In Class Manual
Dissection of the Rat

Grading

Your grade on this laboratory will be assessed according to the following criteria

1. Class Participation
   (serious approach, proper cleanup and lab safety)
2. Lab Checklist
3. Quizzes throughout
4. Lab Practical Exam (at the end of lab)

DO NOT WRITE IN THE MANUAL
It can be accessed on the sternmass.org website

Introduction

In this laboratory exercise, the anatomy of the rat will be examined in some detail. You may recall that in your first year biology course you dissected a frog ir a fetal pig. You may recognize and remember structures that you learned during that dissection. You will get to know and love your preserved rat over the course of this dissection.

The classification of the Rat (*Rattus norvegicus*)

Kingdom *Animalia*
Phylum *Chordata*
Subphylum *Vertebrata*
Class *Mammalia*
Order *Rodentia*
Family *Muridae*
Genus *Rattus*
Species *norvegicus*

The lab books and diagrams available to you are supplemental. You are expected to follow the directions in this lab. You will be held responsible for being able to locate all the structures. You are expected to have exhausted all possibilities in attempting to located structures before asking for assistance. Using the available material, instructions and diagrams, most students will be able to locate many structures for themselves. If after an earnest effort, you cannot find a structure, ask for assistance. Remember, this is a learning experience, it is quite permissible to discuss and observe other students' specimens. Compare you dissection with others, for animals often differ, ***be sure to look at animals of the opposite sex, you will be responsible for both sexes on the lab practical.***

The specimen you will receive is a preserved double-injected specimen. Double injected refers to the arteries being filled with a red latex, and the veins being filled with blue latex. You will notice various incisions on the external surface of the rat where the latex was injected.

The rat is a vertebrate, which means that many aspects of its structural organization are common with all other vertebrates, including man. The similarity of structures among related organisms shows evidence of common ancestry. In a way, studying the rat is like studying a human. As the leading theme of this lab, ask yourself: for every structure observed in the rat, there is an equivalent structure in your own body - what is the structure and where is it located.

As the second leading theme, pay particular attention to the relationships among organs and groups of organs. Structural parts are not "just there" in random locations. Their specific layout within the body contributes to making certain functions possible. Therefore, for every structure seen, you should determine the following:

* What organ system it belongs to
* How it is connected with other components
* Its general function
* Its specific function (if applicable)

Dissection

Dissecting tools will be used to open the body cavity of the rat and observe the structures. Keep in mind that dissecting does not mean "to cut up"; in fact, it means "to expose to view". Careful dissecting techniques will be needed to observe all the structures and their connections to other structures. You will not need to use a scalpel. Contrary to popular belief, a scalpel is not the best tool for dissection. Scissors serve better because the point of the scissors can be pointed upwards to prevent damaging organs underneath. Always raise structures to be cut with your forceps before cutting, so that you can see exactly what is underneath and where the incision should be made. Never cut more than is absolutely necessary to expose a part.

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Glossary of Terms

Dorsal: toward the back
Ventral: toward the belly
Lateral: toward the sides
Median: near the middle
Anterior: toward the head
Posterior: toward the hind end (tail)
Superficial: on or near the surface
Deep: some distance below the surface
Sagittal: relating to the midplane with bisects the left and right sides
Transverse: relating to the plane separating anterior and posterior
Horizontal: relating to the plane separating dorsal and ventral
Proximal: near to the point of reference
Distal: far from the point of reference
Caudal: toward the tail end
Pectoral: relating to the chest and shoulder region
Pelvic: relating to the hip region

Dermal - relating to the skin
Longitudinal - lengthwise

Right & Left - refers to the specimen's right and left, not yours
Abdominal Cavity - related to the area below(posterior) the ribcage
Thoracic Cavity - related to the area above(anterior) the ribcage.

Rat External Anatomy

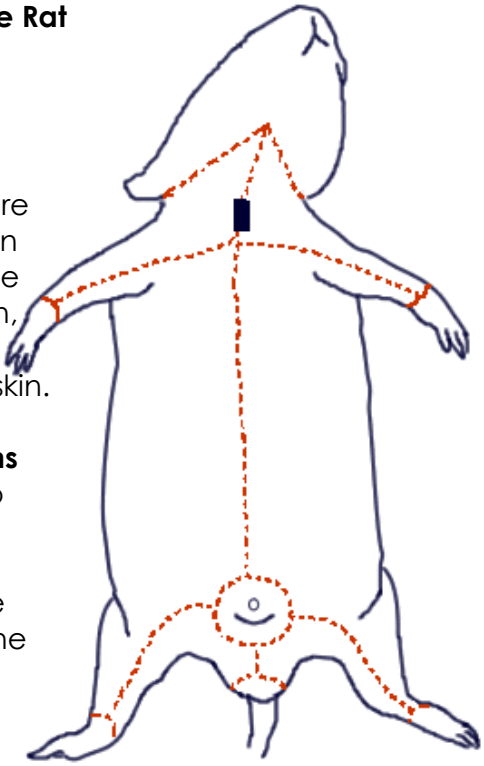
⇨ Procedure: Obtained your rat. Rinse it off with water ***if*** *necessary* and place it in your dissecting pan to observe the general characteristics. Make sure you know each of the **bolded** words.

The rat's body is divided into six anatomical regions:

cranial region - head
cervical region - neck
pectoral region - area where front legs attach
thoracic region - chest area
abdomen - belly
pelvic region - area where the back legs attach

1. Note the hairy coat that covers the rat and the sensory hairs (whiskers) located on the rat's face, called **vibrissae**[1].
2. The mouth has a large cleft in the upper lip which exposes large front **incisors**[2]. Rats are gnawing mammals, and these incisors will continue to grow for as long as the rat lives.
3. Note the eyes with the large **pupil**[3] and the **nictitating membrane**[4] found at the inside corner of the eye. This membrane can be drawn across the eye for protection. The **eyelids**[5] are similar to those found in humans.
4. The ears are composed of the external part, called the **pinna**[6], and the **auditory meatus**, the ear canal.
5. Locate the **teats**[7] on the ventral surface of the rat. Check a rat of another sex and determine whether both sexes have teats.
6. Examine the tail, the **tails**[8] of rats do not have hair. Though some rodents, like gerbils, have hair on their tails.
7. Locate the **anus**[9], which is ventral to the base of the tale.
8. On female rats, just posterior to the last pair of teats, you will find the **urinary aperture** and behind that the **vaginal orifice** which is in a small depression called the **vulva**[10].
9. On males, you will find a large pair of of **scrotal sacs**[10] which contain **testes**. Just anterior to the scrotal sacs is the prepuce, which is a bulge of skin surrounding the penis. The end of the penis has a **urogenital orifice**, where both urine and sperm exit.

The Muscular and Skeletal System of the Rat



Procedure: Skinning the Rat

You will carefully remove the skin of the rat to expose the muscles below. This task is best accomplished with scissors and forceps where the skin is gently lifted and snipped away from the muscles. You can start at the incision point where the latex was injected and continue toward the tail. Use the lines on the diagram to cut a similar pattern, avoiding the genital area. Gently peel the skin from the muscles, using scissors and a probe to tease away muscles that stick to the skin.

Muscles are attached to bones by connective tissue called **tendons** that adhere to spines, knobs, and ridges on bones. You will need to refer to the rat skeleton to determine where the muscles are attached to bones. The end attached to the bone that does not move during contraction is called the origin. The end of the muscle that attaches to the bone that does move is called the insertion. The movement caused by the contraction of the muscle is called the **action**. Muscles can be easily identified from one another by their shape and overlap.

Identify the following muscles:

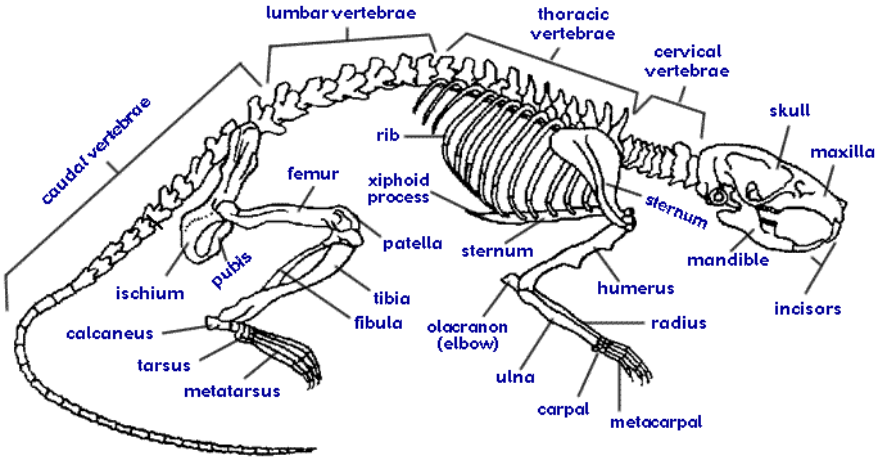
1. **Biceps brachii** - located on the anterior surface of the humerus. Action: flexes lower arm
2. **Triceps brachii -** located on the sides and back of the upper arm. Action: extends lower arm
3. **Biceps femoris** - located on the side of the thigh, in two bundles. Action: flexes the lower leg
4. **Tibialis Anterior** - located on the front of the leg. Action: flexes foot
5. **Gastrocnemius** - located on lower leg, bulk of the calf muscle. Attaches to heel by the Achilles Tendon. Action: extends the foot

Checkpoint

Procedure: Exposing the bones of the leg.

Carefully tease away the biceps femoris and gastrocnemius to expose the 3 leg bones: **Tibia**, **Fibula**, and **Femur** and the small *patella* (kneecap). You can also see the *ligaments* around the knee that attach the bones of the lower leg to the femur and the achilles tendon which attaches the the gastrocnemius to the ankle.

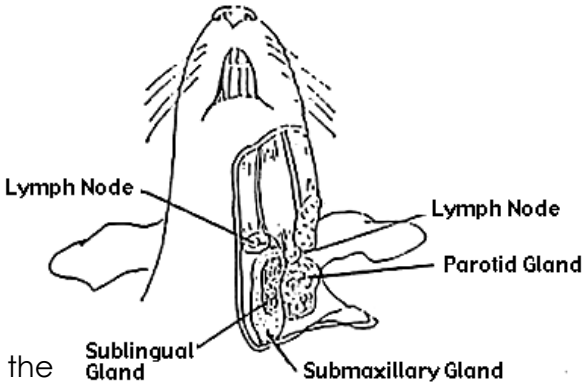
Note that the joint of the hip is called a ball and socket joint. Examine how the bones fit into the pelvis.



Checkpoint

Rat Anatomy - Head, Thoracic, and Abdominal Organs

Organs of the Head and Neck



1. Locate the salivary glands, which on the sides of the neck, between muscles. Carefully remove the skin of the neck and face to reveal these glands. Salivary glands are soft spongy tissue that secrete saliva and amylase (an enzyme that helps break down food). There are three salivary glands - the *sublingual*, *submaxillary*, and *parotid*.

2. Find the **lymph glands** which lie anterior to the salivary glands. Lymph glands are circular and are pressed against the jaw muscles.

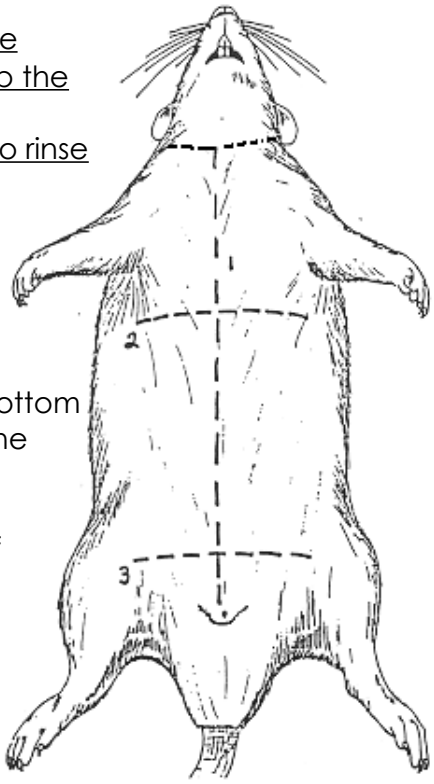
3. After you have located the submaxillary glands, remove them to find the underlying structures.

4. The **thyroid gland** is a gray or brown swelling on either side of the **trachea**. To locate the trachea you will need to carefully remove the *sternohyoid muscles* of the neck. The trachea is identifiable by its ringed cartilage which provides support. The esophagus lies underneath the trachea, though it is easier to locate in the abdominal cavity where it enters the stomach.

⇨ Procedure: Pin the structures of the head and neck. ***In your notes describe the function of the lymph nodes, thyroid, trachea and esophagus***

Checkpoint

The Thoracic Organs



⇨ Procedure: Cut through the abdominal wall of the rat following the incision marks in the picture. Be careful not to cut to deeply and keep the tip of your scissors pointed upwards. Do not damage the underlying structures. Once you have opened the body cavity, you *may* need to rinse it in the sink.

1. Locate the **diaphragm**, which is a thin layer of muscle that separates the thoracic cavity from the abdominal cavity.

2. The ***heart*** is centrally located in the thoracic cavity. The two dark colored chambers at the top are the **atria** (single: atrium), and the bottom chambers are the **ventricles**. The heart is covered by a thin membrane called the *pericardium*. (We will come back to the heart later.)

3. Locate the *thymus gland*, which lies directly over the upper part of the heart. The thymus functions in the development of the immune system and is much larger in young rats than it is in older rats.

4. The *bronchial tubes* branch from the trachea and enter the **lungs** on either side. The lungs are large spongy tissue that take up a large amount of the thoracic cavity. Bronchial tubes may be difficult to locate because they are embedded in the lungs.

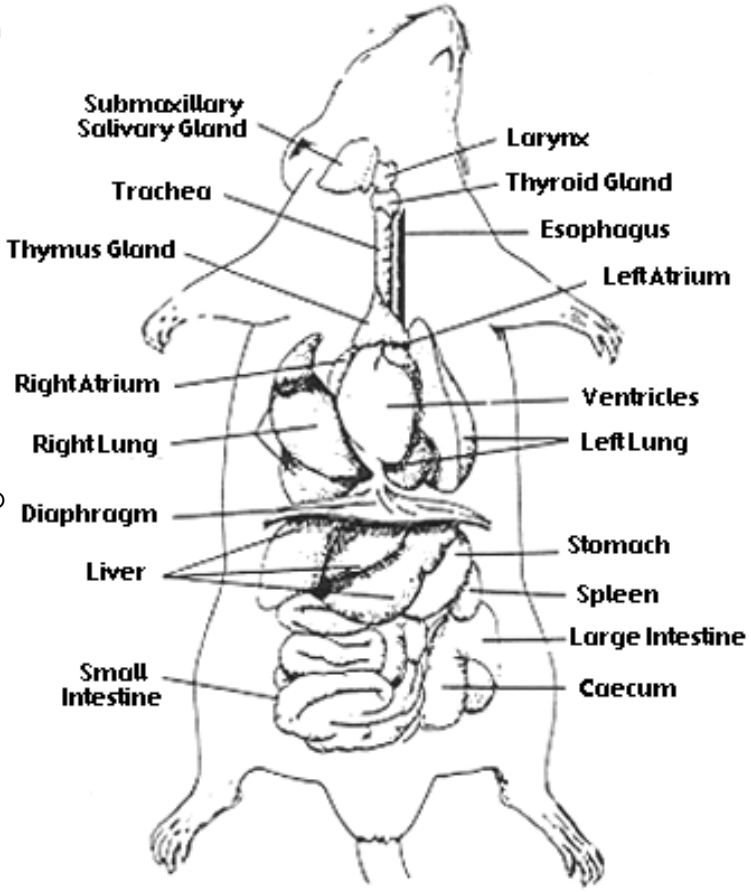
⇨ Pin and **Describe functions** of diaphragm, atria, ventricles and lungs

Checkpoint

The Abdominal Organs

1. The coelom is the body cavity within which the viscera (internal organs) are located. The cavity is covered by a membrane called the peritoneum, which covers four region

- *visceral peritoneum* - covers the internal organs
- *mesenteries* - attach the internal organs to the dorsal body wall
- *omentia* - connect organ to organ



2. Locate the **liver**, which is a dark colored organ suspended just under the diaphragm. The liver has many functions, one of which is to produce bile which aids in digesting fat. The liver also stores glycogen and transforms wastes into less harmful substances. Rats do not have a gall bladder which is used for storing bile in other animals. There are four parts to the liver:

3. The **esophagus** pierces the diaphragm and moves food from the mouth to the stomach. Is is distinguished from the trachea by its lack of cartilage rings.

4. Locate the **stomach** on the left side just under the diaphragm. The functions of the stomach include food storage, physical breakdown of food, and the digestion of protein. The opening between the esophagus and the stomach is called the cardiac sphincter. The outer margin of the curved stomach is called the *greater curvature*, the inner margin is called the *lesser curvature*.

5. The **spleen** is about the same color as the liver and is attached to the greater curvature of the stomach. It is associated with the circulatory system and functions in the destruction of blood cells and blood storage. A person can live without a spleen, but they're more likely to get sick as it helps the immune system function.

6. The **pancreas** is a brownish, flattened gland found in the tissue between the stomach and small intestine. The pancreas produces digestive enzymes that are sent to the intestine via small ducts (the pancreatic duct). The pancreas also secretes insulin which is important in the regulation of glucose metabolism. Find the **pancreas** by looking for a thin, almost membrane looking structure that has the consistency of cottage cheese.

7. The **small intestine** is a slender coiled tube that receives partially digested food from the stomach (via the pyloric sphincter). It consists of three sections: *duodenum*, *ileum*, and *jejunum*.

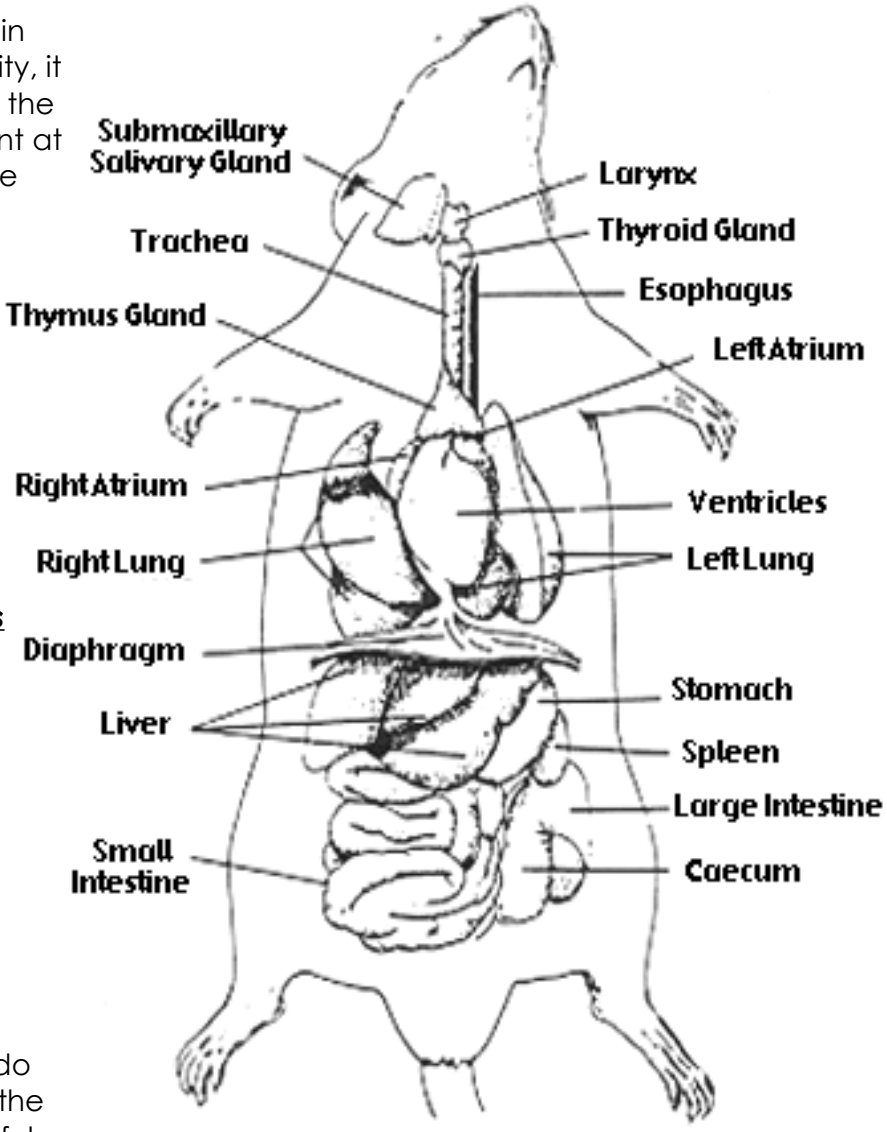
⇨ STart Pinning Major Organs mentioned above. ***Note the function of the major organs***

Rat Anatomy - Head, Thoracic, and Abdominal Organs -
The Abdominal Organs
continued...

8. Locate the *colon*, which is the large greenish tube that extends from the small intestine and leads to the anus. The colon is also known as the **large intestine**. The colon is where the finals stages of digestion and water absorption occurs and it contains a variety of bacteria to aid in digestion. The colon consists of five sections:

9. Locate the *cecum* - a large sac in the lower third of the abdominal cavity, it is a dead-end pouch and is similar to the appendix in humans. It also is the point at which the small intestine becomes the large intestine.

10. Locate the *rectum* - the short, terminal section of the colon between the descending colon and the anus. The rectum temporarily stores feces before they are expelled from the body.



⇨ Procedure: Finish pinning the organs of the digestive cavity.
Note the function of the major organs

⇨ Procedure:

11. Slit the stomach lengthwise and notice the ridges, called *rugae*. The attachment between the stomach and the intestine is called the *pyloric sphincter.*

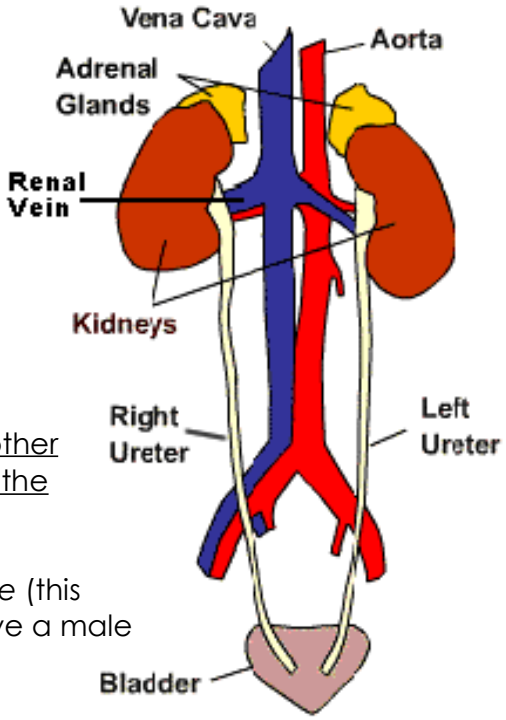
⇨ Procedure:

12. Use your scissors to cut the mesentery of the small intestine, but do not remove it from its attachment to the stomach and rectum. If you are careful you will be able to stretch it out and untangle it so that you can see the relative lengths of the large and the small intestine.

Checkpoint

Urogenital System

The Excretory Organs



1. The primary organs of the excretory system are the **kidneys**. These organs are large bean shaped structures located toward the back of the abdominal cavity on either side of the spine. Renal arteries and veins supply the kidneys with blood.

2. Locate the delicate *ureters* that attach to the kidney and lead to the bladder. Wiggle the kidneys to help locate these tiny tubes.

⇨ Procedure: Remove a single kidney (without damaging the other organs) and dissect it by cutting it longitudinally. PIN the **cortex** (the outer area) and the **medulla** (the inner area).

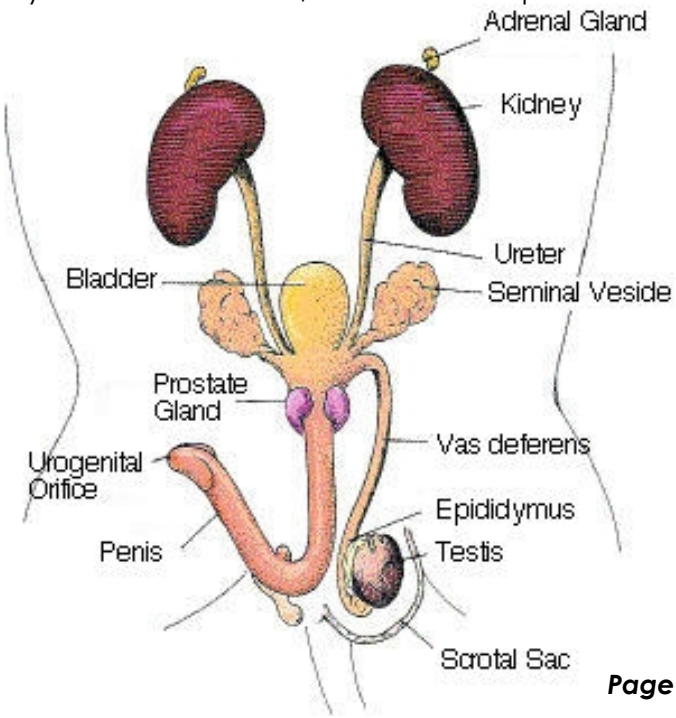
3. The *urethra* carries urine from the bladder to the *urethral orifice* (this orifice is found in different areas depending on whether you have a male or female rat).

4. The small yellowish glands embedded in the fat atop the kidneys are the **adrenal glands**

⇨ Procedure: Pin the adrenal glands. ***In your notes, describe the function of kidneys and adrenal glands***

The Reproductive Organs of the Male Rat

1. The major reproductive organs of the male rat are the **testes** (singular: testis) which are located in the **scrotal sac**. Cut through the sac carefully to reveal the testis. On the surface of the testis is a coiled tube called the **epididymus**, which collects and stores sperm cells. The tubular **vas deferens** moves sperm from the epididymus to the **urethra**, which carries sperm though the penis and out the body.



2. The lumpy brown glands located to the left and right of the urinary bladder are the **seminal vesicles.** The gland below the bladder is the **prostate gland** and it is partially wrapped around the penis. The seminal vesicles and the prostate gland secrete materials that form the seminal fluid (semen).

⇨ Procedure: Pin the organs of the urogenital system. ***Note the function of the organs***.

The Reproductive Organs of the Female Rat

1. The short gray tube lying dorsal to the urinary bladder is the **vagina**. The vagina divides into two **uterine horns** that extend toward the kidneys. This duplex uterus is common in some animals and will accommodate multiple embryos (a litter). In contrast, a simple uterus, like the kind found in humans has a single chamber for the development of a single embryo.

2. At the tips of the uterine horns are small lumpy glands called **ovaries**, which are connected to the uterine horns via oviducts. *Oviducts* are extremely tiny and may be difficult to find without a dissecting scope.

⇨ Procedure: Pin the organs of the urogenital system. ***Note the function of the organs.***