## AMPHIBIAN NOTES

- "Amphibian" comes from the Greek meaning "both life". Amphibians can live on water and on land.
- Scientist infer that amphibians evolved from lobe-finned fishes called crossopterygians.
- Biologist conclude that amphibians appeared during the late Devonian period, about 345 million years ago.
- Crossopterygians had no gills but they had internal nostrils and a primitive lung that may have enabled them then to respire for periods of time on land.


## CHARACTERISTICS OF AMPHIBIANS

- Amphibians are cold-blooded, which means their blood temperature rises and falls with that of the surrounding environment
- They use gills, lungs, skin, and mouth cavity in respiration.

- They have moist, smooth, thin skin with no scales. Feet are webbed and the toes lack claws.
- Amphibians have many prominent characteristics that are adaptations to a life spent both on land and in water: They change from an aquatic larval stage to a terrestrial adult form. This transformation is called metamorphosis

- Amphibians enter a state of dormancy or torpor when conditions are unfavorable.

They often bury themselves in mud or leaves, emerging when conditions are better.

- Such states of inactivity are known as known as:
- Hibernation when it occurs in the winter

Estivation when it occurs in the summer
[ Larvae have two-chambered hearts; adults have three-chambered hearts and well-developed circulation.

Eggs lack multicellular membranes or shells. They are usually laid in water or in a moist environment and fertilized externally.

## CLASSIFICATION OF AMPHIBIANS

Biologists have identified about 2,375 living species of amphibians and have classified them into four orders

Anura - Frogs \& Toads<br>Urodela-Salamanders<br>- Trachystoma - Mud eels<br>Apoda-Caecillians

- Frogs and toads make up the Order Anura ("without a tail").
- Salamanders and other amphibians with legs and tails make up the Order Urodela ("visible tail").
- Some aquatic amphibians (mud eels \& sirens) belong to the Order Trachystoma ("rough mouth")
- Apoda includes caecilians, a tropical, burrowing worm-like amphibians that is often Legless


## ANURAN CHARACTERISTICS

Frogs and toads comprise the order Anura

- There are about 3,500 known species of frogs and 300 kinds of toads They are found on every continent except Antarctica
$\square$ Some types spend their entire life in or near water, but others live mainly on land and come to the water only to mate
- Some frogs and toads are climbers that dwell in trees or burrowers that live underground.

Toads and frogs have many similarities in the way they look. Some basic differences between them are: toads have dry, warty skin, while frogs have smooth, wet skin
B Both frogs and toads return to water to reproduce. In nearly all species eggs are fertilized externally. The fertilized eggs hatch into swimming larval forms called tadpoles

## URODELAN CHARACTERISTICS

Salamanders, typical members of the Order Urodela, have elongated bodies, long tails, and smooth, moist skin
Compared to the anurans, salamanders are less able to remain on dry land, although some can live in dry areas by remaining inactive during the day
Salamander lay their eggs in water and like anurans they hatch into swimming larva
O Other species can reproduce in damp land environments. Eggs laid on land hatch into miniature adult salamanders

## APODAN CHARACTERISTICS

Caecilians, members of the Order Apoda, compose a highly specialized group of tropical burrowing amphibians

* These legless wormlike creatures average 30 cm long, but they can be up to 1.3 m long.
* They have very small eyes and are often blind.
* They eat worms and other invertebrates

The caecilian male deposits sperm directly into the female, and the female bears live young

## TRACHYSTOMA CHARACTERISTICS

* The Order Trachystoma contains three living species of mud eels, or sirens.
* Sirens live in the eastern United States and northeastern Mexico.


## FROG EXTERNAL ANATOMY

The frog's powerful hind legs are equally effective in jumping or swimming. On land frogs sit with their hind legs folded against the body, poised to jump at the first sign of danger.

- Most frogs can make leaps many times their body length

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
The frog's thick, moist skin serves two important functions- respiration and protection

- Glands secrete mucus to keep it from drying up
- Some glands secrete foul-tasting or poisonous substances that protect the frog from enemies Some frogs, such as Hyla versicolor, can change color in order to blend with the environment.


## FROG'S INTERNAL ANATOMY

## SKELETAL SYSTEM


. The frog's spine has nine vertebrae
The cervical vertebra at the anterior end of the spine allows neck movement that helps frogs catch preyPosterior to this are seven trunk vertebrae, and then a single sacral vertebra that supports the hind legs

- A long, slim bone called the urostyle extends from the sacral vertebra
$\square$ Bones of the pectoral girdle, which form the shoulders, connect to the front legs
$\square$ They also provide the primary protection to the internal organs, since the frog has no ribs
$\square$ The pelvic girdle connects to the hind legs


## DIGESTIVE SYSTEM


$\square$ Most frogs feed on insects, and their digestive system is adapted to their diet
$\square$ A frog's tongue is an excellent insect catcher. The frog simply flicks out its long sticky tongue, curls it around its prey, and pulls the insect back into its mouth. Then the frog snaps its mouth shut and swallows.
$\square$ Frogs have two types of teeth that hold on to prey. A row of maxillary teeth line the perimeter of the upper jaw. Two patches of vomerine teeth project from bones in the roof of the mouth.

$\square$ Sometimes the frog blinks, pulls its eyes inward, and presses them against the roof of its mouth. This action helps push the food down its throat
$\square$ Digestion in frogs takes place in the alimentary canal, which includes the esophagus, stomach, small intestine, large intestine, and cloaca

## CIRCULATORY SYSTEM

- An adaptation to the greater oxygen needs of land animals is a more efficient circulatory system than the fish's two-chambered heart.
The amphibian's three-chambered heart partially mixes oxygenated with deoxygenated blood and pumps the blood throughout the body at higher pressure than does the fish's heart

The left atrium receives oxygenated blood from the lungs, and the right atrium receives deoxygenated blood from the body.

- Both the atria empty into the ventricle, the main pumping chamber of the heart.

In the ventricle oxygenated and deoxygenated blood mix partially and are pumped to the lungs and the rest of the body.
From the right atrium the blood enters the single ventricle. The ventricle then contracts, pumping some blood to the lungs to receive oxygen and some to the rest of the body.
The blood going to the body leaves the ventricle through the conus arteriosus, a large vessel that lies against the front side of the heart

- This vessel divides into a right and a left truncus arteriosus, which immediately branch again into three arches that carry blood to various parts of the body.
D Deoxygenated blood travels in veins back to the right atrium from the various regions of the body.
- Oxygenated blood returns from the lungs to the left atrium via the pulmonary veins



## RESPIRATORY SYSTEM

Tadpoles respire, or exchange carbon dioxide and oxygen, through gills

- Adult frogs lose the gills but can respire in three ways: through the lungs, through the skin, and through the mouth.
- Respiration through the lungs is called pulmonary respiration.
- A frog breathes by changing the volume and pressure of air in its mouth while either opening or closing its nostrils
- Air moves from the throat to the lungs through a slit-like passage called the glottis.
- Because the frog's lungs are small, cutaneous respiration, or respiration through the skin in both air and water, is very important, especially during estivation (summer dormancy) or hibernation (winter).
Oxygen can diffuse across the lining of the mouth and into the blood.
- Frogs use mouth breathing for only a relatively small amount of their respiration.


## 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.
- 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


## NERVOUS SYSTEM

The frog brain is more complex than the fish brain, enabling the frog to contend with a more varied environment.
$\square$ 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 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.


## 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
- Female frogs a pair of large, lobed ovaries containing thousands of tiny immature eggs lie near the kidneys

D 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.
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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UROGENITAL ORGANS OF THE FROG


## 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.

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

