

An Illustrated Dissection Guide To The...

Frog



Rana forreri



by David H. Hall

An Illustrated Guide to the Dissection of the Frog

Introduction

The frog is the most widely used animal for laboratory dissections and anatomy lessons. The frog is in the phylum Chordata, subphylum Vertebrata, class Lissamphibia, order Anura. Most frogs used for dissection are from the family Ranidae, genus *Rana*.

Careful dissection methods along with reading this manual before you begin will help you to avoid damaging features of the frog. In order to achieve the best results. The following dissecting tools are recommended:

1. Dissecting scissors
2. Forceps
3. Scalpel
4. Dissecting needle
5. T-pins to hold the body down
6. Dissecting pans
7. Eye dropper-pipette

It is important to keep your frog moist throughout the dissection process. We strongly recommend that you use Delta-sol for this. Delta-sol is a nontoxic, odorless liquid that preserves the tissue and prevents molding. In addition, Delta-sol rinsing virtually eliminates the unpleasant odor associated with formalin and is nonirritating to the skin. Delta-sol is available in concentrate form; see our catalog for details.

I. Anatomical Terms

Throughout this manual several terms are used to denote the location of various body parts. The student should familiarize himself with the following words and their definitions.

- Cranial**—toward the head, forward
- Caudal**—toward the rear, backward
- Dorsal**—toward the backbone
- Ventral**—toward the belly
- Lateral**—toward the side
- Medial**—toward the midline
- Proximal**—lying near to
- Distal**—lying away from

II. External Features (Figure 1)

The frog body is divided into two sections: The head and the trunk. The frog has no neck so the trunk follows immediately behind the head. The frog has three eyelids: the fleshy upper-eyelid, the thinner lower-eyelid, and the transparent nictitating membrane. The nictitating membrane is drawn up over the eye when the frog is underwater. Its function is to compensate for the different refractive index water has compared with air; this allows the frog to see clearly underwater. The large circular disk just posterior to the eye is tympanum. This thin membrane is functionally equivalent to the human eardrum in that it transmits sound waves mechanically to one bone (there are three in mammals) which in turn transmits the mechanical energy to the nervous system receptor. The cloaca services a common urogenital opening to release the gametes of both sexes (eggs and sperm) and also to void waste products.

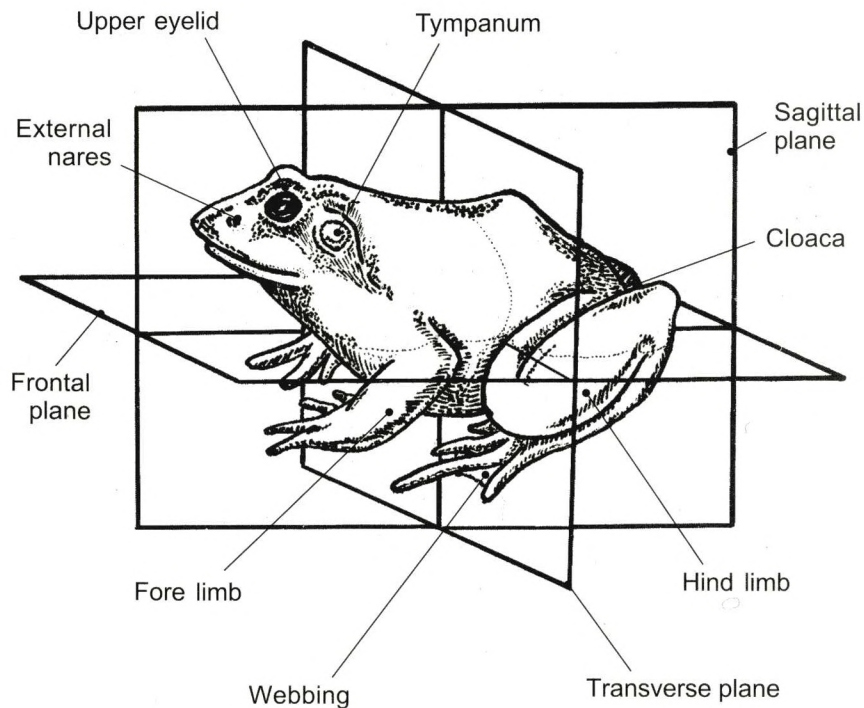


Figure 1. External-features and anatomical planes.

III. Mouth Structures (Figure 2)

With a wooden stick hold the mouth open. It may be necessary to cut the jaw bones apart with scissors in order to see all of the mouth details. With the jaw bone cut at the point where both of them come together in the caudal end of the mouth, the top portion of the head can be folded back. Look at Figure 2 and identify the features shown with your frog.

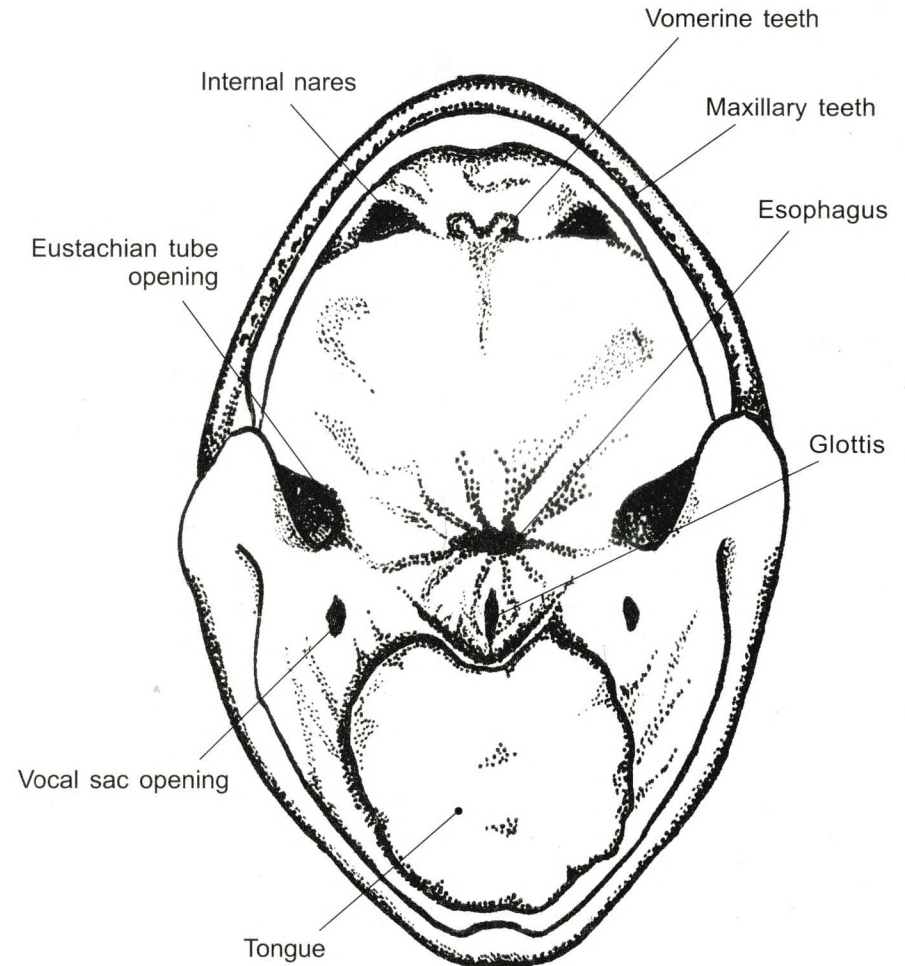


Figure 2. Mouth Structures.

Maxillary Teeth—Run your finger along the upper jaw and feel these small sharp teeth. These teeth are not used for chewing but only to hold the frog's prey firmly. Frogs swallow their prey whole.

Vomerine Teeth—These are two sets of teeth located in the cranial portion of the upper jaw. Not for chewing, these teeth are pointed inward to prevent struggling prey from escaping.

Tongue—this muscular structure is attached to the cranial end of the mouth (unlike humans) so that the tongue can be flipped out (longer than it could be if attached caudally) to snare prey.

Glottis—A small rounded structure with a vertical slit found just caudal to the tongue. This is the air passage to the lung.

Esophagus—In the center of the mouth this passageway is to pass food from the mouth to the stomach.

Eustachian Tubes—On both sides of the upper jaw these openings serve to equalize pressure between the inside and outside of the ear. Humans also have these tubes and they are responsible for what we call "popping our ears".

Internal Nares—At the cranial end of the upper jaw these two openings allow the frog to breathe with its mouth close.

Vocal Sac Openings—Found in male frogs only, these are small slits on either side, distally of the glottis. These passages allow the male frog to fill his vocal sacs with air which, allows him to produce his mating call.

IV. Major Muscles of the Limbs and Back, and Skeleton (Figures 3, 4 and 5)

1. Remove the skin of the frog by making shallow cuts around the wrists and ankles of your frog. Then make the cuts outlined in *Figure 6*. Remove the skin just anterior of the tympanum, proximal to the eye.

2. With the frog placed so that the dorsal side is up, identify the muscles of the limbs and back as shown in *Figure 3*.

3. Turn the frog over so that the ventral side is facing up and identify the muscles of the limbs as seen in *Figure 4*.

4. Study *Figure 5* and familiarize yourself with the bones, and their relationships with each other.

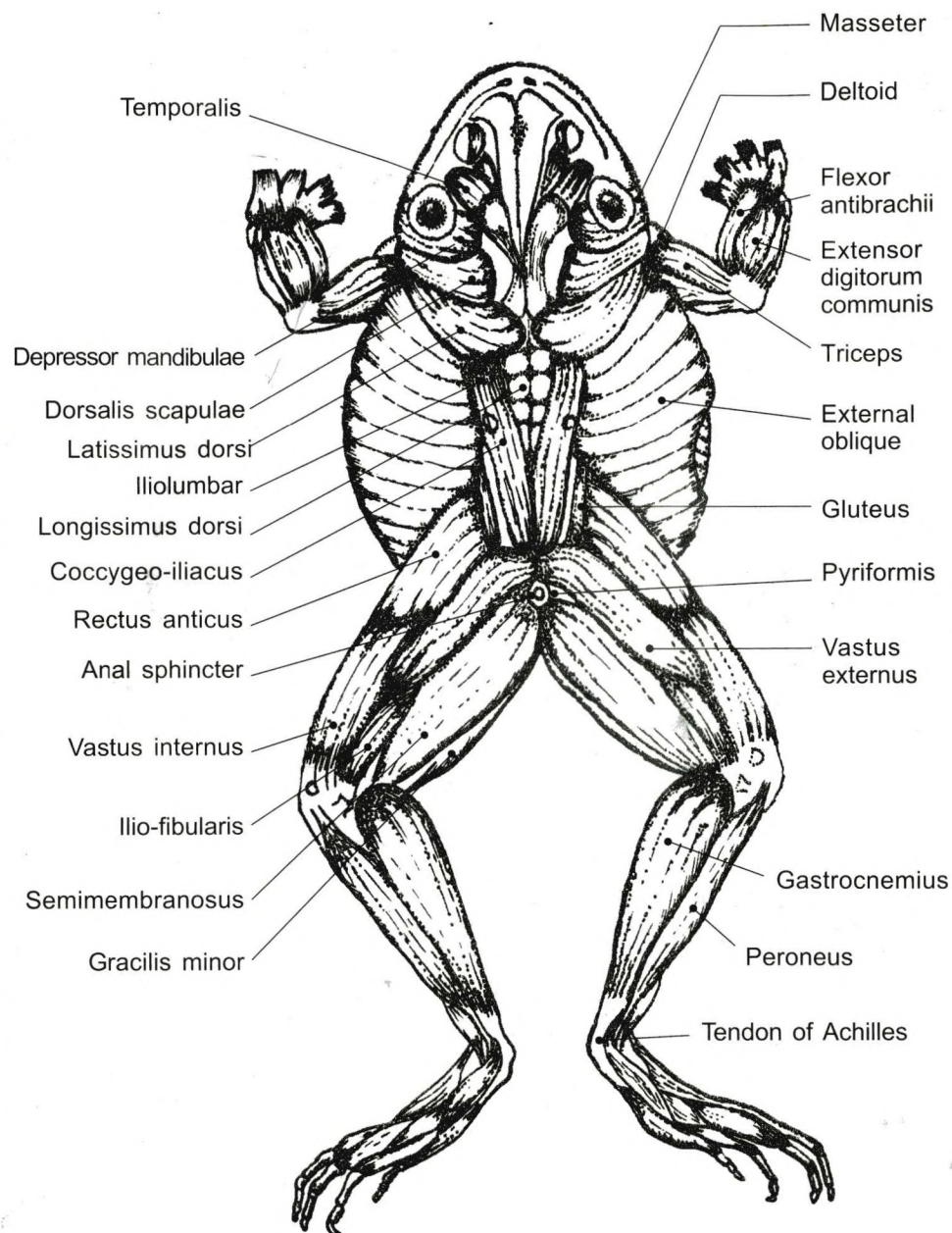


Figure 3. Dorsal muscles.

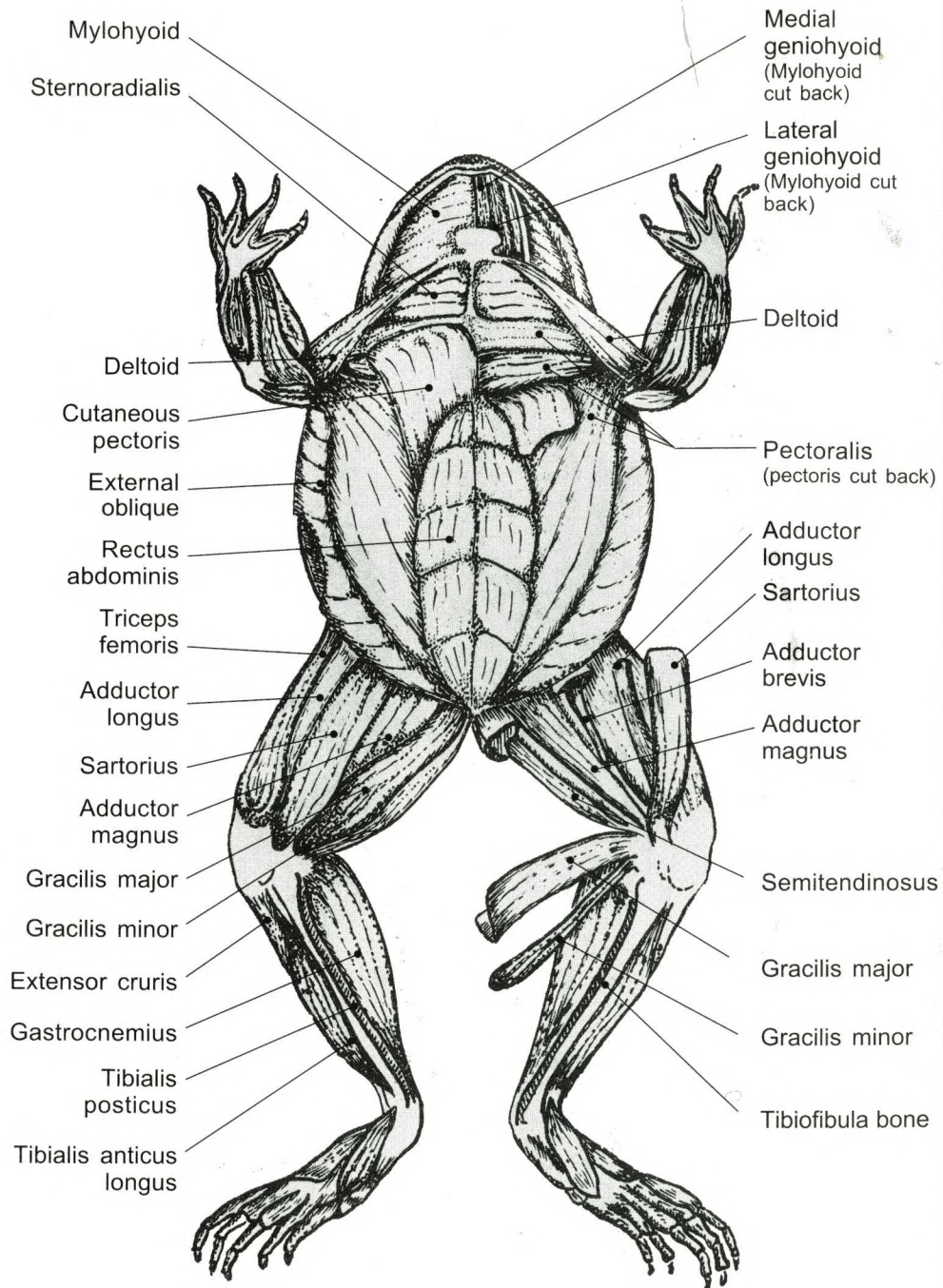


Figure 4. Ventral muscles.

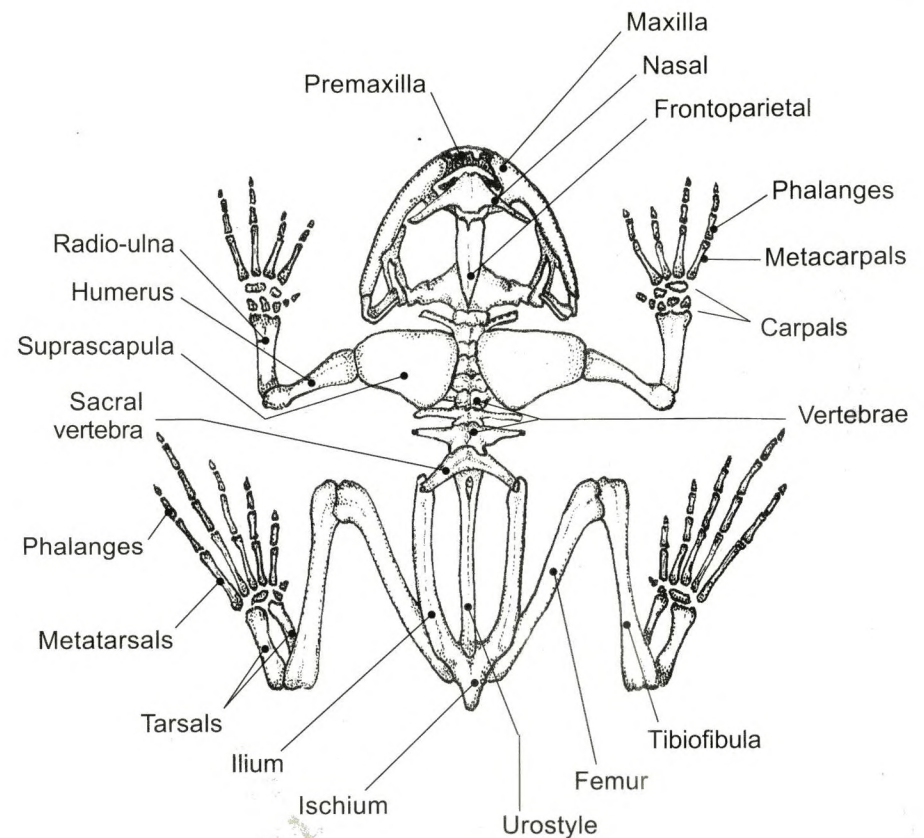


Figure 5. Dorsal view of frog skeleton.

V. Internal Anatomy—Steps in Dissection (Figure 6)

1. Refer to *Figure 6* to open the body wall. Be sure you make your first incision to one side of the midline, starting from the caudal end cutting to the pectoral girdle. Make these cuts as shallow as possible in order to avoid damaging the internal organs. Use the blunt end of the scissors to go underneath the body wall. Make the other cuts as outlined in *Figure 6*. Before pinning the body wall flaps away from the body, free the ventral abdominal vein from the underside of the body wall (ask your teacher if you need help in identifying this vein).

2. In order to view the heart and lungs it is necessary to remove the pectoral girdle. Grasping the sternum with forceps cut the clavicle and coracoid bones at the joint where these bones join the scapula and humerus, then lift out the pectoral girdle (which includes: The clavicles, coracoids and sternum which is made up of four small bones: The mesosternum attached to the coracoids and the xiphisternum at the end, the interior omosternum attached to the clavicles and at the end of the episternum).

3. The exposed organs are wrapped in the peritoneum membrane except for the heart which is wrapped separately in the pericardial sac. In mammals these two membranes are further distinguished by being separated by the diaphragm which divides the coelom (body cavity) into two sections: The abdominal and thoracic cavities. The frog, however, does not have a diaphragm. The membranes can be easily cut away with a scalpel or scissors.

4. If your specimen is female, a large or portion of the coelom (body cavity) may be filled with black and cream colored eggs. It is necessary to move these aside or remove them completely to view the rest of the internal organs (if you do remove the egg masses, you will also remove the ovaries). Compare and find all of the organs shown in Figure 7 with your frog.

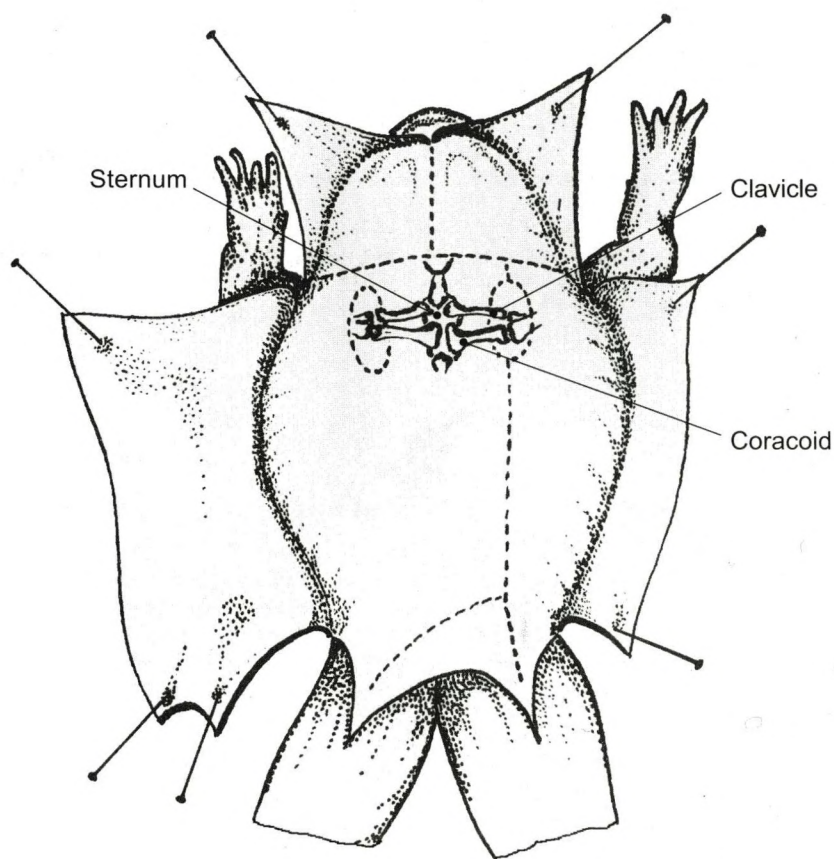


Figure 6. Body wall incisions.

VI. Digestive System (Figure 7)

1. The **liver** consists of three reddish lobes (left cranial, left caudal, and right lobe). The liver surrounds the caudal sides of the heart. The liver is a vital organ which helps purify blood and store glycogen. In addition, the liver secretes a digestive juice: **bile**.

2. **Gall Bladder**—located dorsally and between the left and right lobes of the liver this greenish organ stores bile from the liver.

3. **Stomach**—this is found laterally under the left lobes of the liver. Follow the stomach cranially to identify the **esophagus** which connects the stomach to the mouth.

4. **Small Intestine**—is attached at the caudal end of the stomach and is absorbed into the body. Note that the small intestine is attached to the body wall by a transparent membrane called the **mesentery**.

5. **Large Intestine**—is the enlargement at the end of the small intestine. The large intestine absorbs water from the material passed from the small intestine.

6. **Cloaca**—located at the caudal end of the large intestine, the cloaca is the vessel where the digestive and urogenital systems meet.

7. **Spleen**—located within the coils of the small intestine, this brownish, round organ is actually a part of the circulatory system in that it filters red blood cells. It is described here because it is so closely associated with the digestive organs.

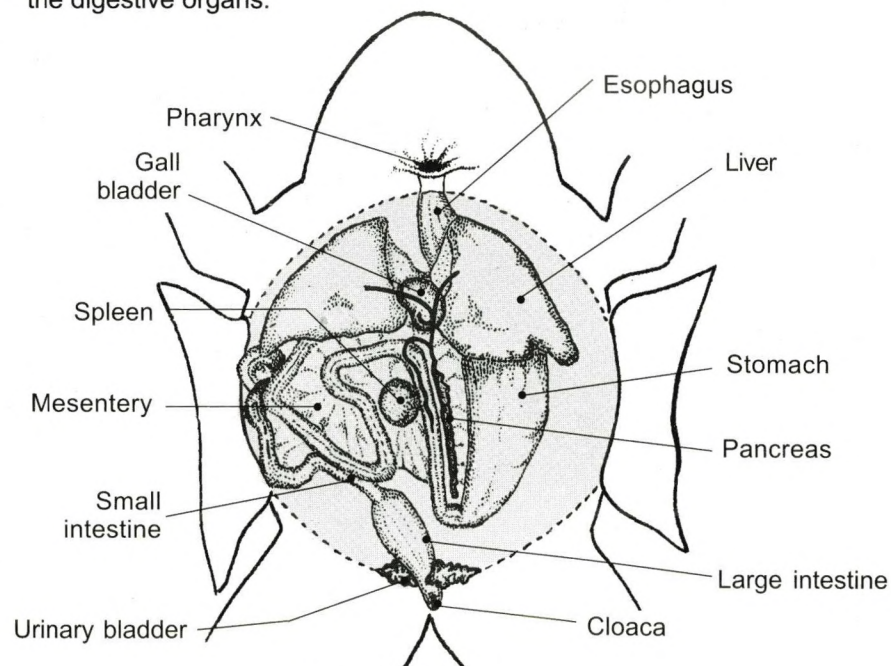


Figure 7. Digestive organs.

8. **Pancreas**—is located between the small intestine and the stomach and is an elongated, yellow organ. The pancreas is a gland which secretes pancreatic enzymes and the hormone insulin.

9. **Fat Bodies**—a cluster of oblong, yellow lobes attached to the cranial end of each kidney. Frogs do not store fat in layers under the skin like humans do but use these organs for the storage of fat. These are reservoirs for food used during hibernation or periods of breeding. The size of these organs varies depending on the season.

10. Dissect out (carefully) all of the above listed organs after you have familiarized yourself with their shapes, location to each other, and function. Leave the liver lobes untouched, however, for the study of the circulatory system.

VIII. Respiratory/Circulatory System (Figures 8, 9, 10 and 11)

1. **Lungs**—locate both lungs (one on each dorsal side of the heart). Trace the cranial ends of the lungs to the bronchi of each lung which leads to the glottis in the mouth. Frogs have simple, single chamber lungs which are not very efficient. Frogs of the Genus *Rana* do most of their respiration through their highly moist and vascularized skin. Hence there is no need for complicated lungs. The mouth and buccal cavity of the frog is also highly vascularized for respiratory purposes (the buccal cavity is the pouch that lies ventral to the jaw and is the bottom of the mouth). See Figure 8.

2. **The Heart**—the frog heart has three chambers: The **ventricle**, the **right**

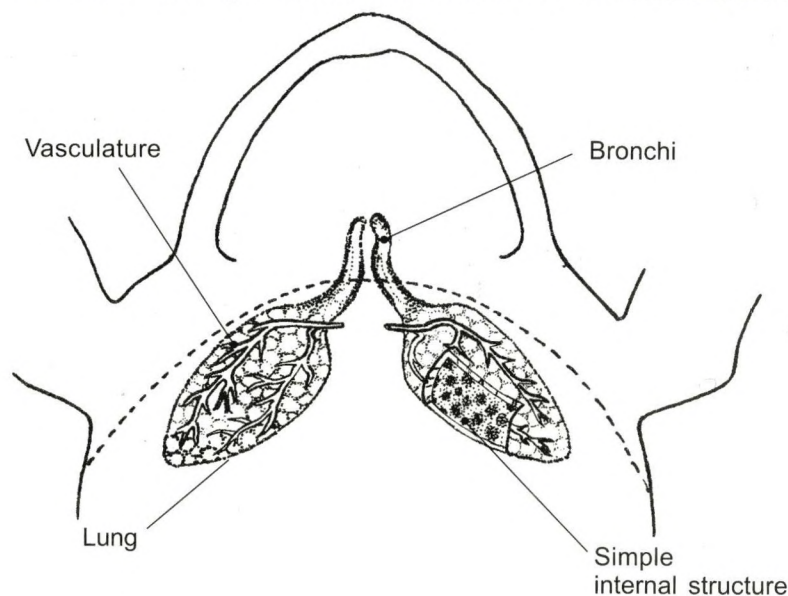


Figure 8. Lungs.

atrium and the **left atrium**. Although this allows some mixing of the venous blood with arterial blood, studies have shown that very little mixing actually occurs; but the reason for this is still poorly understood. Carefully dissect out the heart by first removing the thin surrounding pericardial membrane. If the heart is surrounded by latex (commonly it is) carefully remove the latex with forceps. Next carefully cut the arteries (red if your frog is latex injected) and veins (blue) as far as possible from the heart (about 1/8" to 1/4"). Remove the heart from the body and place it in your pan so that the heart's dorsal side is up. Compare your frog's heart with the one illustrated in Figure 9. You may need to use a small magnifying glass for this.

The venous blood enters the **sinus venosus** from the cranial and caudal **vena cava**. From there it enters the right atrium after a contraction. At the same time blood returning from the lungs via the pulmonary veins enters the left atrium. At this point when both atria are filled they contract sending the blood into the ventricle. From here the oxygenated blood from the left atrium is sent into the truncus arteriosus (Figure 10) and the un-oxygenated blood is directed into the pulmo-cutaneous arch which leads to the skin and lungs for oxygenation. This latter blood flow occurs after the ventricle contracts.

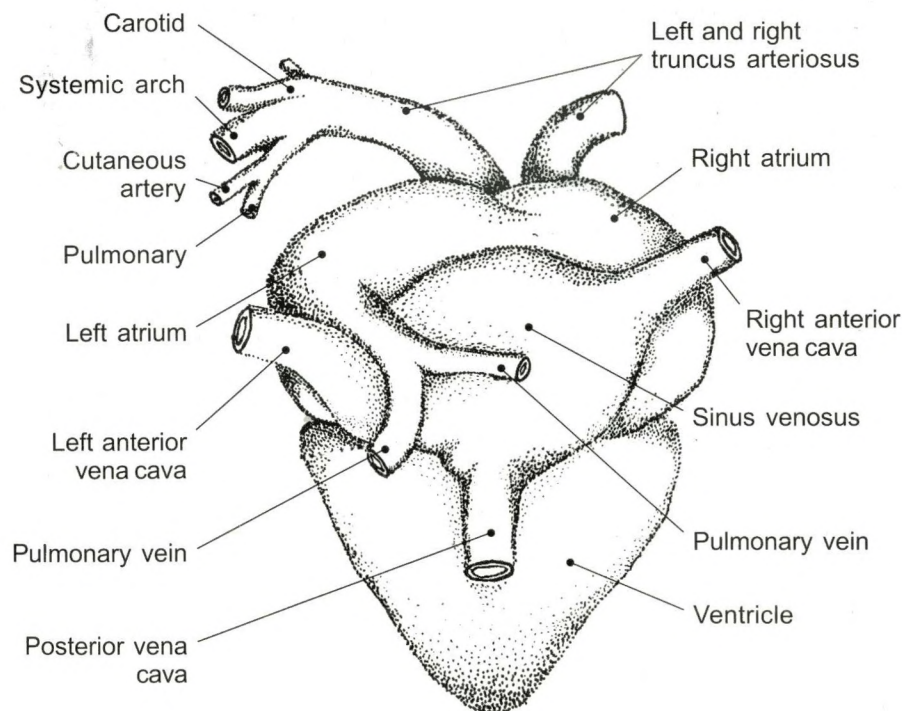


Figure 9. Dorsal view of the heart.

3. The Major Arteries—Look at *Figure 10* and use it to identify the major arteries of the frog. If your frog has been injected with latex, this is relatively simple as arteries will be colored red.

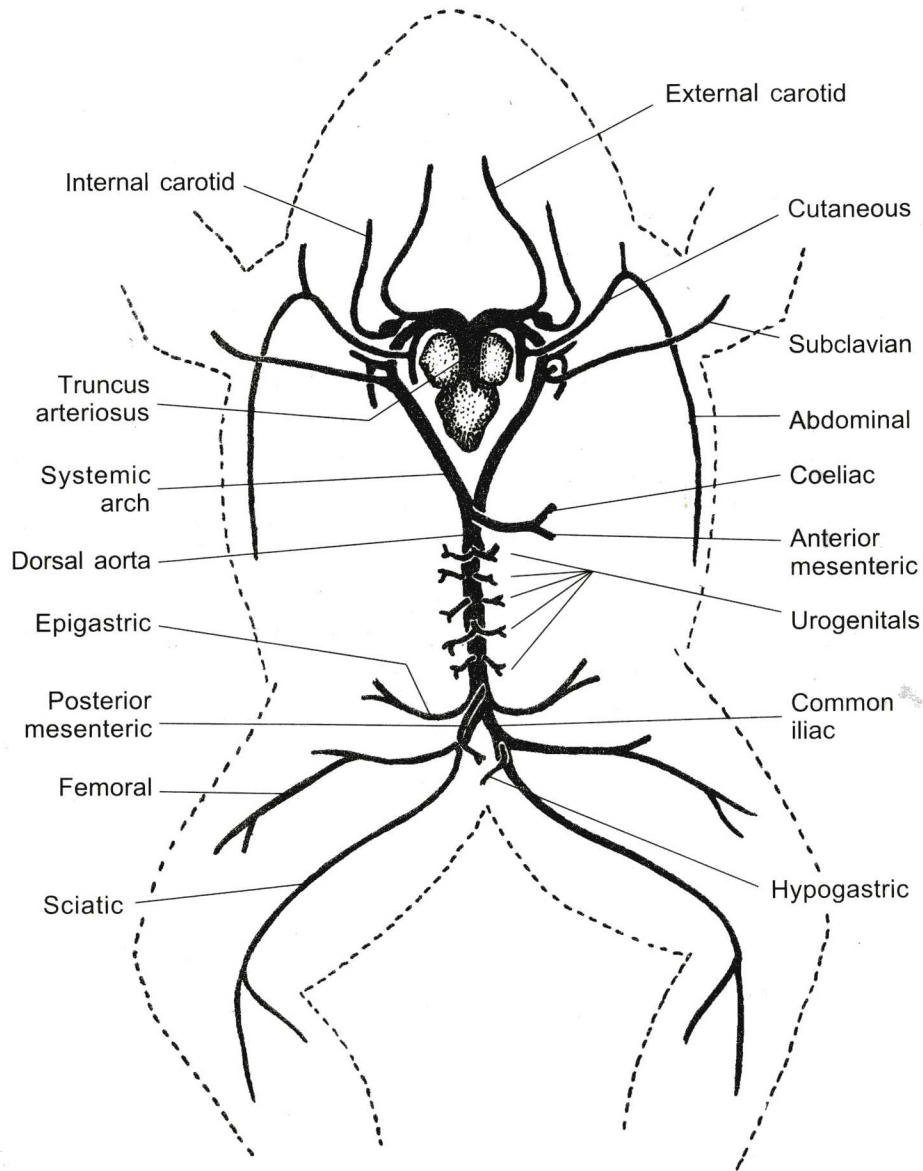


Figure 10. Major arteries.

4. The Major Veins—Look at *Figure 11* and use it to identify the major veins. If your frog has been injected with latex the veins will be colored blue.

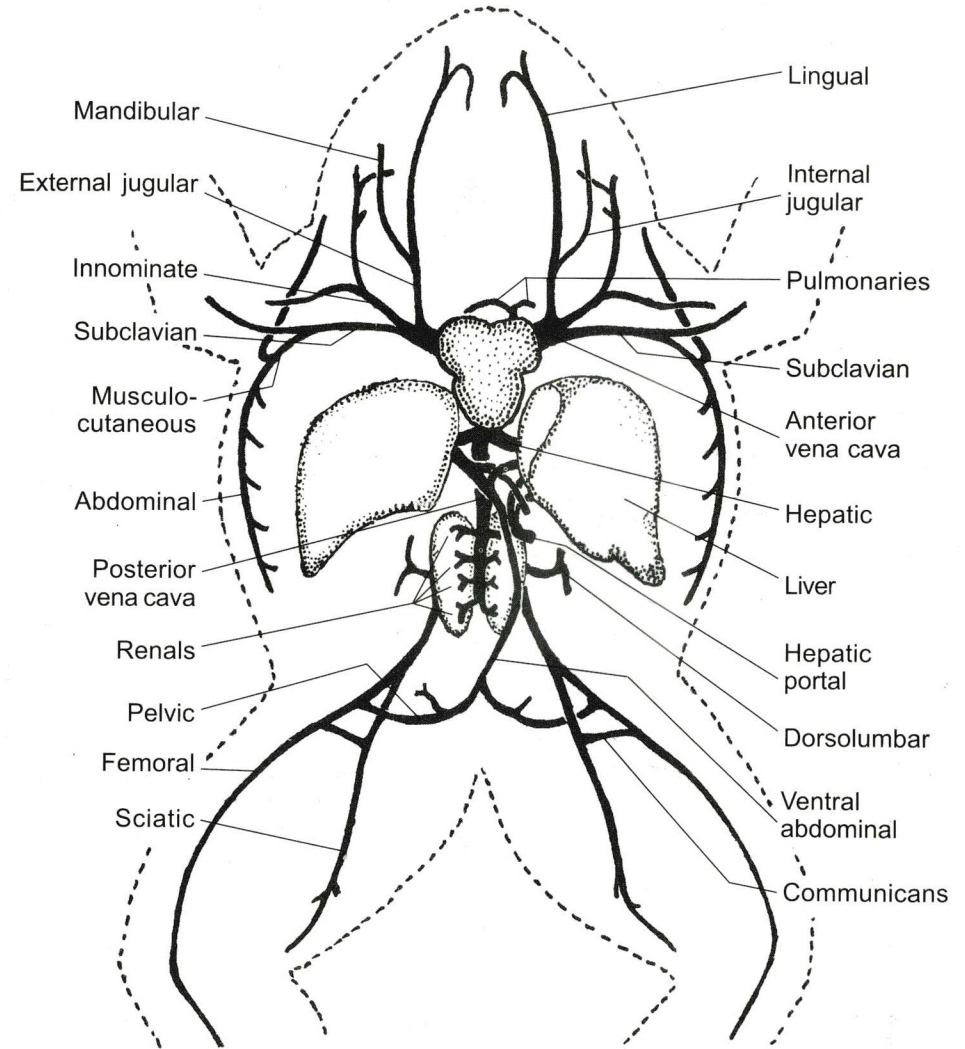


Figure 11. Major veins.

VIII. The Urogenital System (Figures 12 and 13)

The urogenital system is actually two separate systems; the reproductive system and urinary system that are closely allied and in the same body area. Look at *Figure 12* or *13* depending on the sex of your frog. By comparing your frog with these illustrations you should be able to sex your frog.

1. Female reproductive system (Figure 12)

Ovaries—These are often full of eggs which had to be removed in the beginning of the dissection. If they are not, then the **ovaries** are located ventrally and cranially to the kidneys. There are two ovaries, one associated with each kidney. The ovaries produce the female gamete, the egg, and female sex hormones.

Oviducts—These are the long, whitish twisted tubes through which the eggs travel in order to pass out of the body. The eggs enter the mouth of the oviduct (ostium) by coelomic fluid flow and pass through the oviduct by ciliary movement of the inner oviduct cells.

Uteri—These are the caudal enlargements of the oviducts which open into the **cloaca**.

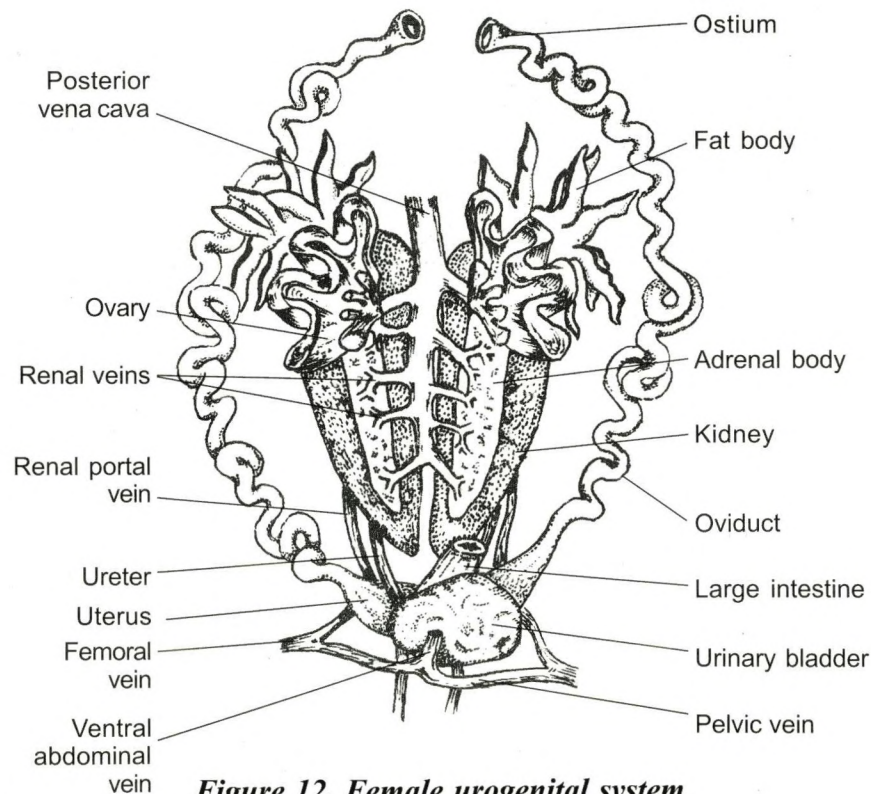


Figure 12. Female urogenital system.

2. Male reproductive system (Figure 13)

The Testes—these are small cream colored and pear shaped organs that are located above the cranial end of each kidney. The testes produce **sperm** the male gamete cells. From the testes the sperm travels to the kidneys via the small **vasa efferentia** (you will need a hand lens to see these). From the kidneys the sperm travels to the bladder with the **urine**.

3. The Urinary System (Figure 11 or 12 depending on sex)

The Kidneys are elongated brownish-red organs which sly dorsally on either side of midline, in the caudal half of the body cavity. The kidney removes body wastes from the blood, producing urine.

Ureters carry urine, and in males sperm, from the kidney to the cloaca.

Urinary Bladder—This is a thin bilobed sac at the caudal end of the body cavity and is ventral to the cloaca. Find where the two lobes join to the cloaca. Urine is stored within the bladder and the frog can use these as reservoirs for water which can be extracted for use through the bladder membranes.

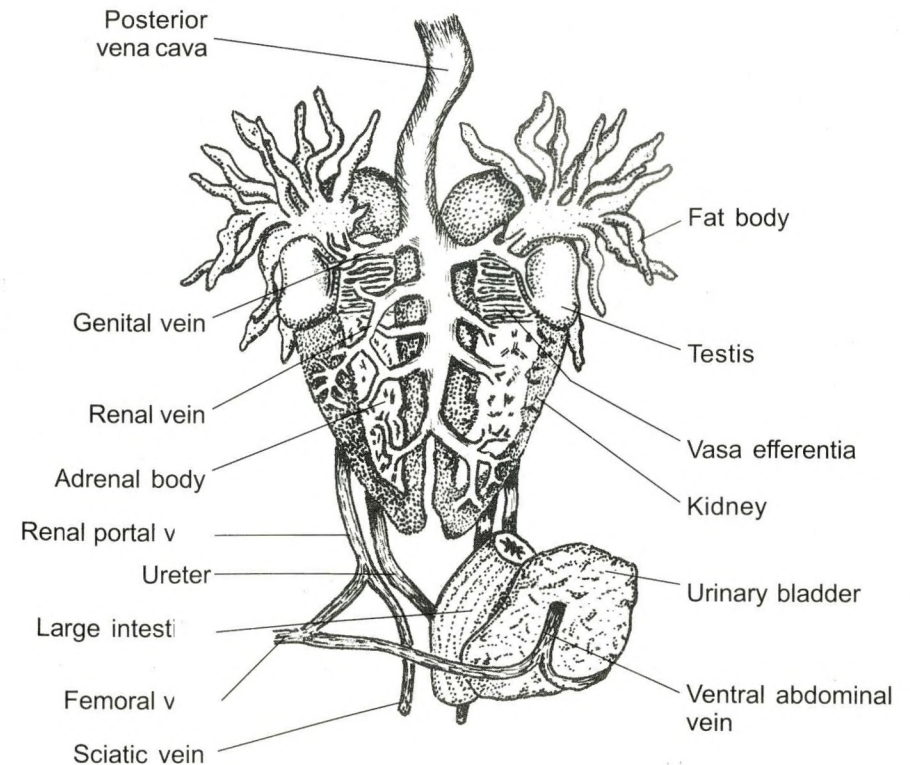


Figure 13. Male urogenital system.

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IX. Brain and Spinal Column (*Figure 14*)

1. With the frog laying dorsal side up pin the limbs to the dissecting pan. Cut away the tissue on both sides of the spinal column. Use the same techniques in removing the tissue as you did to open the body cavity. Be careful not to cut too deeply or you will cut the nerves coming from the spine. Using forceps and scalpel cut and tease away all the tissue surrounding the spinal column but leave all of the white tubular nerve undamaged. This is perhaps the most demanding dissection you will do on your frog so take your time and be patient.

2. With the spinal column and skull exposed, the **brain** can be seen by removing the fronto-parietal bone (top of the **cranium** *Figure 14*). To do this make two cuts with a pair of strong scissors on either side of the cranium, cranially to the nostrils. Then by pressing in on both lateral sides of the head with one hand (to loosen the skull bones) remove the fronto-parietal bone with forceps. The brain is now exposed; compare it with *Figure 14* and identify the structures shown with your frog's brain.

3. To expose the spinal cord insert the tip of a pair of scissors into the underside of a neural arch in one of the posterior vertebral bones. Cut through all of the vertebral bones in this manner but be careful not to cut through the spinal cord. With all nine of the vertebral bones cut, press down on the **transverse** processes on each side of the vertebrae and expose the spinal cord.

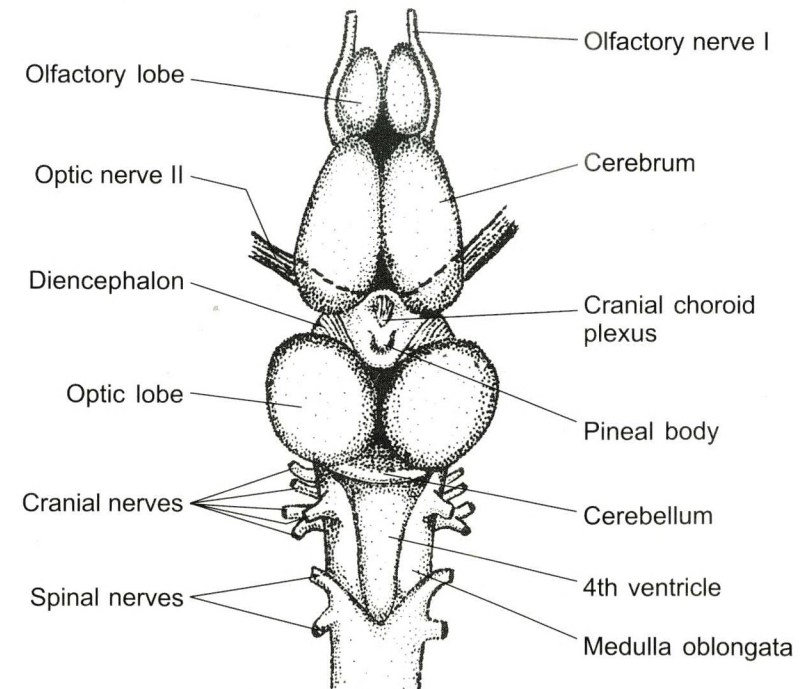


Figure 14. Dorsal view of the frog brain.