateral view)

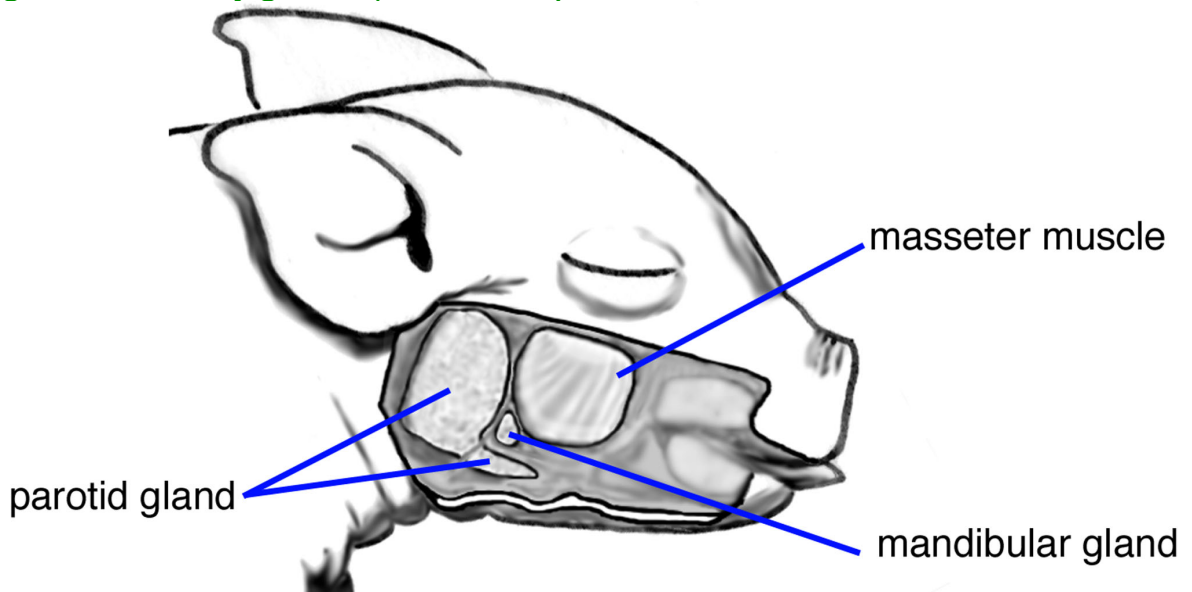


Figure 3 - Oral cavity and pharynx (ventral view, lower jaw reflected)

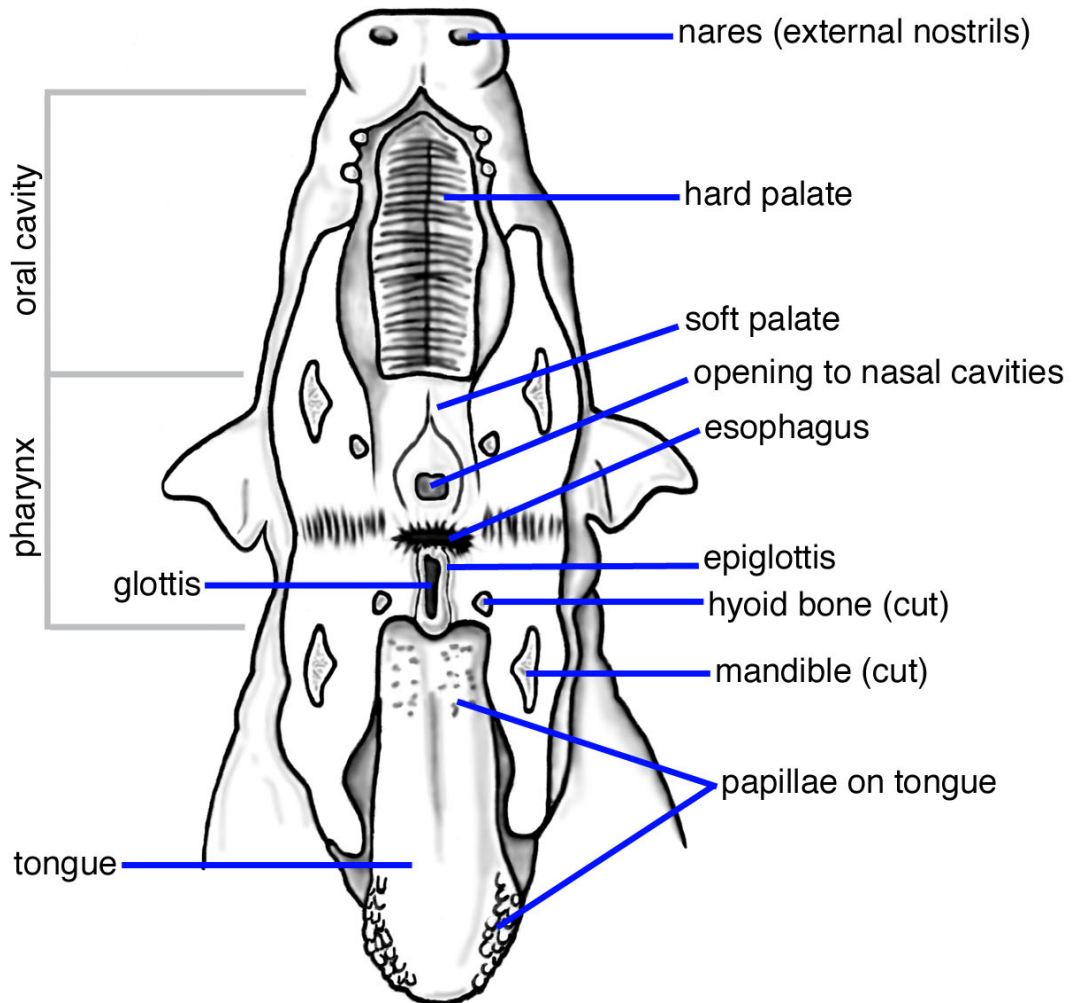


Figure 4 - Opening the Body Cavity (ventral view)

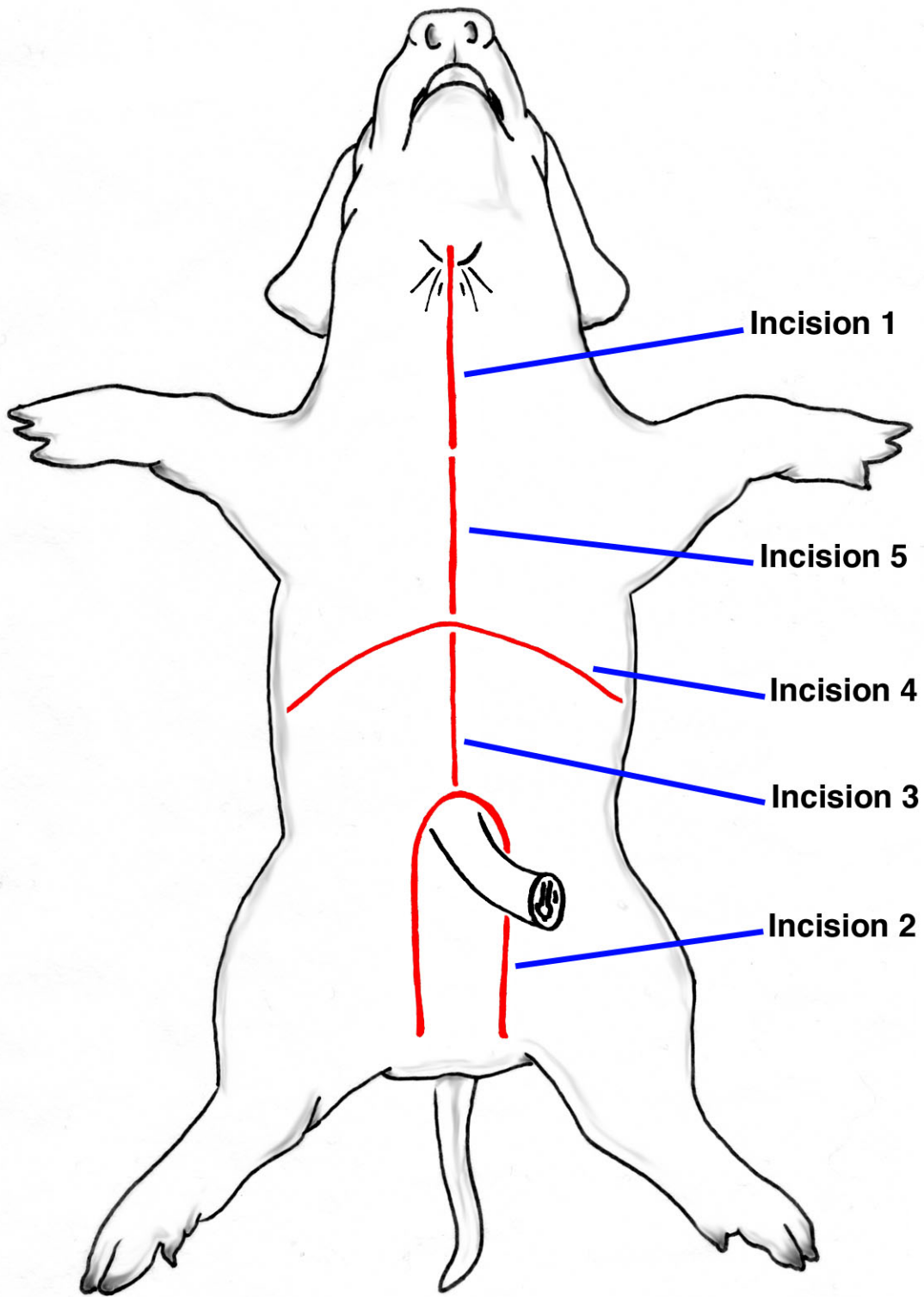


Figure 5 - Thoracic and Abdominal Organs (ventral view)

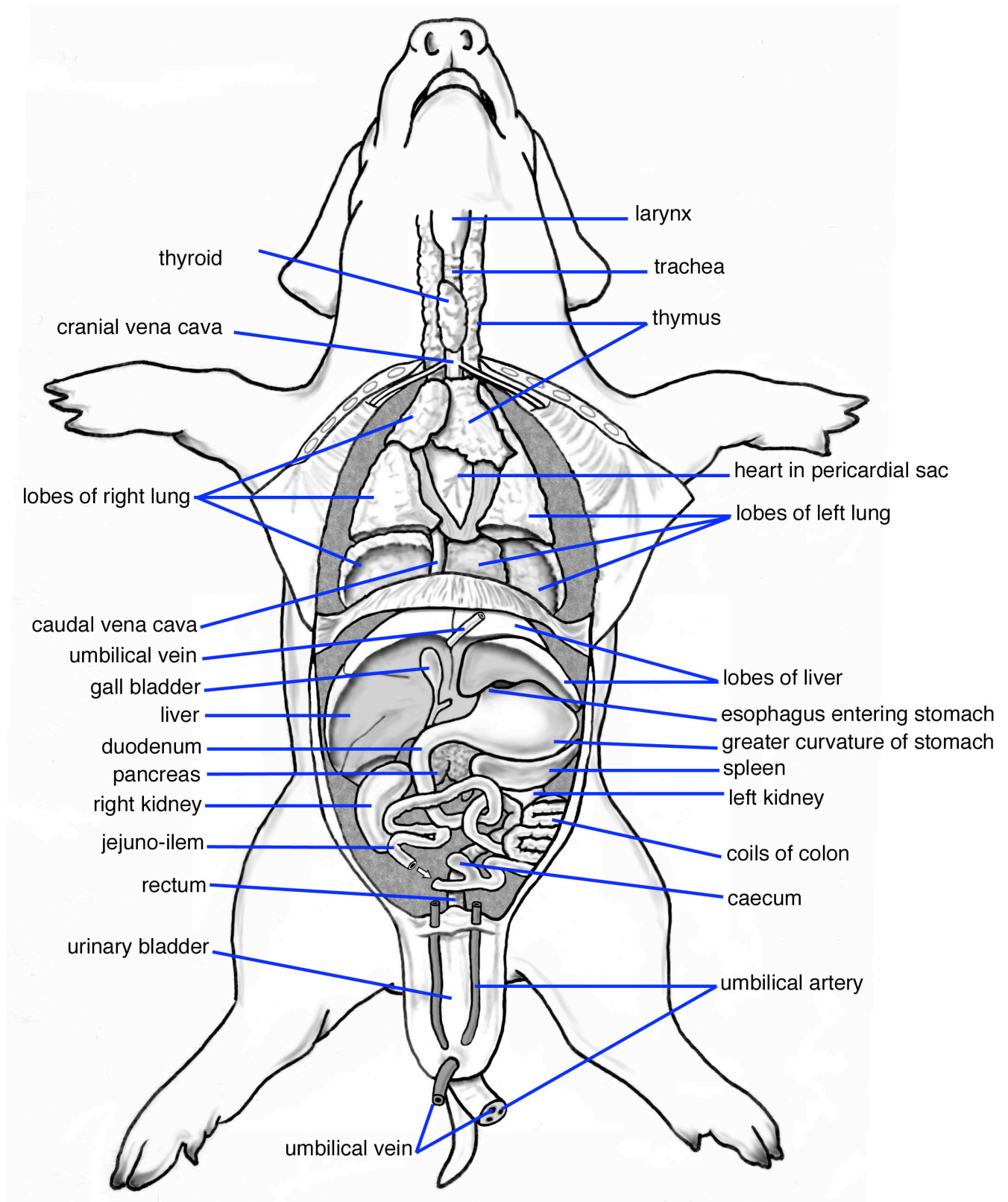


Figure 6 - Heart and Associated Vessels (ventral view)

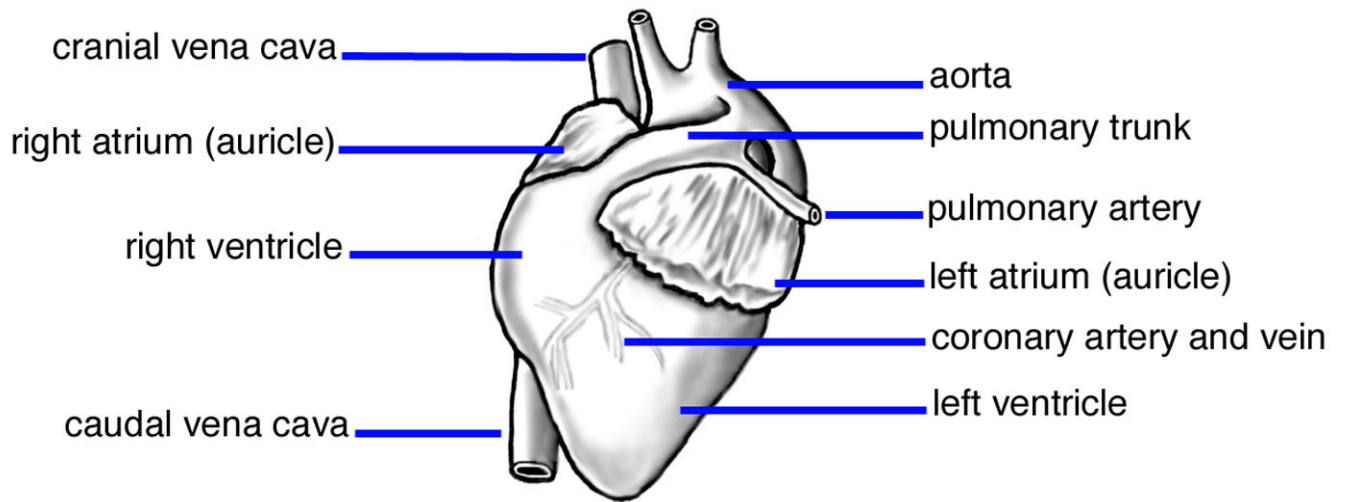


Figure 7 - Excretory and Reproductive (Urogenital) Systems – Male

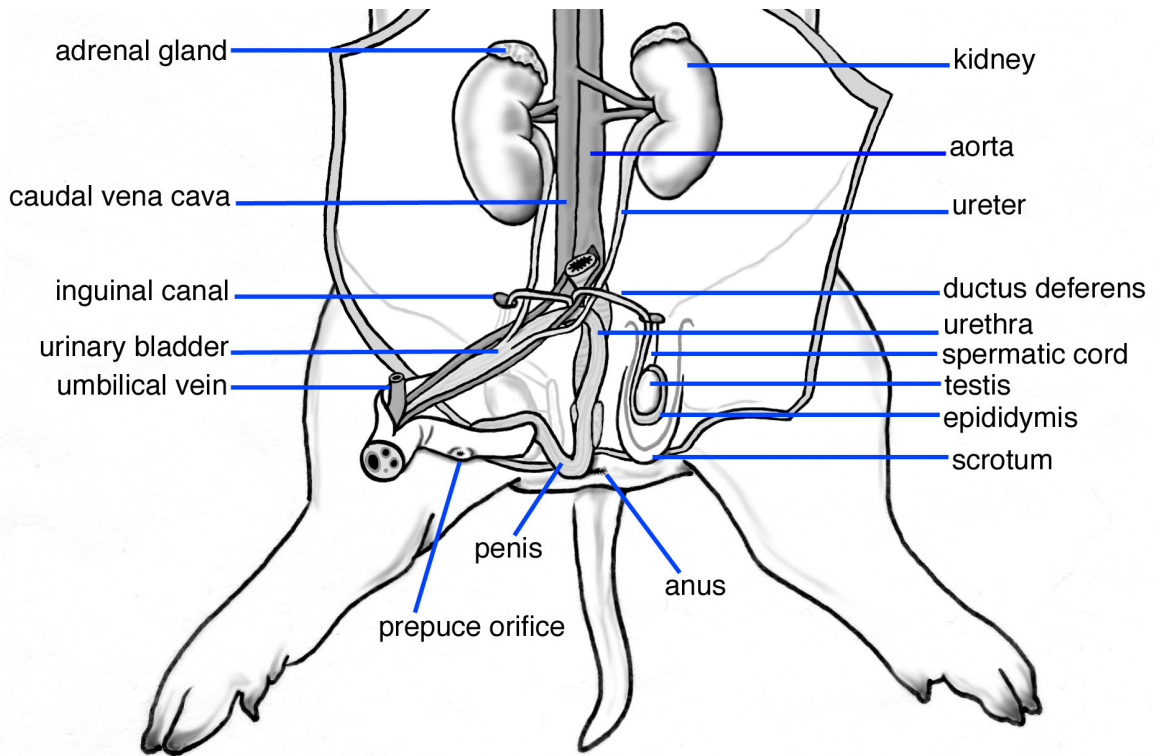


Figure 8 - Excretory and Reproductive (Urogenital) Systems – Female

