

Adult Rat Dissection

Introduction:

The Norway rat (*Rattus norvegicus*) belongs to the family Muridae, a large group of rodents that includes the house mouse, gerbil, and hamster. It is an Old World species and reached North America, after stowing away on ships bound for the colonies, in about 1775. The Norway rat is commonly dissected in studies of comparative anatomy because it displays the typical mammalian body plan. What you will learn from this dissection can be broadly applied to human anatomy.

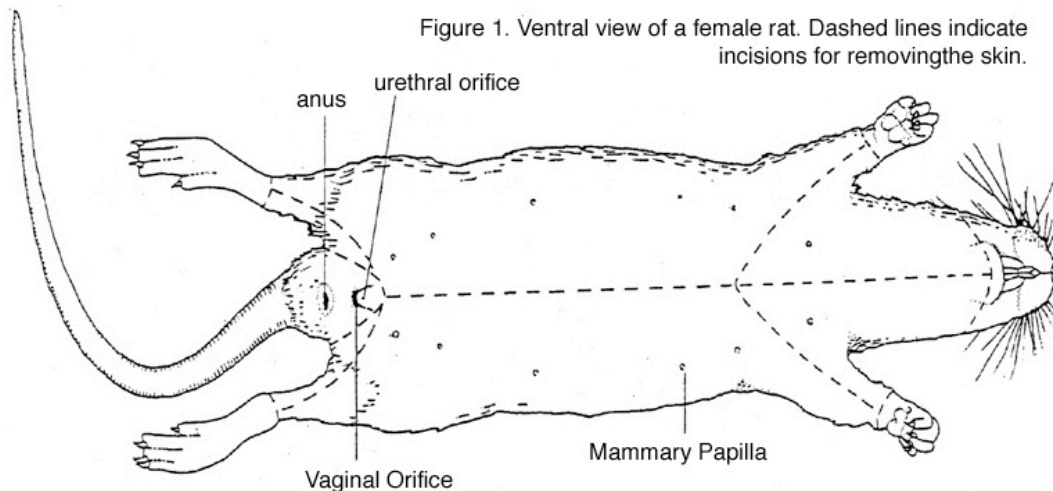
Check these websites out

<http://www.utm.edu/~rirwin/RatAnat.htm>

<http://faculty.fmcc.suny.edu/mcdarby/Pages/Lab%20Exercises/Rat.htm>

Procedure: Day 1

1. Collect dissection tray and equipment
2. Secure your specimen *ventral side up*, with the legs spread laterally with thread or pins (thread under the pan works better, usually).
3. Beginning at the opened skin of the throat, and cutting very shallowly (scissors work better than scalpels for this), make a medial ventral incision the length of the body, then lateral incisions at the collar bones, the posterior margin of the rib cage, and at the hips, cutting deep enough to reach the body cavities but not so deep as to damage the organs inside.
4. Free the resulting flaps of tissue, gently disconnecting it from underlying tissue with a blunt probe or careful cutting. You can pin the flaps aside or completely remove them.



Digestive System.

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.

Digestive System: Identify the following structures and their functions:

	Name	Function
A		
B		
C		
D		
E		
F		
G		
H		
I		
J		
K		
L		
M		

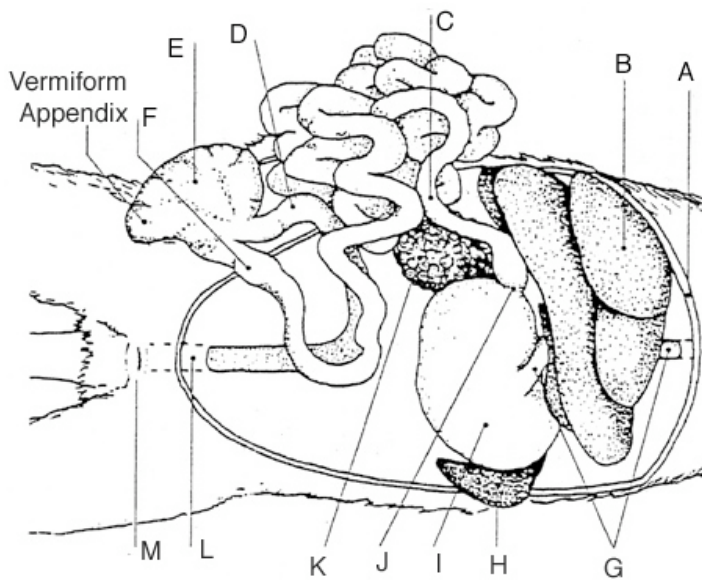


Figure 2: Digestive System

Questions:

1. Why would the mesentery be used for primary fat storage in men but not women?
2. Why might the use of the hips for such storage in women be a deceptive *secondary sexual characteristic*?
3. People whose spleens have been removed are often told to avoid traveling to Third-World countries. Why?
4. Having your gall bladder removed does not have a serious effect upon your digestive abilities, even though fat emulsification is very important. Why not?

1. Liver: The liver does many more things than making bile. It collects almost all of the blood circulated through the intestines and processes many of the chemicals picked up there (such as alcohol, which your liver detoxifies). Waste products from protein metabolism are processed into the less-toxic form of **urea**, which will be removed in the kidneys. Old red blood cells are broken down, with important things like the iron recycled; the liver is also a major staging site for white blood cells of the immune system. Temporary storage of sugar occurs in the liver: in response to **insulin** hormone from the pancreas, sugar in the blood is absorbed and stored as the simple starch **glycogen**; another pancreas hormone, **glucagon**, causes conversion of glycogen back to sugar and its release into the blood as needed.

2. Gall Bladder: Tucked into a recess underneath is the **gall bladder**, where a secretion called **bile**, also produced in the liver, is stored. Bile is a salty fluid (if too concentrated, crystals can form - *gallstones*) used in the small intestine to *emulsify* fat, physically making tiny, digestible blobs out of big, separated-out globs of fatty materials (dish detergents do the same thing to grease).

3. Spleen: The spleen is not a digestive organ, but rather a major storage site for oxygen-carrying red blood cells, and immune-system white blood cells, as well as a processor. In areas of the world with many disease organisms, the stress on the body's immune system can cause both spleen and liver to expand, giving a "pot belly" appearance that is sometimes wrongly attributed to malnutrition.

4. Stomach: This organ has an incoming tube, the **esophagus**, and an outgoing tube, the **small intestine**. The stomach serves two major functions: it churns up the balls of food sent down the esophagus from the mouth reassembling the pieces, and it begins the chemical breakdown of the food with strong *acids* and with a powerful protein-digesting *enzyme*. The stomach (and much of the intestines) is lined with a **mucus** layer to protect the linings from the digestive secretions.

5. Intestines: The intestines (**small and large**) are held together by the **mesentery** membrane, which also supports the **pancreas**. As mentioned before, the pancreas controls blood sugar levels with hormone commands mostly to the liver, but it also makes many digestive chemicals. **Enzymes**, specifically targeted at particular molecules, are made in the pancreas, as is **sodium bicarbonate**, which neutralizes the acids in the "soup" that comes out of the stomach. Most large molecules are broken down to absorbable size as they travel along the small intestine; an exception is **cellulose**, "fiber," which is undigestible to most mammals except those few with bacterial "buddies" to do the job for them. Separate out the small intestine, clipping gently through the mesentery holding it together, until you have separated out a long single tube (you're going to measure them for question 10). At a certain, clearly recognizable point, the small intestine joins the large intestine, or **colon**, at the **cecum**. In the colon, water is drawn out of the food, and a few vitamins and minerals, are processed by specialized bacteria that live there. The cecum is a sac for fermentation of fibrous plant materials, also processed by symbiotic bacteria.

6. Kidneys: With the intestines removed, the cavity is pretty much empty; however, beyond the peritoneal membrane dorsally are the two **kidneys**. On the body wall are the two main blood vessels: the **abdominal aorta**, a artery, and the **inferior vena cava**, a vein; both send branches, to the kidneys. Expose the kidneys and the tubes connected to them, which will include **ureters**, which connect to the **bladder**. On the kidneys' anterior edge, or slightly separate from them but often difficult to see are the **adrenal glands**, which produce a wide variety of hormones (including adrenaline). In the kidneys, blood passes through physical filters that remove all molecules below a certain size (proteins are too big to be lost); then, in a series of tubes, small molecules the body needs back (sugar, water, some salts, etc...) are reabsorbed by the blood and larger molecules the body does not need are pumped out - the resulting, waste-filled fluid is **urine**, which leaves through the **ureters** and is stored in the **urinary bladder**. From there, urine leaves the body through a single **urethra**.

Reproductive System: Identify the following structures. Make sure to find another specimen of the **opposite sex** to yours - you'll need it for comparison purposes.

	Name		Name
A		B	
C		D	
E		F	
G		H	
I		J	
K		L	
M		N	

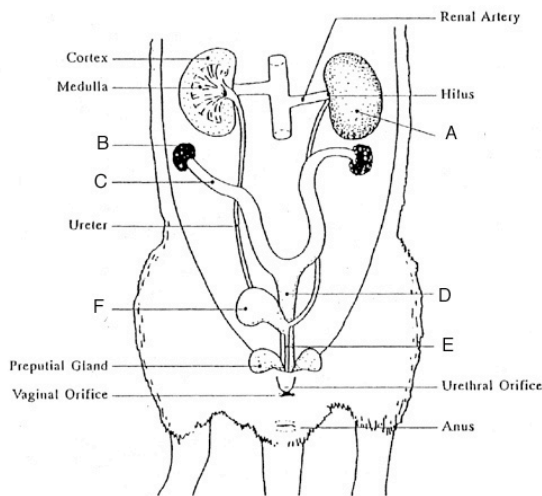


Figure 3 Top Female urogenital system.

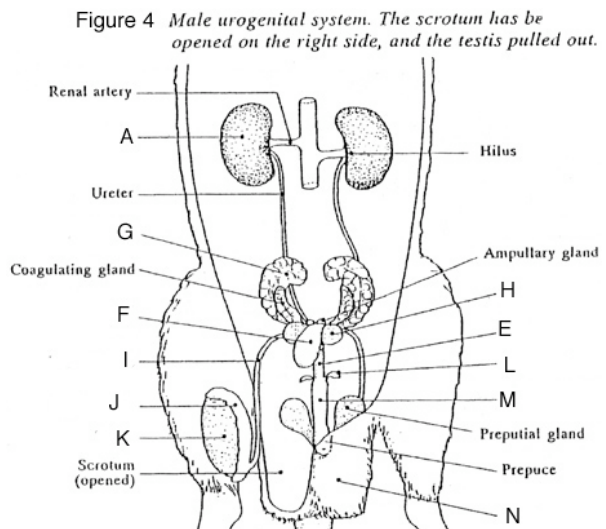


Figure 4 Male urogenital system. The scrotum has been opened on the right side, and the testis pulled out.

In females, the **ovaries**, which produce egg cells and female hormones, are small and somewhat peanut-shaped, located just posterior to the kidneys, inside the peritoneal membrane. These organs produce egg cells (**ova**) in the middle of blister-like **follicles**, and female hormones in the follicle lining cells. To find an intact ovary, you may need to look at the side opposite to where you removed the kidney. The **oviducts** lead from the ovaries to the medial, Y-shaped **uterus**, which connects by way of the **vagina** to the urogenital opening.

In males, **testes**, which produce sperm and male hormones, start out up inside the body cavity during fetal development, then migrate out through two canals into the **scrotum**, passing through two slits in the abdominal wall. Attached to each testis is an **epididymis**, which stores sperm and leads to the **sperm duct**. The duct, and some semen glands, attach to the **urethra**, which carries sperm out of the body through the **penis**.

Remove a gonad from your specimen and dissect it. Describe or draw its internal structure.

Procedure: Day 2: Circulatory System

The organs of the chest, or thoracic cavity, are also covered by various membranes: the **lungs** on each side are encased in **pleural membranes**, while the **heart**, located in the middle, is covered by the **pericardium**. These lubricated surfaces allow the two sets of organs to move vigorously without wearing each other away. The posterior wall of the cavity is the **diaphragm**. When its muscle contracts, the dome-shape flattens and moves downward, increasing the space of the chest cavity; the lungs will with air to fill that extra space. Ventral and somewhat anterior to the heart is the **thymus gland**. In this organ, some white blood cells from the bone marrow mature, becoming *T Cells* (it is one type of T Cell that is attacked by the AIDS virus). Activity in the thymus gland begins during the first few months of life, peaks around puberty, then drops off steadily; our increased susceptibility to disease in old age is probably due at least partly to the shrinkage of our thymus glands.

Behind the heart is a stiff tube, whitish with rings around it, which splits into tubes that run to the lobes of the lungs. The main tube is the **trachea**, and the branches are **bronchi**. The rings around the tube are cartilage, and reinforce the tubes in a way similar to the way that vacuum cleaner hoses are reinforced.

Working up the trachea to the **larynx** (voice box) in the throat area, the **thyroid gland** should be a small structure on the surface. This organ produces hormones that control metabolic rates, the general level of chemical activity in the cells. On each side, somewhat anteriorly, of the larynx are **salivary glands** (there are others up by the tongue and cheeks). Saliva from these glands sticks chewed-up food into a slick, swallowable ball. Saliva also contains an *amylase*, an enzyme that can break down starches to sugars.

The Head.

The top, somewhat rounded part of the head is the **cranium** ; it protects the brain. Carefully remove the skin and underlying tissue from this area, exposing the skull. You need to remove the top of the skull - the best way is to use a scissor tip to get just inside, then snip along the seam where the skull bone knit together. Be careful not to dig into the brain beneath. Don't try to take the entire bone off at once - cut it into small pieces as you go. The part of the brain that you're exposing is the **cerebrum** , the main information processor. You may see some thin covering membranes: these **meninges** surround the brain and spinal cord.

The larger anterior, upper brain, the **cerebrum**, is the area that processes "higher" thinking, including complex memory analysis and decision-making. The **cerebellum**, posterior and slightly underneath, coordinates muscles and controls balance. Posterior still is the **medulla**, which runs such "automatic" functions as heartbeat, breathing, and digestion. Very carefully remove the brain, noting that major **cranial nerves** are connected underneath in addition to the **spinal cord** that runs out the posterior of the skull and down runs down a canal in the **vertebral column**.

Clean-up:

Upon completion of your observations, discard the carcass of the rat in the designated plastic bag. Clean with soap and water and dry all dissecting instruments. Wash your table top with soap and rinse.

Wash your hands

Circulatory System: Identify the following structures and their functions:

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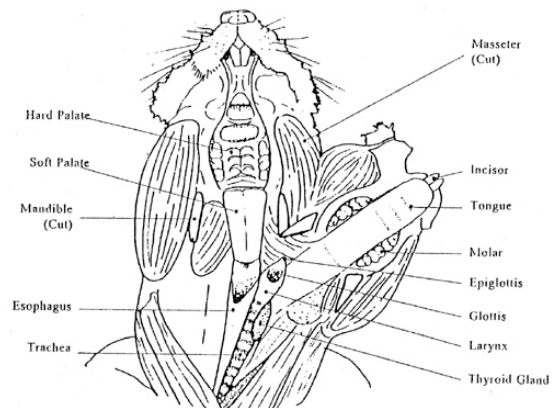
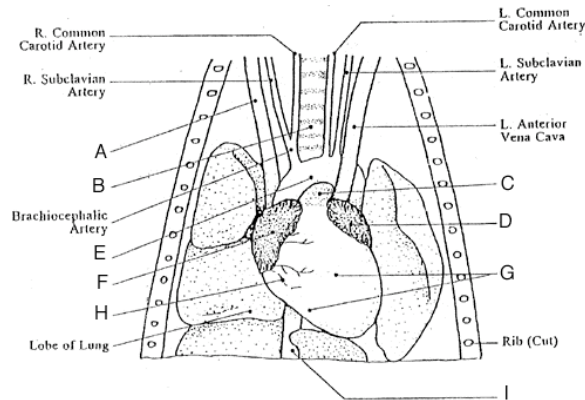


Figure 5 Ventral view of thoracic cavity with thymus and pericardium

Cut through the heart, producing a front and back half. Draw and label, indicating what chambers are visible.