

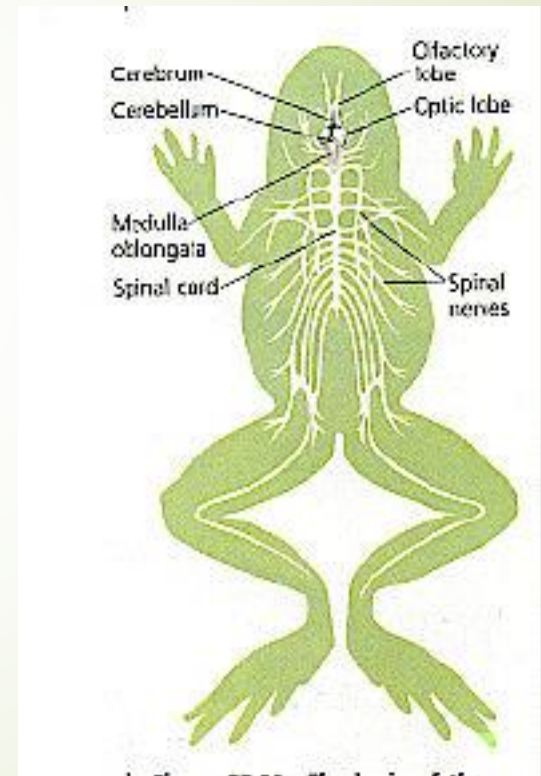
**Nervous and Sensory
Functions, Excretion and
Osmoregulation;
Reproduction, Development
and Metamorphosis**

Amphibian Nervous and Sensory Functions

- ▶ The amphibian brain consists of three embryological subdivisions:
 1. The forebrain contains olfactory center and regions that regulate color change and visceral functions.
 2. The midbrain contains a region called the optic tectum that assimilates sensory information and initiates motor responses, and also processes visual sensory information.
 3. The hindbrain functions in motor coordination and in regulating heart rate and the mechanics of respiration.

The Nervous System

- ❑ The frog brain is more complex than the fish brain, enabling the frog to contend with a more varied environment.
- ❑ The optic lobes, which control vision, lie behind the cerebrum.
- ❑ The cerebellum, a small band of tissue lying at right angles to the long axis of the brain, is the center of balance and coordination.



The Nervous System

- ❑ The medulla oblongata lies at the back of the brain and joins the spinal cord. It controls organ functions.
- ❑ Ten pairs of cranial nerves extend out directly from the brain.
- ❑ The spinal cord transmits signals from all parts of the body to the brain and from the brain back to the body.
- ❑ The spinal nerves branch from the spinal cord to various parts of the body.

Amphibian Nervous and Sensory Functions Continued

- **Sensory receptors are widely distributed across the skin that respond to heat, cold and pain.**
- **Amphibians have singly or small grouping of lateral line systems that respond to low frequency vibrations in water.**
- **They have chemoreceptors in the nasal epithelium and the lining of the mouth, on the tongue, and over the skin.**
- **Olfaction is used in mate recognition as well as in detecting noxious chemicals and in locating food.**

- ❑ Vision is one of the most important senses in amphibians because they are primarily sight feeders.**
- ❑ Eyes are located at the front of the head, providing binocular vision and depth perception.**
- ❑ The lower eyelid is moveable and it cleanse and protects the eye.**

Frog's eyes also work equally well in or out of water. Because the eyes bulge out from the head, the frog can stay submerged while literally "keeping an eye out" for predators



- ❑ Eyelids that can blink protect the frog's eyes from dust and dehydration
- ❑ In addition to upper and lower eyelids, a third, transparent eyelid called a nictitating membrane covers each eyeball and joins the lower eyelid
- ❑ This membrane keeps the eyelid moist and protects it when it is under water



Frogs have eardrums, or tympanic membranes, which are circular structures located behind each eye



Amphibian Excretion and Osmoregulation

- **The kidneys of amphibians lie on either side of the dorsal aorta on the dorsal wall of the body cavity. A duct leads to the cloaca, and a storage structure, the urinary bladder, is a ventral outgrowth of the cloaca.**
- **Nitrogenous waste product comes in the forms of either ammonia or urea.**
 - **Freshwater amphibians excrete ammonia.**
 - **Land-based amphibians excrete urea that is produced from ammonia in the liver.**

Amphibian Excretion and Osmoregulation

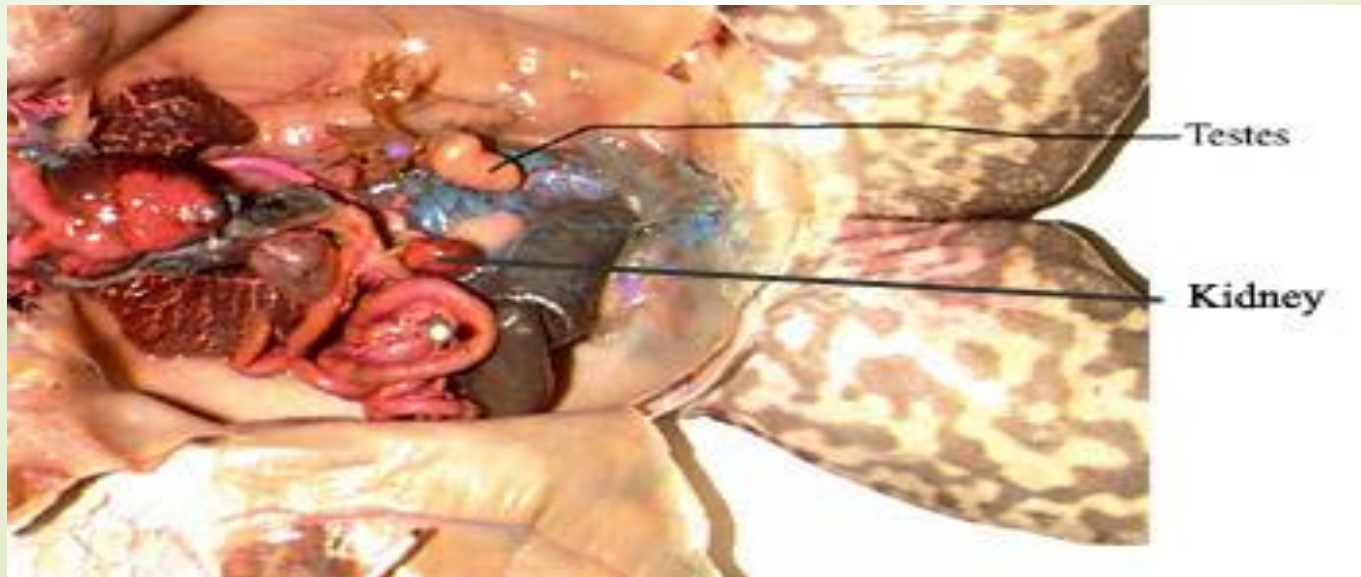
- **One of the biggest problems amphibians face is osmoregulation.**
 - **Facing the same osmoregulatory problems as freshwater fishes they must rid the body of excess water and conserve essential ions.**
- **Amphibians must conserve water.**
 - **Many amphibians reduce evaporative water loss by reducing the amount of body surface exposed to air.**

Excretory System

- ❑ Urine and wastes from the digestive system are eliminated through the anus.
- ❑ When a frog is in water, its permeable skin allows the water to enter its body.
- ❑ Frogs that *live* primarily in water rid themselves of excess water by excreting a large volume of very dilute urine.
- ❑ Frogs that live mainly on land conserve water by producing a small volume of more concentrated urine.

Excretory System

- ❑ Amphibians eliminate two primary types of metabolic waste products—carbon dioxide from respiration and waste compounds from the breakdown of foods.
- ❑ Are the primary excretory organs and lie on either side of the spine against the dorsal body wall. The kidneys filter nitrogenous wastes from the blood

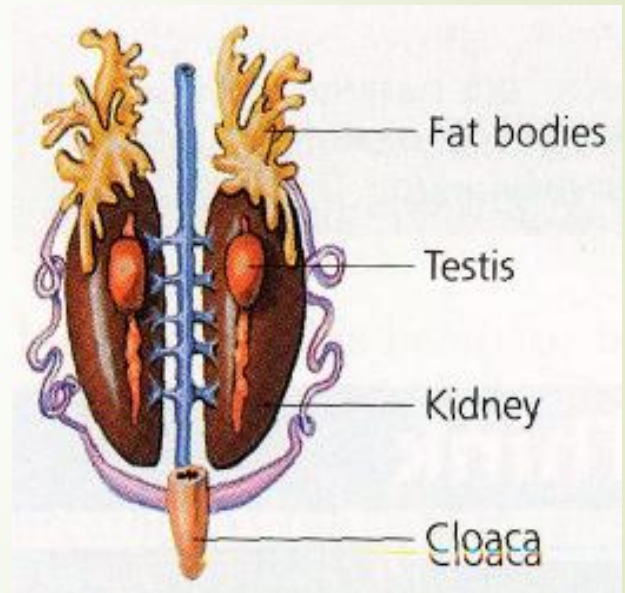


Amphibian Reproduction, Development and Metamorphosis

- Amphibians are dioecious with ovaries and testes located near the dorsal body wall.
- Fertilization is usually external (caecilians are an exception), and because the developing eggs lack any resistant covering, development is tied to moist habitats, usually water.
 - Some anurans have terrestrial nests that are kept moist by being enveloped in foam or by being located near the water and subjected to flooding.
- Only about 10% of all salamanders have external fertilization while all others produce spermatophores, and fertilization is internal.
 - 75% have internal development.
- Metamorphosis is a series of abrupt structural, physiological, and behavioral changes that transform a larva into an adult.
- A variety of environmental conditions, including crowding and food availability, influence the time required for metamorphosis.

Reproductive System

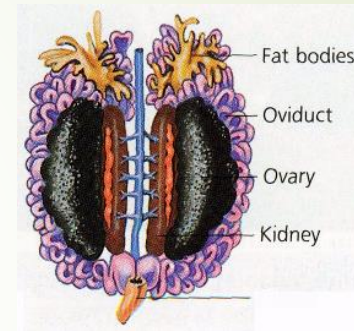
- ❑ Both male and female frogs have internal sex organs
- ❑ The male frog's foreleg muscles and first fingers swell
- ❑ These swellings help the male maintain his grasp on the female
- ❑ The reproductive system of the male frog includes two bean-shaped creamy white or yellowish testes located near the kidneys
- ❑ Sperm cells develop in the testes and pass through tubes to the kidneys and urinary ducts



Male System

Reproductive System

- ❑ Female frogs a pair of large, lobed ovaries containing thousands of tiny immature eggs lie near the kidneys
- ❑ During the breeding season eggs enlarge, mature, and burst through the thin ovarian walls into the body cavity.
- ❑ They remain in structures called ovisacs until ovulation is complete and then leave the body through the cloacae opening.



Female System

Reproductive System

- ▶ The vast majority of eggs and tadpoles are eaten by predators such as fish, birds, snakes, and turtles. Some species of frogs have
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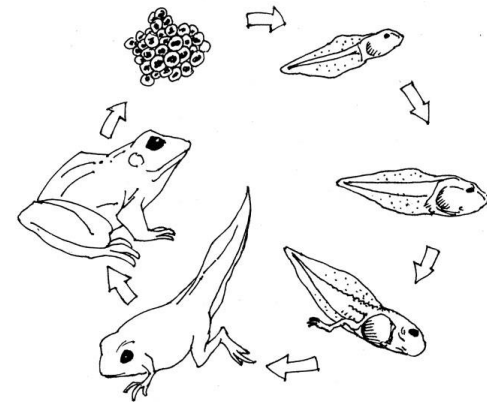
Amplexus

Metamorphosis

- ❑ Newly hatched tadpoles live off yolk stored in their bodies. They gradually grow larger and develop three pairs of gills.
- ❑ Tadpoles have a two-chambered heart. Tadpoles can also regenerate injured or lost body parts such as a leg or tail.
- ❑ Legs grow from the body, and the tail disappears.

Metamorphosis

- The mouth broadens, developing teeth and jaws. A saclike bladder in the throat divides into two sacs that become lungs. The heart develops a third chamber.
- A hormone called thyroxin circulates throughout the bloodstream and stimulates metamorphosis.
- The cells of the tadpole are genetically programmed to respond to thyroxin at the appropriate stage of development.



Frog Life Cycle

