

Dissection of a Frog



Name: _____

Partner(s): _____

Biology of the Grassfrog

Frogs, toads, and salamanders all belong to the class Amphibia. As a member of this class, the grassfrog occupies a unique evolutionary position, retaining certain primitive features of fishes, yet also has evolved certain features characteristic of the more advanced terrestrial vertebrates. In this unit we shall explore and study some of these features.

Although frogs are quite successful as land animals and can live in comparatively dry places, they must return to water to reproduce (amphibia - **amphi** on both sides + **bio** life). Eggs and sperm are generally shed, with resultant fertilization and development occurring, in water. The intermediate (larval) stage of a frog is called the tadpole. Tadpoles breathe by means of gills, feed on aquatic plants with their sucker-like mouths, and move about aided by long flexible tails. After a time, tadpoles undergo an abrupt transition to the adult form. This change is called metamorphosis. During metamorphosis both internal and external anatomical changes occur: fore and hind limbs develop, gills are replaced by functional lungs, tail is reabsorbed, digestive tract is shortened to aid in digestion of animal matter, a tongue develops, eyelids appear and the eye lens changes shape. These specialized anatomical changes enable the frog to function better in both modes of life — in water and on land.

Anatomical Orientation Terminology

Dorsal — Back or upper part

Ventral — Abdominal or lower side

Anterior — Forward or front part

Posterior — Hind or rear part

Median — Towards the middle

External Anatomy of the Grassfrog

Body Shape

The body shapes of vertebrate animals are closely related to their methods of locomotion. The grassfrog, like all other vertebrates, possesses **bilateral symmetry** (equivalent right and left sides). Unlike most terrestrial vertebrates, frogs and fish do not have a **neck**. The main propulsive organs are powerful legs with enlarged webbed feet, which in the adult frog replace the tail lost at metamorphosis.

Terms For Recognition and Learning (Figure 1)

A. Head Region

Mouth — Anterior end of animal.

External Nares ('na (e)r - ēz) (Nostrils) — A pair of openings through which air reaches lungs by way of the mouth cavity.

Eye — Two large, nearly spherical eyes are lodged in orbits on either side of the head. Each eye is protected by two eyelids: an upper fleshy opaque lid and a lesser lower lid.

Nictitating ('nik-te-tāt-ing) **Membrane** — Lies in a position beneath the lower eyelid. This membrane moves upward to protect the eye while underwater, or from moisture loss out of water.

Brow Spot — Between and in front of the eyes, on dorsal surface of the head, is a light-colored spot about the size of a pinhead. This is a vestige of a median eye that was present in primitive vertebrates.

Tympanum ('tim-pe-nem) — The eardrum; lies posterior to each eye. This membrane receives sound waves from air or water and transmits them as nerve impulses to the brain. Frogs are insensitive to most sound except mating calls.

B. Trunk Region

Cloacal (klo-'ā-kel) **aperture** — Located at posterior end of trunk. The word cloaca means "sewer"; it is a chamber that receives products of the digestive, excretory, and reproductive systems. This anatomical relationship does not exist in the higher vertebrates.

C. Appendages (extensions that form the extremities of the frog):

Forelimb — Located at the anterior region of the trunk; is much shorter than hindlimb and functions mainly in body support. Each forelimb consists of an **upper arm, forearm, and hand**.

Hand Digits — Four digits are present. The medial (center) or longest digit bears, in the male, a **nuptial pad** for grasping the female during mating.

Hindlimb — Located at the posterior region of the trunk; is the primary organ of locomotion. Each hindlimb consists of a **thigh, leg (shank), and foot**.

Foot Digits — Five digits are present, along with a vestigial (missing or greatly reduced) digit on the medial side.

Web — A membranous sheet extending between each digit of the foot. Webbing increases surface area for increased efficiency in swimming.

Ankle Bones — Between the ankle joint and the foot; are very long to aid in jumping and swimming.

Skin and Coloration — The soft, smooth, moist, skin of the frog is a very complex body organ. It serves for protection, sensory reception, thermoregulation and, to some extent, as a breathing organ as well.

Numerous **poison** and **mucus** glands are located in the skin. The poison secreted by these glands makes frogs distasteful to other animals. The slimy mucus produced by mucus glands helps reduce friction while the frog swims through water, and helps to protect against desiccation (drying out) and excessive water entrance.

The frog's skin is richly-colored. The general body tone blends with the surroundings, while the darker spots and blotches tend to hide the animal from predators. Most of the **pigment** and refractive granules producing color (yellowish to reddish, brownish to blackish) are located in special cells (chromatophores) which are dispersed throughout the skin beneath the epidermis. Grassfrogs do not contain any green pigment. Light reflected back (blue and yellow) results in the greenish color; the rest of the light is absorbed by the various pigments or scattered by refractive granules. Changes in color tone are due to migration of pigment within the chromatophores. Movement of pigment is controlled by a hormone secreted by the pituitary gland in the base of the brain.

FROG BODY PLAN

The internal body organs of the frog protrude into a **body cavity** or **coelom** ('se-lom), which aids organ expansion and contraction. This body cavity is further divided into an anterior **pericardial cavity** containing the heart, and a posterior **pleuroperitoneal** (ploor-o-per-e-ton-e-al) **cavity** containing the other body (visceral) organs. The coelom, and body organs inside, are lined with a membrane (peritoneum). A type of peritoneum, termed **mesenteries**, supports internal body organs.

INTERNAL ANATOMY OF THE GRASSFROG

Mouth Cavity

TERMS FOR RECOGNITION AND LEARNING (FIGURE 2).

Maxillary Teeth — Located along the upper curvature of the mouth; to help grasp food.

Vomerine Teeth — Located posterior to maxillary teeth, in the roof of mouth between the external nares; to help grasp food.

Internal Nares — Located laterally from the vomerine teeth, these are internal openings by which air reaches the mouth cavity.

Eustachian (yu-'sta-shen) tube — Tube from mouth cavity to middle ear, allowing for equalization of air pressure between the mouth cavity and middle ear.

Pharynx ('far-inks) — Throat area in back of mouth cavity. Begins at the hinge of the jaw and extends posteriorly to the esophagus.

Esophagus — Observed at the back of the **pharynx**. This tube connects, and allows passage of food from the mouth cavity, to the stomach.

Glottis — Opening of the "windpipe", immediately posterior to the esophagus.

Tongue — A muscular structure hinged at the floor of the mouth cavity so that it can be extended to catch food. In life, the surface is covered by a sticky secretion produced by glands in the roof of the mouth.

Throat Muscles — Muscles on floor of mouth cavity, helping to force air during breathing.

CIRCULATORY SYSTEM

Function The transport system of the body, it supplies oxygen and nourishment to body cells, and removes metabolic waste products. The circulatory system consists of a pump (**heart**), circulatory fluids (**blood**), and a network of vessels (**arteries** and **veins**).

TERMS FOR RECOGNITION AND LEARNING (FIGURE 2).

Heart — A three-chambered muscular organ (as compared to our own four-chambered type) that receives blood from the body, circulates it to the lungs and/or skin for oxygenation, and then back to the body.

Atria ('a-tree-a) — The two chambers that form the wider anterior region of the heart.

Ventricle (vent-re-cal) — A single, large, chamber which is conical in shape and occupies the posterior region of the heart. Observe the major vessels leading to, and away from, the heart.

Arteries — Carry blood from the heart to body tissues.

Veins — Carry blood to the heart from body tissues.

Related Circulatory System Organs

Spleen — A dark, reddish body found near the back body wall of the body cavity. Its function is to remove old blood cells and break down hemoglobin, in addition to storing blood.

Liver — (See Digestive System.)

RESPIRATORY SYSTEM

Function

The exchange of gases with the environment. This activity is carried out by membranes (lungs and skin) in which blood cells absorb environmental oxygen and release waste gases. In the frog, about one third of this gas exchange occurs in the skin and two thirds in the lungs. This accounts, in part, for the animal's ability to remain submerged for extended periods of time.

TERMS FOR RECOGNITION AND LEARNING (FIGURES 2 and 4).

lungs — The two lungs lie to the right and left of the heart in the chest area. By referring to Figure 4, one should observe the **bronchus** (bron-kus) that connects each lung to the **laryngotracheal** (larr-in-joe-'tray-key-al) chamber which connects to the **glottis**. The lung of the frog is a hollow sac, as compared with the spongy organs of higher vertebrates such as man.

bronchus — Paired tubes leading from the laryngotracheal chamber to the lungs.

laryngotracheal chamber (voicebox) — Comparable to the larynx and trachea of higher vertebrates, it is composed of cartilage bands. Air forced from the lungs causes two elastic bands (**vocal cords**) to vibrate, along with the pharynx and mouth, to generate sound.

DIGESTIVE SYSTEM

Function

Composed of a **digestive tract** and related **digestive glands**, this system functions to both mechanically and chemically break down food into simple components that can be easily absorbed by the blood and passed throughout the body to provide body cells with nourishment.

TERMS FOR RECOGNITION AND LEARNING — DIGESTIVE TRACT (FIGURE 2)

esophagus — Located behind the heart, this short tube functions to transport swallowed food from the pharynx to the stomach.

stomach — This J shaped white organ, located on the left side of the abdomen, functions to receive food from the esophagus and digest its **protein** components. Partially digested food is then passed to the small intestine for final digestion. The stomach should be cut to observe the variety of foods eaten (worms, crustaceans, insects, etc.). Observe the numerous folds of the stomach's lining.

pyloric sphincter — A muscular valve observed at the junction of the small intestine and stomach. This valve opens periodically, allowing partially digested food to pass to the small intestine.

small intestine — Begins at the pyloric sphincter and extends as a coiled tube of small diameter, terminating at the large intestine. This organ receives ducts from the **liver** and **pancreas**; final digestion of food and its absorption takes place here.

large intestine — A short tube of large diameter following the small intestine; opens into the **cloaca**. Its function is to store solid waste material and absorb water before passing waste to the cloaca.

cloaca — A common meeting point of the digestive, reproductive, and excretory systems. This chamber opens into the **cloacal aperture** described earlier (Section B, Lesson 1).

DIGESTIVE GLANDS (FIGURE 2).

liver — Reddish-brown lobed organ beneath the heart, which has a twofold function: the production of **bile** which aids in **fat** digestion, and the regulation of nutrient levels in the blood.

pancreas — Elongate yellowish structure located between the stomach and small intestine. This gland manufactures **pancreatic juices** that further digest **proteins**. Pancreatic juice is delivered to the small intestine by the **pancreatic duct**.

gall bladder — Greenish sac between the lobes of the liver; stores bile and delivers it by way of the **bile duct** to the small intestine.

EXCRETORY SYSTEM**Function**

To remove metabolic waste products from the blood.

**TERMS FOR RECOGNITION AND LEARNING —
(FIGURES 5 and 6).**

Kidneys — Two reddish-brown flattened, elongated structures lying dorsal to the peritoneum and covered by it only on the ventral surface. The kidneys extract wastes from the blood.

Ureter — A short straight tube, leading from each kidney, that transfers waste products (**urine**) from the kidney to the urinary bladder for storage. The ureters also function, in the male, as ducts for transporting sperm to the cloaca.

Urinary Bladder — This thin-walled sac attached to the ventral wall of the cloaca functions to store urine.

Part 7

REPRODUCTIVE SYSTEM**Function**

Responsible for the production of sex cells (**eggs** or **sperm**) and their delivery to produce offspring. Sex organs are separate in the frog.

**TERMS FOR RECOGNITION AND LEARNING —
MALE ANIMAL (FIGURE 5).**

Testes — Pair of ovoid yellowish bodies lying at the anterior region of each kidney on the ventral side. The testes produce **sperm**, which are transported to the cloaca by the ureters.

**TERMS FOR RECOGNITION AND LEARNING —
FEMALE ANIMAL (FIGURE 6).**

Ovaries — These paired organs vary greatly in size depending upon the season of the year. In the spring they are greatly enlarged, occupying a great deal of the body cavity. The black and white spherical **eggs**, if present, should be visible immediately. In the fall of the year, the ovaries are much smaller and are located in a position similar to the testes. The ovaries produce eggs.

Oviducts — Paired, thin, white coiled tubes with funnel-like openings in their anterior region.

Uterus — A pear-shaped expansion of each oviduct near the cloaca. Eggs in the body cavity enter the funnel-like oviduct opening and are stored just prior to release in the uterus. During release into the water for fertilization, the eggs pass through the **cloacal aperture**.

Fat Bodies — Finger-shaped bright yellow fatty masses lying in front of the testes or ovaries. Fat bodies contain a food reserve which is used during hibernation.

NERVOUS AND SENSORY SYSTEMS

Function

To integrate and control body processes. The roles of organs of touch, smell, taste, hearing, and vision in transferring external stimuli into nerve impulses which are sent to the brain for integration.

SENSORY SYSTEM

TERMS FOR RECOGNITION AND LEARNING

Eyeball — Organ of vision. Images are focused by a **lens** onto the **retina** for transmittance as electrical impulses to the brain by way of the **optic nerve**. Fish as well as frogs possess an eye that is focused like a camera; lens muscles bring the lens closer to, or away from, the retina to achieve image focusing. In mammals, the ciliary muscles shape the lens to achieve the same result. Have the students remove the lens, noticing that it is very hard and nonpliable.

Optic Nerve — A whitish structure located at the back of the eyeball. This nerve conducts impulses, transferred from light, from the eye to the brain.

NERVOUS SYSTEM

TERMS FOR RECOGNITION AND STUDY

Brain — Begins at a point between the eyes and extends posteriorly to the back of the skull. The brain integrates nerve impulses sent to it as well as coordinates all body processes.

Cranial Nerves — Whitish cords extending from the brain. These nerves have specific sensory and motor (movement) functions. The optic nerve is one such nerve.

Spinal Cord — Dissection Instructions: Remove skin and muscle along the center of the back to expose the vertebrae. Cut the vertebrae on each side with scissors, to expose the spinal cord. The spinal cord is the main bundle of nerve fibers extending posteriorly from the brain.

Spinal Nerves — Paired nerves that branch off the spinal cord at various distances from the brain. They appear to be white cords.

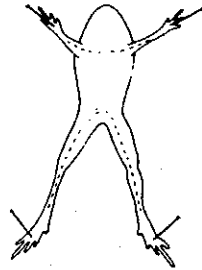


Figure 3

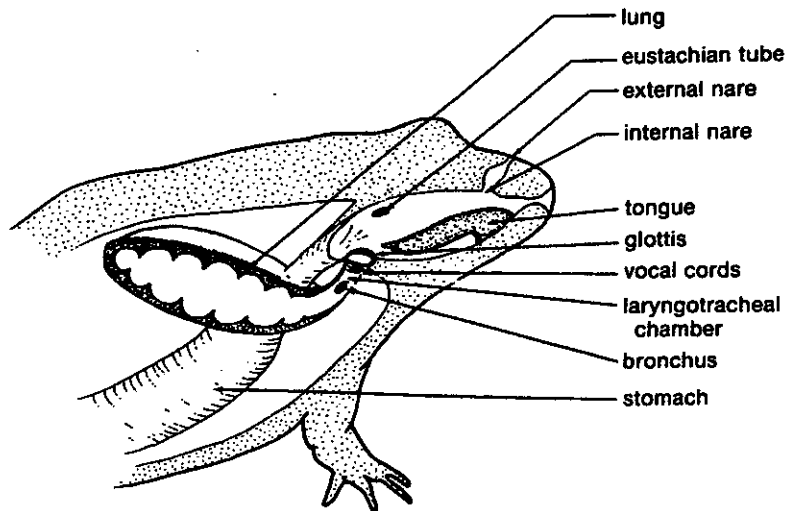


Figure 4 Grassfrog. Side view of respiratory system.

Name _____ Date _____

Dorsal view.

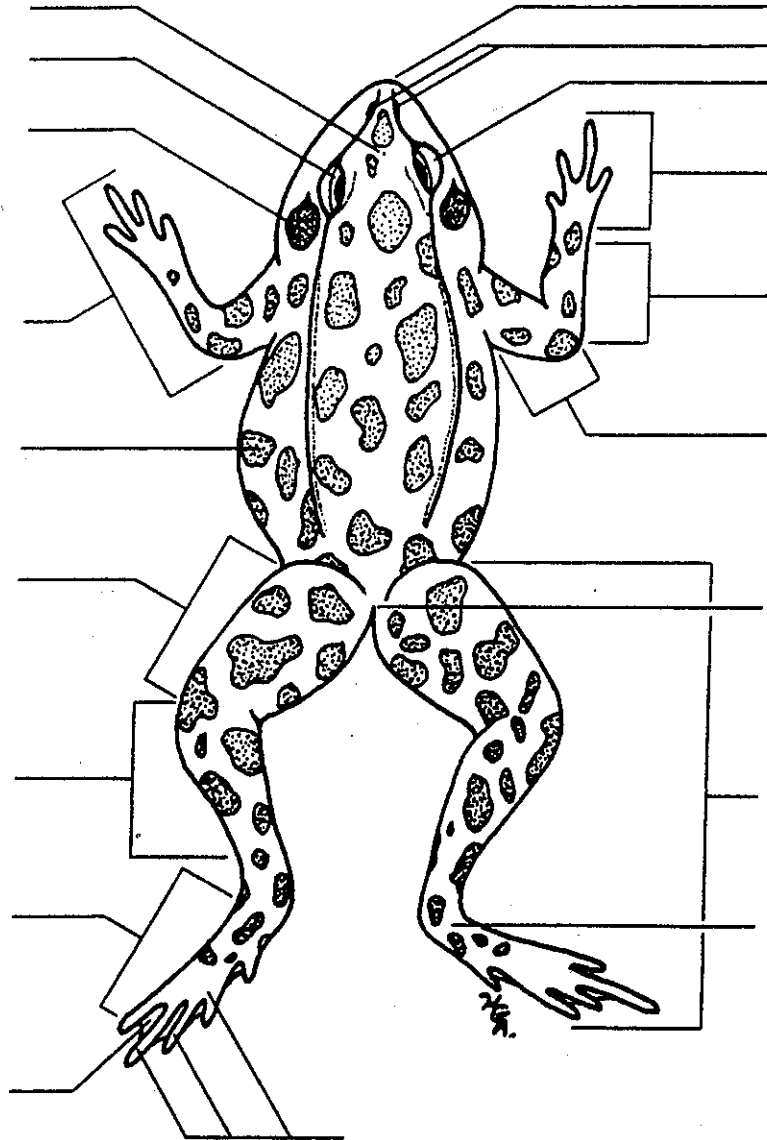


Figure 1

Name _____ Date _____

Dorsal view.

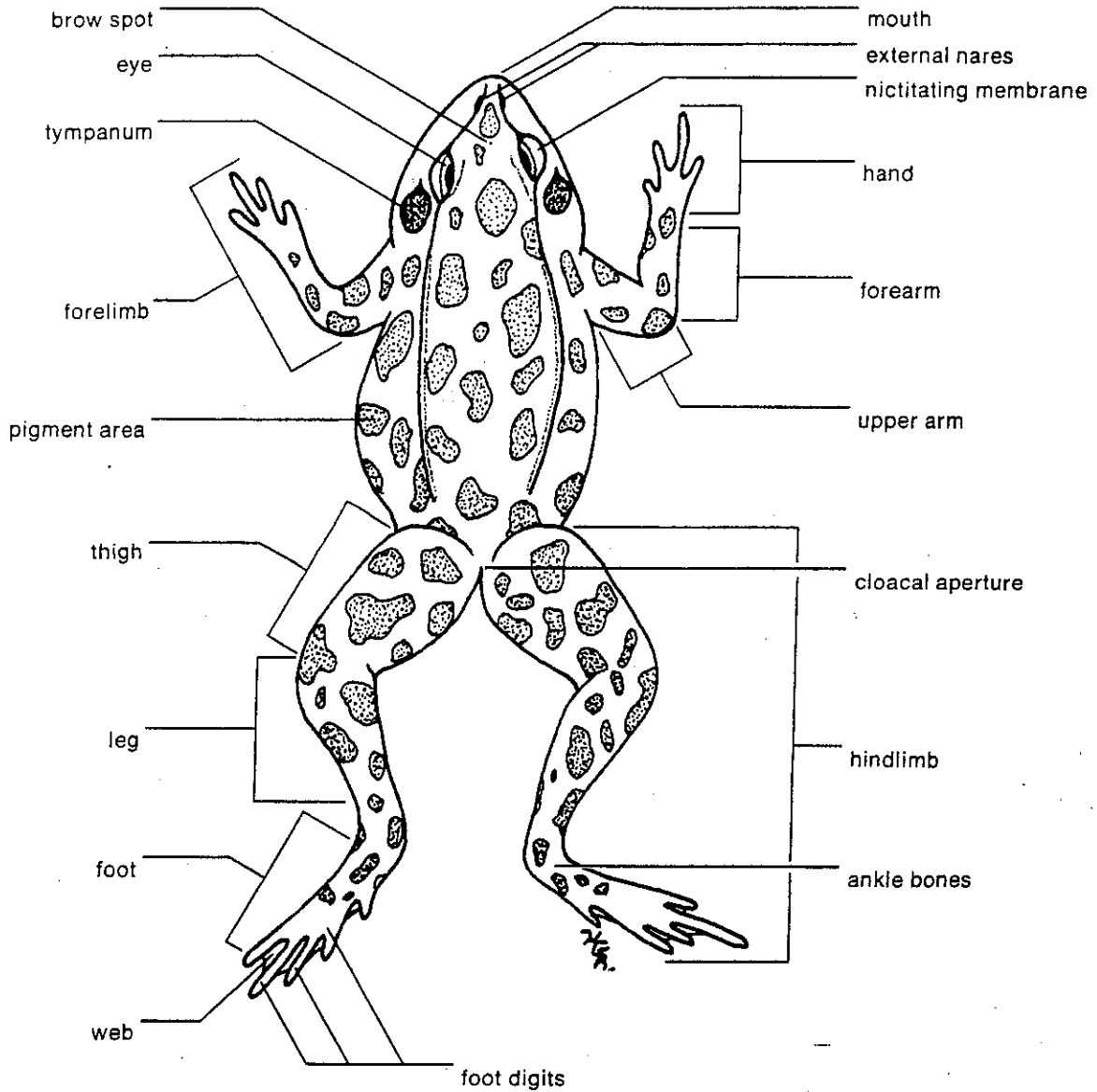


Figure 1

Name _____ Date _____

Ventral view of digestive system.

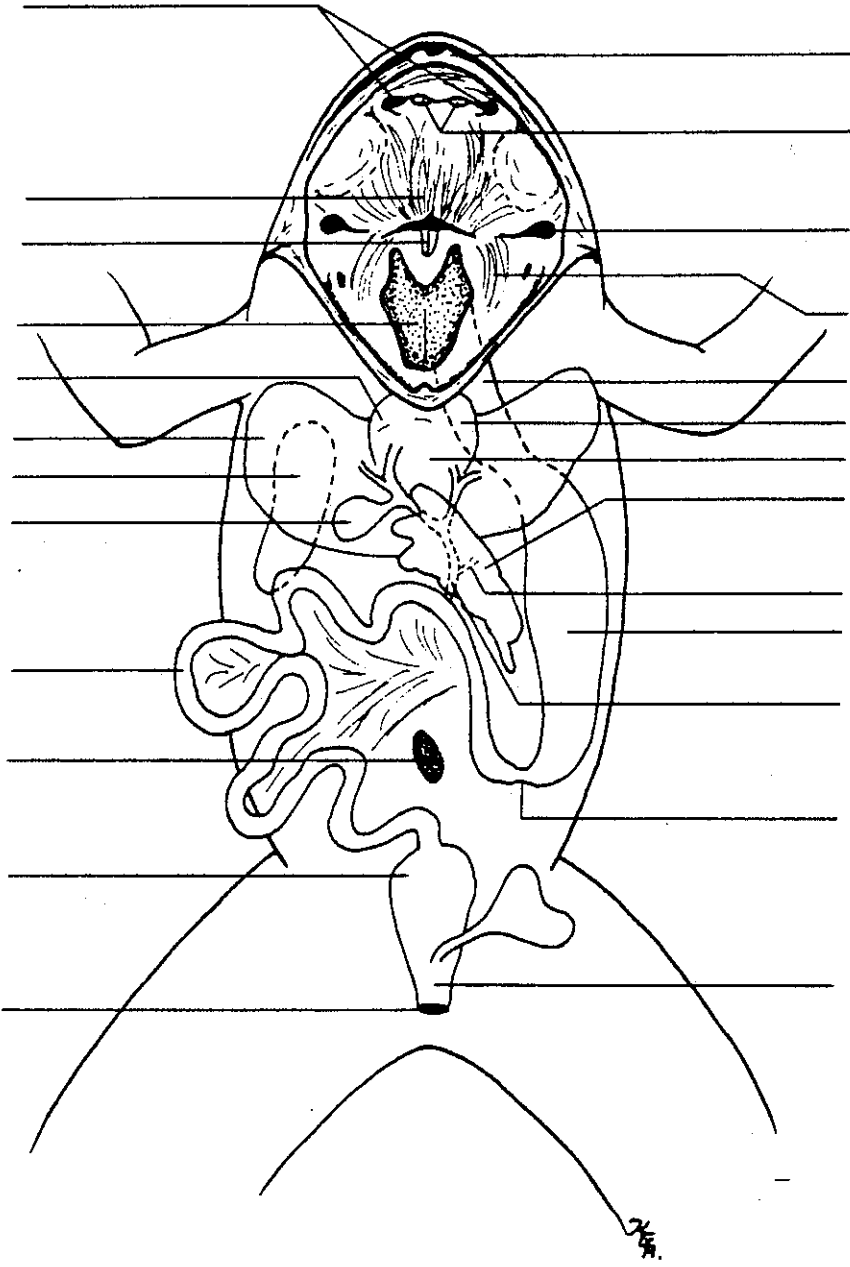


Figure 2

Name _____ Date _____

Ventral view of digestive system.

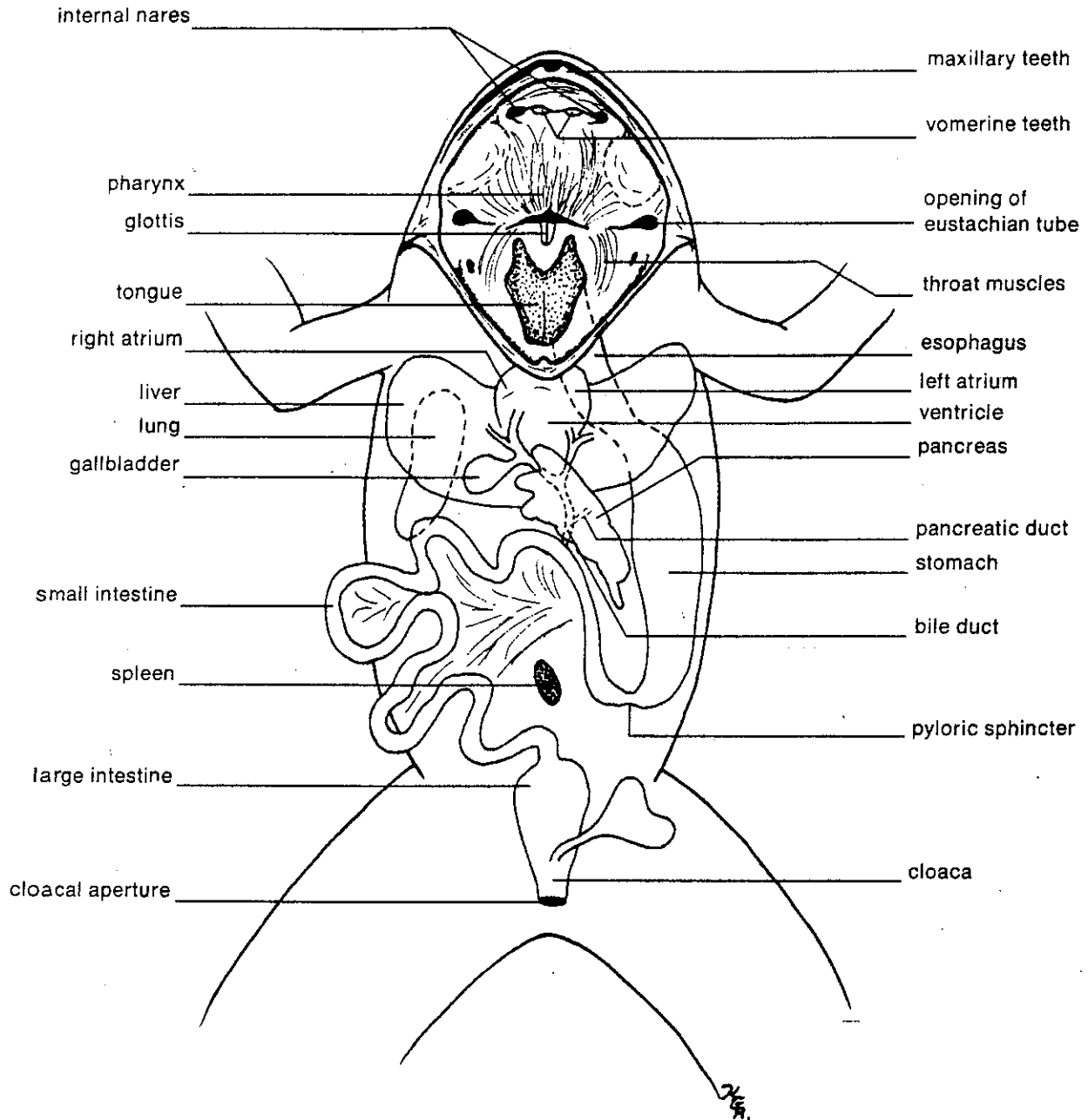


Figure 2

Name _____ Date _____

Ventral view of male reproductive system.

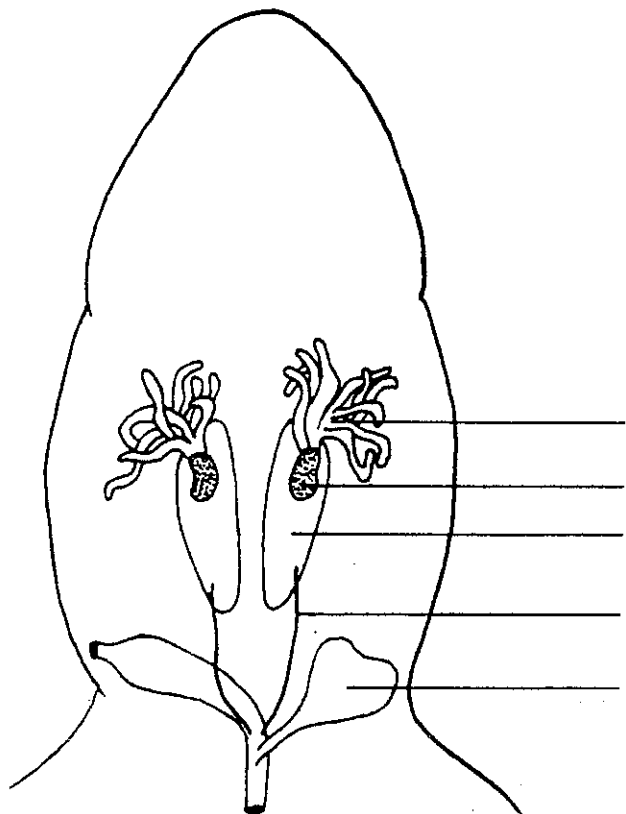


Figure 5

Ventral view of female reproductive system.

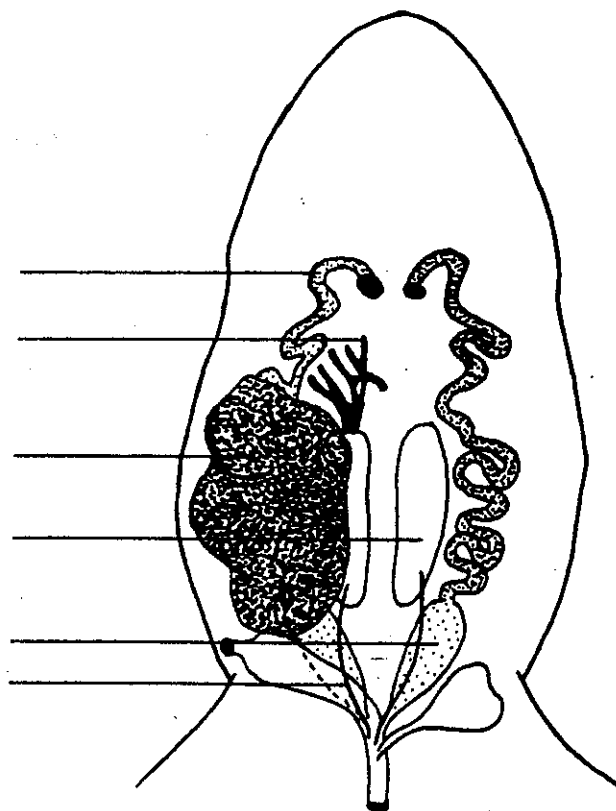


Figure 6

Name _____ Date _____

Ventral view of male reproductive system.

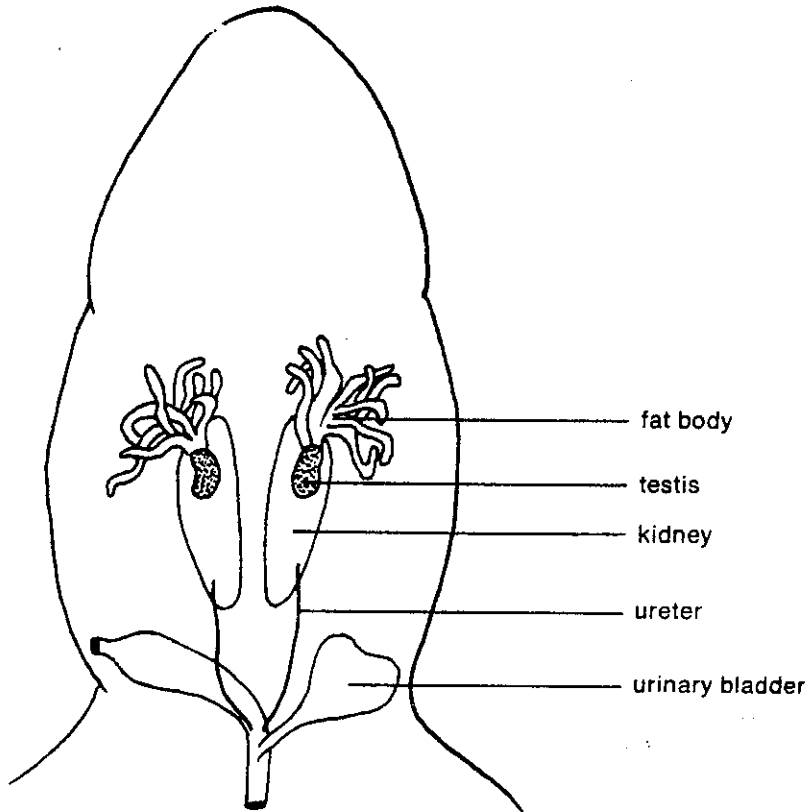


Figure 5

Ventral view of female reproductive system.

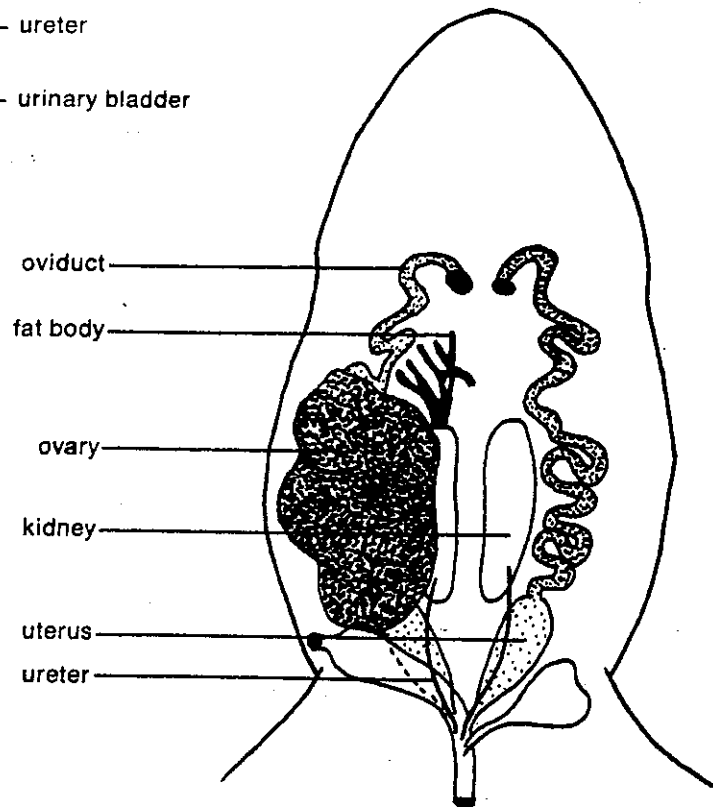


Figure 6

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