

Dissection of the Rat

Introduction

You will be looking at the anatomy of the white rat. Believe it or not, the white rat is similar in composition to a human. It has the same circulatory system, similar muscles, and a similar skeletal structure.

The classification of the Rat (*Rattus norvegicus*)

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



We will be looking at many different parts of the rat. 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 your dissection with others, for animals often differ.

Step #1 Name Your Rat!

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.

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 are 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.**

STRUCTURES TO IDENTIFY

These are the structures that you are expected to identify.
Check each box as you identify it.

Muscular System

- Biceps brachii (arm)
- Biceps femoris (leg)
- External Oblique (chest/stomach)
- Pectoralis Major/Minor

Skeletal System

- Tibia
- Fibula
- Femur
- Ulna
- Radius
- Humerous

Digestive System

- Liver
- Esophagus
- Stomach
- Small intestine
- Large intestine

Excretory/Reproductive System

- Kidneys
- Ovaries (female only)
- Testes (male only)

Thoracic Cavity

- Heart
- Lungs
- Diaphragm
- Trachea

Circulatory System

- Vena Cava
- Renal Artery
- Right/Left external jugular
- Aortic arch
- Right/Left subclavian
- Right/Left femoral

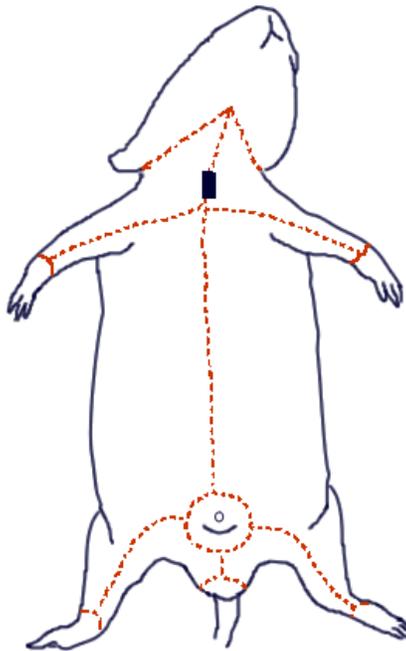
Rat Anatomy Checklist

Throughout the course of the investigation, you will be asked to stop and have your teacher check your progress. At each checkpoint, you should have the box initialed by your teacher to ensure adequate progress.

1. External Features . [Instructor initials_____]
2. Muscular system. [Instructor initials_____]
3. Skeletal system. [Instructor initials_____]
4. Digestive system. [Instructor initials_____]
5. Excretory system and dissection of the kidney. [Instructor initials_____]
6. Reproductive system. [Instructor initials_____]
7. Circulatory system and dissection of heart. [Instructor initials_____]
8. Final check—all structures identified. [Instructor initials_____]

Rat External Anatomy

Procedure: Obtained your rat and observe the general characteristics. Key terms are highlighted in grey.



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**. 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. Determine whether your rat is male or female by looking near the tail for the male or female genital organs.

The Muscular System of the Rat

Checkpoint—have Your teacher initial lab before continuing.

Procedure: Skinning the Rat

You will carefully remove the skin of the rat to expose the muscles below. This task is best accomplished by making a small incision with your scalpel and the using your probe to separate the connective tissues that connects the skin to the first layer of muscles. **Do not cut into 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.

Identify the following muscles:

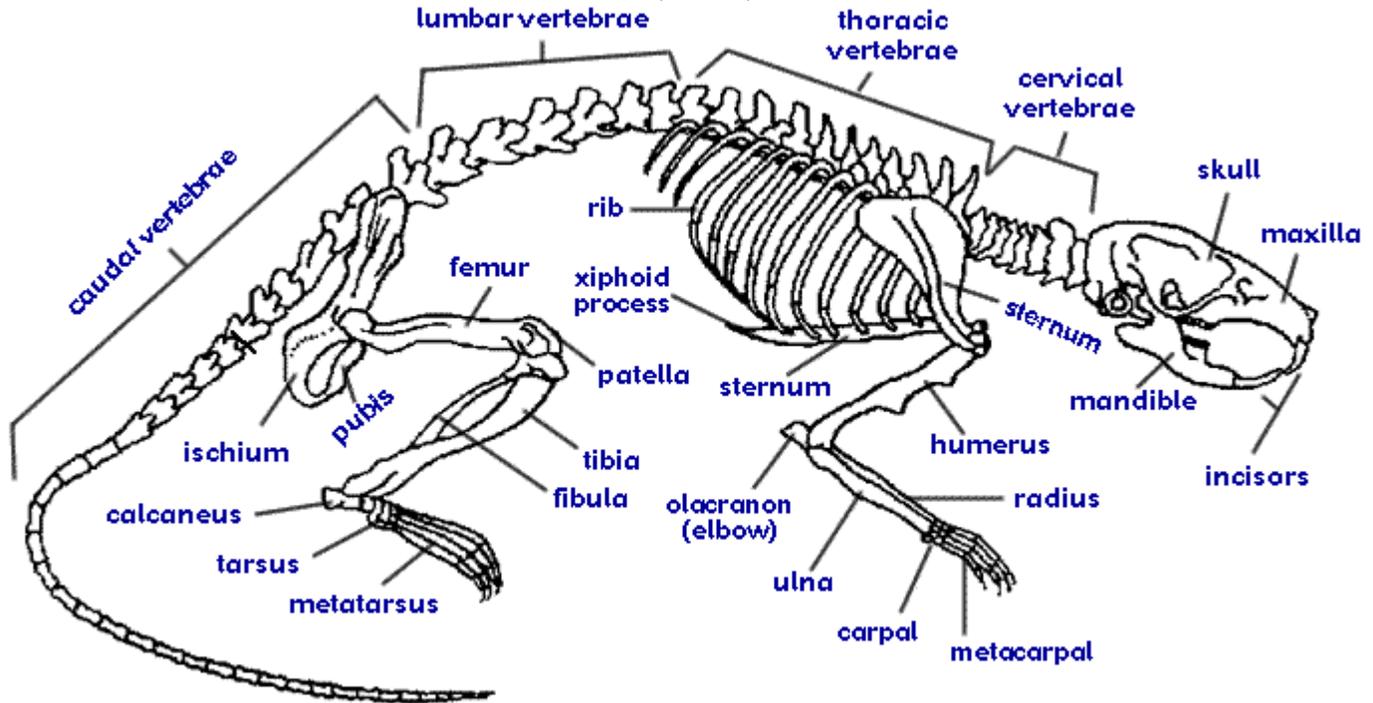
1. **Biceps brachii** - located on the anterior surface of the humerus (arm). Action: flexes lower arm
2. **Biceps femoris** - located on the side of the thigh, in two bundles. Action: flexes the lower leg
3. **External Oblique** - located on the sides of the abdomen. Action: flexes body wall.
4. **Pectoralis Major/Minor** - located in chest area. Action: adducts arm (draws it forward)

The Skeletal System of the Rat

Checkpoint—have your teacher initial lab before continuing.

Procedure: Exposing the bones of the leg.

Carefully tease away the biceps femoris and gastrocnemius on one leg 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 gastrocnemius to the ankle. Remove the muscles from one arm to reveal the ulna, radius, and humerus. Note the size of the radius.



The Digestive System of the Rat

Checkpoint—have Your teacher initial lab before continuing.

Procedure: Use scissors to cut through the abdominal wall of the rat following the incision marks in the picture on pg. 2. Be careful not to cut too deeply and keep the tip of your scalpel pointed upwards. Do not damage the underlying structures.

1. Locate the **diaphragm**, which is a thin layer of muscle that separates the thoracic cavity from the abdominal cavity. The diaphragm is a helpful directional marker.
2. **DO NOT REMOVE OR CUT 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**. (We will come back to the heart later.)

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.

2. Locate the **liver**, which is a large, 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.

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

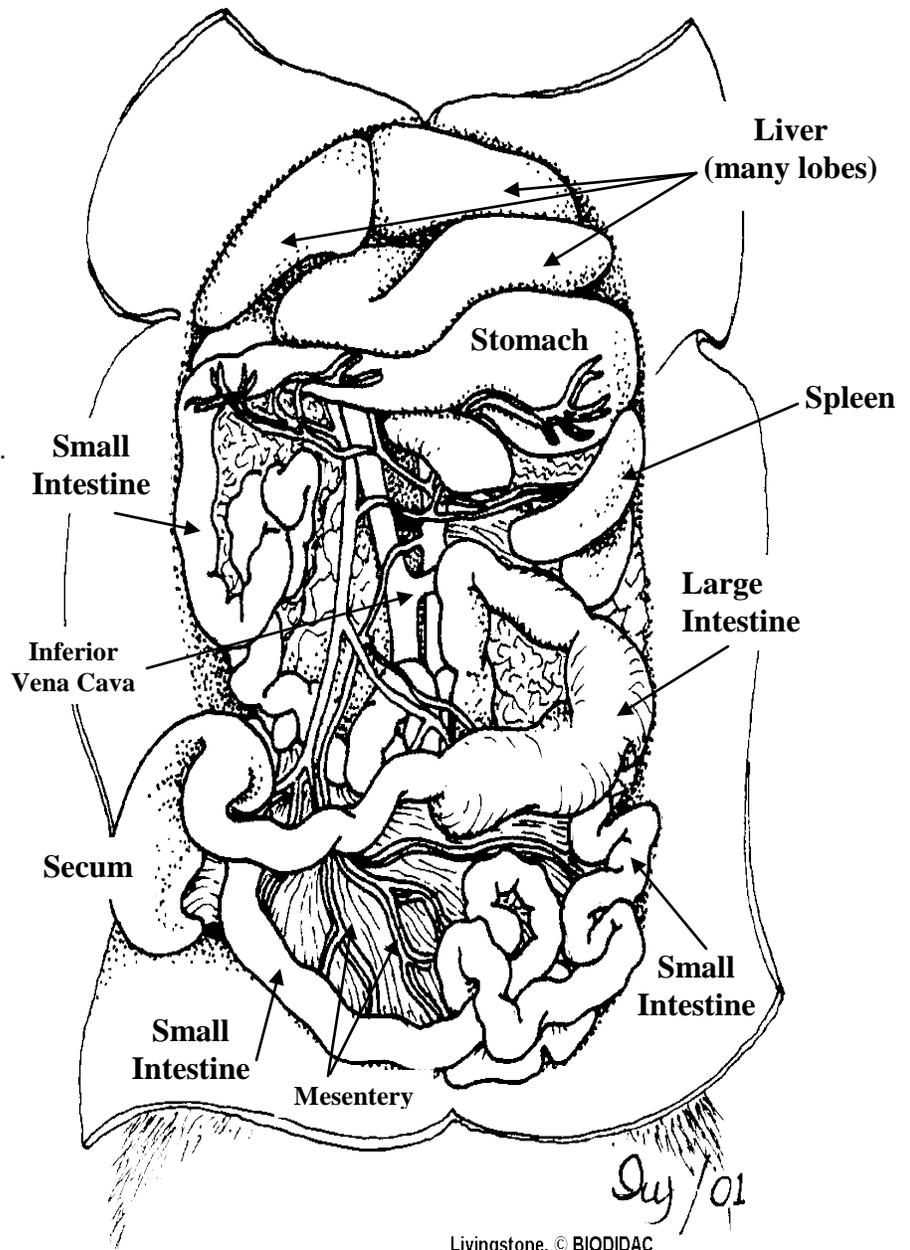
4. Locate the **stomach** on the right side (usually) just under the liver. The functions of the stomach include food storage, physical breakdown of food, and the digestion of protein. The opening between the esophagus and the stomach is called the cardiac sphincter. The outer margin of the curved stomach 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 shaped like a banana and 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 not a clearly identifiable organ but a thin membrane that overlays the stomach and spleen. 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, 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). The term "small" refers to its diameter, not its length. It consists of three sections: **duodenum**, **ileum**, and **jejunum**. The small intestine leads to the cecum.

8. The **cecum** is a pouch that connects the large and small intestines. Food is temporarily stored in the cecum while helpful bacteria digest the cellulose found in plant cells. Most herbivores such as the rat have a large cecum. Humans and other omnivores and carnivores have a much smaller cecum which is referred to as the appendix.



9. Use your scissors to cut the mesentery (connective tissue and network of blood vessels that connects the small intestine) of the small intestine, but do not remove the small intestine 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.

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

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.

The Excretory System of the Rat

Checkpoint—have your teacher initial lab before continuing.

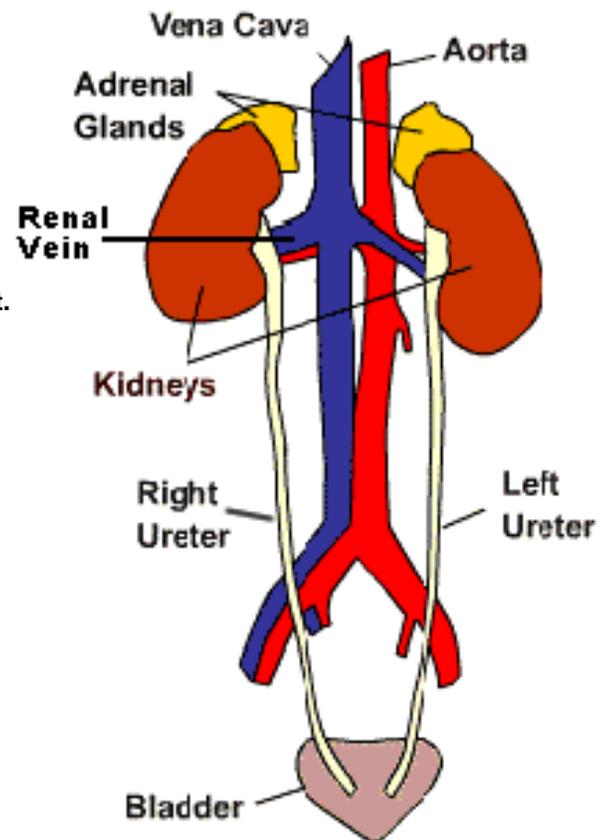
The excretory and reproductive systems of vertebrates are closely integrated and are usually studied together as the urogenital system. However, they do have different functions: the excretory system removes wastes and the reproductive system produces gametes (sperm & eggs). The reproductive system also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

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.

1. Locate the Kidneys. Note the veins and arteries that connect with the kidneys.

2. Remove one of the kidneys and cut it lengthwise. Notice the very fine veins and arteries within. Blood is filtered through the kidneys approximately once every 45 minutes.

3. The small yellowish glands embedded in the fat atop the kidneys are the **adrenal glands** which secrete adrenaline into the blood during times of crisis.



The Excretory and Reproductive System of the Rat

Checkpoint—have your teacher initial lab before continuing.

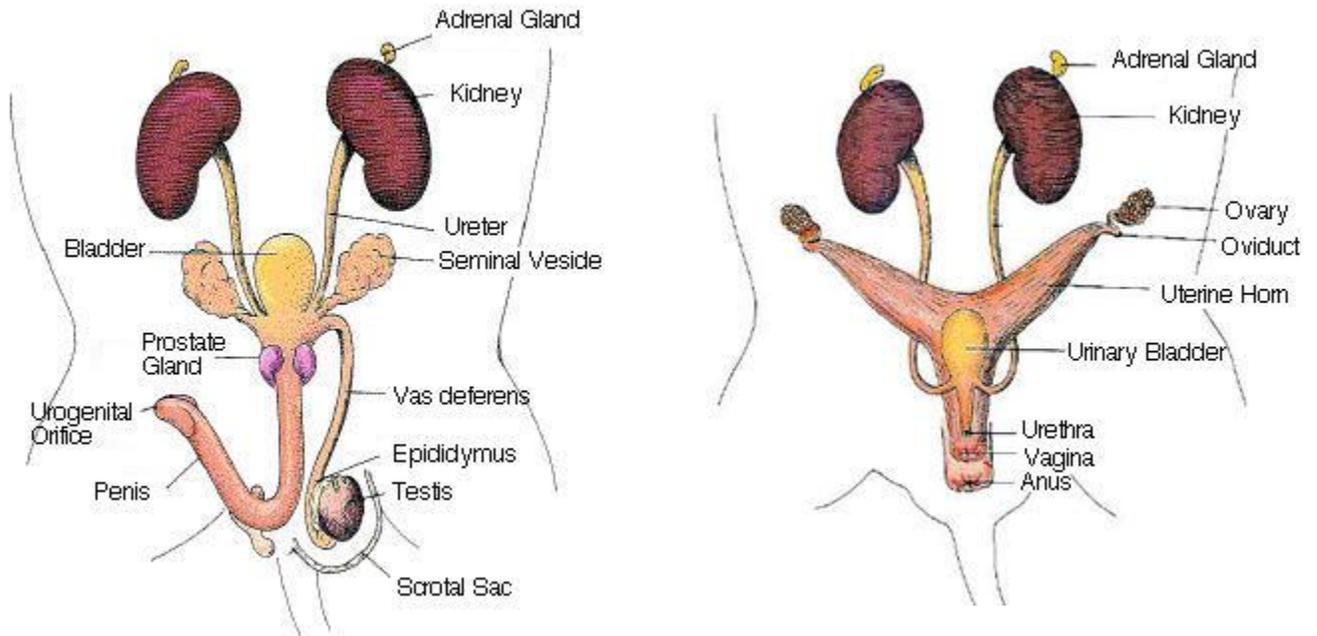
Male Reproductive Organs (refer to diagram below)

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 through 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).

Female Reproductive Organs (refer to diagram below)

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.



**Please be sure to observe the reproductive features of both sexes.
This will require looking at the rat of another group.**

The Circulatory System of the Rat

Checkpoint—have your teacher initial lab before continuing.

The general structure of the circulatory system of the rat is almost identical to that of humans. Pulmonary circulation carries blood through the lungs for oxygenation and then back to the heart. Systemic circulation moves blood through the body after it has left the heart. Use the diagrams on pg. 9, to locate the veins and arteries listed on page 2.

Veins (see diagram page 9)

Your rat specimen has been double injected with latex to help you identify veins and arteries. **Veins carry used blood (blue) back to the heart and lungs.** The lungs re-oxygenate the blood and the heart pumps it back to the rest of the body. In the human body, these veins are not the same bright blue that you see in your rat. However, if you look at your arm, you can see some bluish veins very close to the skin.

Look in your rat specimen for the veins listed on page 2.

Arteries (see diagram page 9)

Arteries carry oxygenated blood to the muscles and organs that need it. Blood is essential for life. Blood carries nutrients to the body, helps repair cells and tissues, fights against disease, and assists in cleansing toxins. Without blood, we would all be dead.

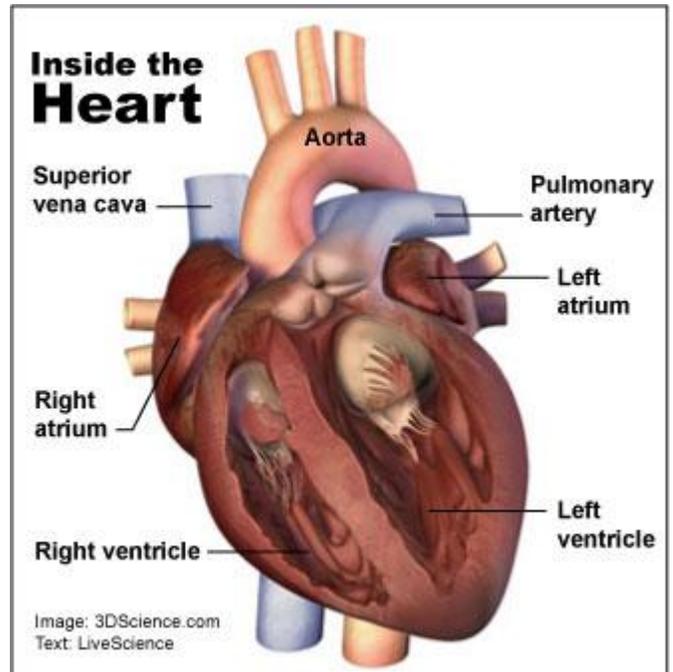
The arteries in your rat are stained red for easy identification. Find the arteries listed on page 2.

Heart

After completing the procedures above dealing with veins and arteries, remove the heart from the pericardial sack. You will need to sever the arteries and veins connecting the heart to the circulatory system. **Do this slowly and carefully so that you do not cut more than is necessary.** Leave as much of the veins and arteries attached to the heart as possible.

Identify the aorta, left and right atrium, and left and right ventricle. Carefully insert your probe into these opening and work it into the center of the heart.

Finally, make an incision between the left and right ventricles with your scalpel. Try to locate the bicuspid and semilunar valves which open and close the ventricles.



Final Check

Can you confidently identify all of the structures listed on pg. 2? These are the structures that you will be tested on. As there are many variations amongst living organisms, **it is strongly suggested that you spend some time looking at the rat of other groups.** Color, location, and size of organs will vary from one rat to another.

Once you feel confident in your ability to identify the parts on pg. 2, ask your teacher to complete the final check point.

Checkpoint—have Your teacher initial lab before continuing.

