# Mr. S. Lewchuk

Health Science 20 **Rat Dissection**

Rat Dissection

**(*Rattus norvegicus*)**

**Introduction**

In this laboratory, the anatomy of the rat will be examined in detail. The rat is a vertebrate mammal, which means that many aspects of its structural organization are common with humans. 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? How do these organs and organ systems make my body function?

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:

* Its function
* What organ system it belongs to
* How it is connected with other components

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.

**Dissection Guidelines**

**TRY!** You are expected to try to locate structures before asking for assistance. Using the instructions and diagrams, you should be able to locate many structures by yourself. If after a good effort, you cannot find a structure, ask for help. Remember, this is a learning experience; it is permissible to discuss and observe other students' specimens. Compare your dissection with others and be sure to look at animals of the opposite sex.

**Dissecting Tools** will be used to open the body cavity of the rat and observe the structures. 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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**Anatomy Glossary of Terms**

**Dorsal:** toward the back
**Ventral:** toward the belly
**Lateral:** toward the sides
**Median:** near the middle
**Anterior/Cephalic:** 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 which 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

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**Pre-Lab Investigation**

Describe the function of each part of the rat and explain approximately where in the rat’s body you would expect to find the organ

Digestive System:

Liver

Stomach

Esophagus

Pancreas

Small Intestine

Large Intestine / Colon

Cecum

Respiratory System:

Diaphragm

Heart

Lungs

Trachea

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**Rat External Anatomy**

**Procedure**

1. Obtain your rat. Rinse it off with water and place it in your dissecting pan to observe the general characteristics. Make sure you know each of the highlighted words below. 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**.
2. The mouth has a large cleft in the upper lip, which exposes large front **incisors** (two middle teeth). 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** and the **nictitating membrane** found at the inside corner of the eye. This membrane can be drawn across the eye for protection. The **eyelids** are similar to those found in humans.
4. The ears are composed of the external part, called the **pinna**, and the **auditory meatus**, the ear canal.
5. Locate the **teats** 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 of rats do not have hair, though some rodents, like gerbils, have hair on their tails.
7. Locate the **anus**, which is ventral to the base of the tale.
8. On female rats, just posterior to the last pair of teats, you will find two openings- 1) the **urinary opening** and behind that 2) the **vaginal orifice,** which is in a small depression called the **vulva**.
9. On males, you will find a large pair of **scrotal sacs,** 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.

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**Rat Internal Anatomy**

**Procedure**

**Be careful not too cut to deeply 🡪 keep the tip of your scissors pointed upwards. Do not damage the underlying structures.**

1. Pin the rat down by placing the rat ventral side up.
2. Lift the abdominal skin with a forceps, and cut through it with the scissors. Close the scissor blades and insert them under the skin. Moving in a cephalic direction, open and close the blades to loosen the skin from the underlying connective tissue and muscle.
3. Once this skin-freeing procedure has been completed, cut the rat along the body midline, from the pubic region to the lower jaw.
4. Make a lateral cut about halfway down the ventral surface of each limb. Complete the job of freeing the skin with the scissor tips.
5. Pin the flaps to the tray.
6. Notice that the muscles are packaged in sheets of pearly white connective tissue called **fascia**, which protect the muscles and bind them together.
7. Carefully cut through the muscles of the abdominal wall in the pubic region, avoiding the underlying organs. To do this, hold and lift the muscle layer with a forceps and cut through the muscle layer from the pubic region to the bottom of the rib cage, in a similar way you did with the skin.
8. When you see the **Checkpoint** sign, check with your instructor to verify that you’ve done it correctly.



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**The Thoracic Organs**

### **Procedure**

### Be careful not to cut too deeply 🡪 keep the tip of your scissors pointed upwards. Do not damage the underlying structures.

1. Make two lateral cuts through the rib cage. A thin muscle attached to the posterior boundary of the rib cage should be obvious: this is the **diaphragm**, which separates the thoracic and abdominal cavities and is responsible for inhalation/exhalation. Cut the diaphragm away to loosen the rib cage. You can now lift the ribs to view the contents of the thoracic cavity.
2. Examine the structures of the thoracic cavity starting with the most superficial structure and working deeper.
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. Observe the **heart** and the **lungs**. With a probe, push the thymus to the side to view the heart. 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** which helps to hold it in place.
5. Observe the throat region to identify the **trachea-** a small, white, ridged tube that runs down the neck. 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.
6. To expose the esophagus, push the trachea to one side using a probe.
7. Follow the esophagus through the diaphragm to its junction with the stomach.
8. Look in the abdominal cavity. The abdominal organs may still be covered with a membrane, the **peritoneum,** but this usually comes off with the overlying layers. Another membrane, the **mesentery,** surrounds and supports most of the digestive system and its related circulation, and in human males is a primary storage site for *fat,* causing "beer bellies" in some men. The primary fat storage site for most human females is usually in the sides and backs of the hips. Lift the small intestine with the forceps to view the mesentery.
9. Locate the remaining abdominal structures. *See below.*



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**The Thoracic Organs**

### **Procedure**

1. 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 for use when you haven’t eaten and transforms wastes into less harmful substances. Rats do not have a **gall bladder,** which is used for storing bile in other animals.
2. The **esophagus** pierces the diaphragm and moves food from the mouth to the stomach. It is distinguished from the trachea by its lack of cartilage rings.
3. 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.** This is where humans sometimes get “heartburn.”
4. Slit the stomach lengthwise and notice the ridges. These help in mechanical digestion. The attachment between the stomach and the intestine is called the **pyloric sphincter**.
5. The **spleen** is about the same color as the liver and is attached to 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. Find the pancreas by looking for a thin, almost membrane looking structure that has the consistency of cottage cheese. 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.
7. The **small intestine** is a slender coiled tube that receives partially digested food from the stomach (via the pyloric sphincter). It continues the chemical digestion of food with enzymes from the pancreas, as well as its own enzymes. It then absorbs the digested nutrients into the blood stream for transportation around the body.
8. Use your scissors to cut the **mesentery** (the thin, connective tissue) 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.
9. Locate the **large intestine** (also known as the **colon**), which is the large greenish tube that extends from the small intestine and leads to the anus. The colon is where the finals stages of digestion and water absorption occurs and it contains a variety of bacteria to aid in digestion.
10. 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.
11. 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.



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## Urogenital System

The excretory and reproductive systems of vertebrates are closely integrated and are usually studied together as the urogenital system. However, they do have different functions: the excretory system removes wastes and the reproductive system produces gametes (sperm & eggs). The reproductive system also provides an environment for the developing embryo and regulates hormones related to sexual development.

### Excretory Organs

### **To locate the** kidneys**, move the stomach and the intestines to one side with the probe. Examine the posterior wall of the abdominal cavity to locate the two kidneys. The primary organs of the excretory system are the** kidneys, **which clean waste from the blood**. **These organs are large bean shaped structures located toward the back of the abdominal cavity on either side of the spine.** Renal arteries **supply the kidneys with blood to be cleaned, while** renal veins **take purified blood away from the kidneys.**

1. Carefully strip away part of the membrane covering a kidney with forceps. Attempt to follow the course of one of the **ureters,** which carry urine to the bladder. Wiggle the kidneys to help locate these tiny tubes.

### **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).**

### **The small yellowish glands embedded in the fat atop the kidneys are the** adrenal glands, **which produce the hormone, adrenaline, when you are scared or excited.**

### rat_maleThe 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 **epididymis**, which collects and stores sperm cells. The tubular **vas deferens** moves sperm from the epididymis 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).

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### 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.



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**Active Dissection Investigation**

Answer the questions below as you proceed with the dissection. Ensure that everyone in the dissection group can identify all structures and explain their functions.

1. What is the sex of your rat? How do you know?
2. Describe the location of the diaphragm and explain its purpose.
3. List five organs found in the Thoracic Cavity.
4. Make a labeled drawing of the Thoracic Cavity and its organs in the space below.

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1. What is the purpose of the Mesentery?
2. Make a labeled drawing of the abdominal cavity and its organs (small intestine, pancreas, esophagus, liver, large intestine, stomach, rectum, spleen, and mesentery) in the space below.
3. Identify the spleen. What is the function of the spleen?
4. Where are the adrenal glands located? What is their function?
5. Why do female rats have uterine horns rather than a simple uterus like humans?

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**Post Lab Reflection**

Rats are similar to humans as they are Mammalian Chordates. Compare and contrast the body orientation, organ systems and functions between these two species.

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Name:

Date:

Lab Partners:

**Pre – Lab Investigation**

I have accurately completed the Pre-Lab Investigation. I have checked my responses against multiple sources and have a complete understanding of the rat’s Digestive and Respiratory Systems

0 1 2 3 4 5

**Active Dissection Investigation**

I was an active participant in the Active Dissection. I have accurately answered all question of the Active Dissection Investigation and accurately completed all diagrams. I have checked my responses against multiple sources and have a complete understanding of all organs and body systems introduced in the Active Dissection Investigation.

0 1 2 3 4 5

**Post Lab Reflection**

Based on the knowledge gained during this lab investigation and previous knowledge introduced regarding the human body, I have displayed an understanding of the anatomical and body system similarities and differences between rats and humans.

0 1 2 3 4 5