

Phylum Amphibia

Phylum Amphibia:

- ~3900 species
- The name amphibian means "**double life**"
- Adult amphibians usually live on land.
- Young amphibians, spend their early years in the water, breathing through gills in the side of their head.
- These were the first chordates that lived on land.
- Dominated the Carboniferous period
 - (345 -285 mya)
 - Therefore we call carboniferous period the "Age of Amphibians"

Characteristics:

- Most amphibians have smooth, moist, soft skin which easily absorbs water.
- Skin has poison glands
- Respiration by lungs, skin and gills either separately or in combo
- All undergo metamorphosis
- Usually 4 limbs
- Young are fish-like, herbivores with 2-chambered heart
- Adults are carnivorous, can live on land, have lungs, 3-chambered heart

Characteristics:

- 3 chambered heart (2 atria, one ventricle)
- Cold-blooded or exothermic (poikilothermic)
- Mouth is usually large
- 2 nostrils open into anterior part of mouth cavity
- Webbed feet without claws (most)
- Skeleton bony; ribs present in some
- Dioecious (separate sexes)
- Most are oviparous
- many amphibians are nocturnal
 - remain in cool burrows or under moist cover during day

Classes:

- **Gymnophiona or Apoda** -- caecilians
 - ~160 species
 - Legless
 - Some have fishlike scales
 - Virtually vertebrae are the only characteristic that distinguishes it from invertebrates
 - Burrow into moist soil
 - Feed on invertebrates




Classes:

- **Urodela or Caudata** -- newts, salamanders, mudpuppies, etc.
 - ~350 species
 - head, tail, trunk, 2pr equal limbs; no scales
 - Body and tail long
 - Most live in moist wooded areas under rocks and logs
 - largest North America: Hellbender ~65cm
 - Mudpuppies keep gills and live in water



Classes:



- **Anura or Salientia**
 - frogs and toads
 - ~3400 species
 - Head, trunk fused, no tail except in larval form, 2pr limbs, no scales, large mouth
 - Toad usually dry, warty skin, more terrestrial
 - Live in areas with ponds and streams and in moist wooded areas

Frog or toad?

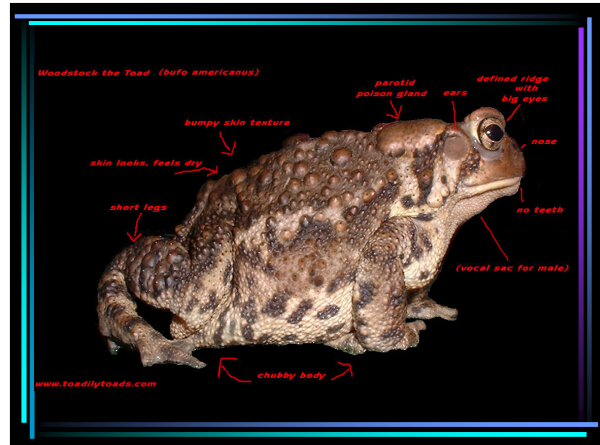
- Frogs:
 - Need to live near water
 - Have smooth, moist skin that makes them look "slimy".
 - Have a narrow body
 - Have higher, rounder, bulgier eyes
 - Have longer hind legs
 - Take long high jumps
 - Have many predators
- Toads:
 - Do not need to live near water to survive
 - Have rough, dry, bumpy skin
 - Have a wider body
 - Have lower, football shaped eyes
 - Have shorter, less powerful hind legs
 - Will run or take small hops rather than jump
 - Do not have many predators. Toad's skin lets out a bitter taste and smell that burns the eyes and nostrils of its predators, much like a skunk does.



Green Pickerel Frog (rana palustris) www.toadilytoads.com

- longer, pointier snout
- bulgier, bulging eyes
- wet looking slime layer
- super long legs for long distance jumping
- teeth in upper jaw
- no parotid glands
- really big ear
- longer, more slender body
- overall smooth skin texture
- large web feet for swimming

Note: some frogs, like this one can produce poisonous secretions



Woodstock the Toad (bufo americanus) www.toadilytoads.com

- parotid poison gland
- ears
- defined ridge with big eyes
- bumpy skin texture
- skin looks, feels dry
- nose
- no teeth
- short legs
- vocal sac for male
- chubby body



Woodstock the Toad (bufo americanus) www.toadilytoads.com

- parotid poison gland
- ears
- defined ridge with big eyes
- bumpy skin texture
- skin looks, feels dry
- nose
- no teeth
- short legs
- vocal sac for male
- chubby body

Green Pickerel Frog (rana palustris) www.toadilytoads.com

- longer, pointier snout
- bulgier, bulging eyes
- wet looking slime layer
- super long legs for long distance jumping
- teeth in upper jaw
- no parotid glands
- really big ear
- longer, more slender body
- overall smooth skin texture
- large web feet for swimming

Note: some frogs, like this one can produce poisonous secretions

Evolution of Amphibians:

- Bones of pelvic girdle and limbs became stronger: allow more efficient movement.
- Broad mouth: allow to feed on plants and insects.
- Lungs: Allow to breathe air
- Ribs form bony cage: internal organs protected.

FEEDING/NUTRITION:

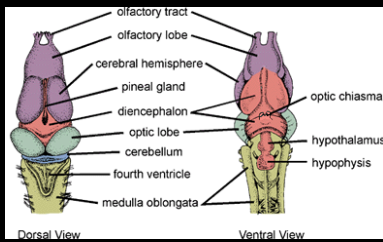
- larva are herbivores- they eat almost continuously, eat algae
- Most amphibians are carnivorous as adults
 - wide variety of inverts
 - diets of some anurans somewhat diverse.
 - Some frogs are known to prey on small mammals, birds and other anurans!
 - Main factors: size, availability
- Anurans prey location by **sight** and then wait for prey to pass by.
- In aquatic salamanders and caecilians **olfaction** important
 - salamanders unspecialized in methods, use only jaws to capture prey
 - Anurans (and some salamanders) use tongue and jaw in a "**flip and grab**" mechanism.
- True tongue first seen in amphibians
 - manipulate food -tongue attached to anterior part jaw, folded back over floor of mouth
 - glands on tip secrete sticky substances
 - When prey is within range the frog lunges forward and flicks out tongue, jaw depresses to create the "flick". Tilting head aids in aiming
 - tip of tongue entraps prey; tongue and prey flip back into mouth
 - 0.05 to 1.5 seconds

Respiration:

- gas exchange across skin: **cutaneous respiration**
- gas exchange on moist surfaces of mouth and pharynx: **buccopharyngeal respiration**
 - 1-7% of total gas exchange
- Larvae use gills and skin
- Adults use lungs, skin, mouth lining
 - Some salamanders have no lungs
 - Salamanders 30-90% gas exchange across skin
- Buccal pump operates ventilation of lung.
 - Muscles of mouth and pharynx create pressure to force air into lungs.

Response:

- Brain: same basic structures as the fishes.



Response:

- Eyes
 - Large
 - Can move around in sockets
 - Probably not very good at distinguishing colors
 - Protected by a nictitating membrane
 - Protects from damage underwater and from drying out on land
 - It is inside the eyelid
- Lateral line system
- Hearing
 - Tympanic membrane
 - Like the eardrum
 - Located on either side of head behind the eyes

Response:

- **AUDITORY SYSTEM**
 - Coevolved w/vocalization; adapted for life on land
- transmits both **substrate borne** and **air borne** vibrations
 - **Tympanic membrane**, middle ear (stapes); inner ear (ossicles)
 - receives high frequency airborne vibrations and transmits to middle ear via stapes, cause pressure waves in fluid of the inner ear and stimulate receptors
 - Substrate borne vibrations are transmitted through front appendages, stimulates second patch of sensory cells, low frequency

*high freq airborne ---> mating
low freq substrate borne ---> warning of predators

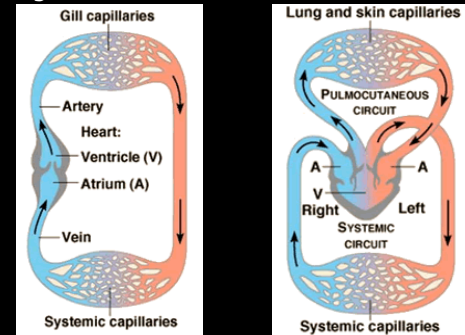
Response System: Vocalization

- Vocalization- use of larynx and vocal cords
- Muscles control tension cords, responsible for regulating frequency of sound
- Vocal sacs act as resonating structure and increase volume
- Well developed in males
 - have vocal sac from lining of the buccal cavity
 - air from lungs forced over vocal cords and larynx causing vibration
- Calls:
 - Advertisement calls (males): attract females, define territories 1
 - Reciprocation calls (females)
 - Release call: given by unresponsive female or offended male 2
 - Distress call: non-reproductive, either sex in response to pain

Circulation:

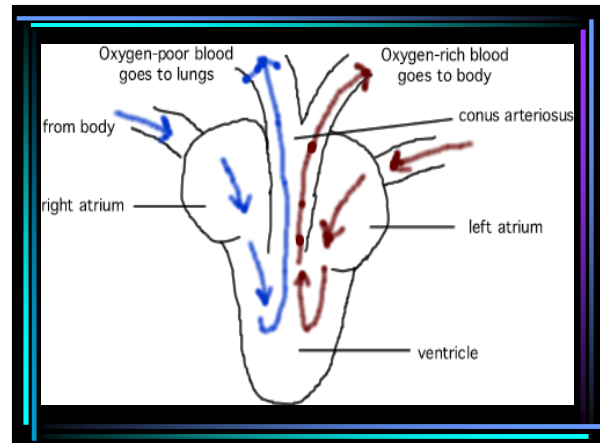
- Double loop circulatory system
 - First loop carries oxygen poor blood from heart to the lungs
 - Second loop carries oxygen rich blood from the heart to the rest of the body (and oxygen poor blood from the rest of the body to the heart.)

Single vs. Double



Circulation:

- The heart has 3 chambers:
 - Left Atrium
 - Oxygen rich blood from the lungs and skin enter the heart here.
 - Right Atrium
 - Oxygen poor blood from the body enters here.
 - Ventricle
 - When atria contract, the blood enters the ventricle
 - When the ventricle contracts, the blood then is pumped to a single blood vessel that divides and transfers blood to the rest of the body through smaller vessels.
 - Conus Arteriosis



Excretion:

- Kidneys filter wastes from the blood
- Kidney excretory product is urine
- Urine passes from kidneys to ureters.
- Urinary bladder can store urine
 - Located just above the cloaca

Movement:

- Dependent on appendages, not body wall, for locomotion
 - Body wall musculature is reduced
- Larvae and salamander movement resembles fish movements;
- Adult amphibians use frogs hind legs and modified pelvic girdle
 - Efficient lever for jumping
- Some have disks on toes that act like suction cups.
 - Helps when climbing

Movement:





- Skeleton modified:
 - Support against gravity
 - Support powerful muscles
 - Skull flattened and relatively small w/few bony elements (lighter skull so it can be supported out of water)
 - Jaw: allow crushing force applied to prey
 - vertebral column provides support and flexibility; like arc of suspension bridge
 - Have neck; cervical vertebrae articulates w/back of skull allowing vertical movement of head
 - Ribs for anchoring pelvic girdle to vertebral column

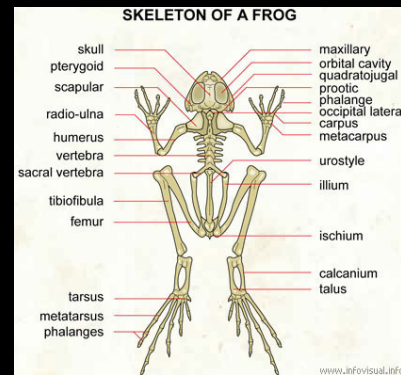
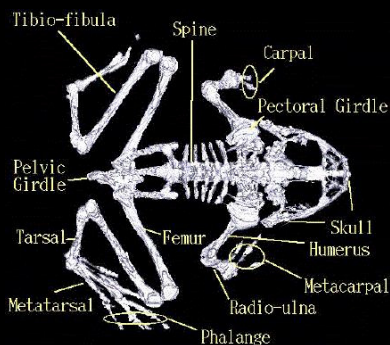
Reproduction:

- Dioecious
- Courtship
- Oviparous
- Fertilization usually external
 - 90% of salamanders though have internal fertilization practices
- Eggs lack resistant coverings
 - Dry out if not kept moist
 - Development usually in moist surroundings (water)
- Most amphibians abandon eggs after they are laid
 - A few take care of them
 - Some even incubate them in their mouth, on backs, or in stomach
- Development includes larval tadpoles; differ from adult in respiration, locomotion and diet (reduces competition)
- Reproduction is hormonally controlled w/seasonal influences
- Males (Anurans) grasp females w/ fore limbs and orient in same direction, male in the dorsal position. Males release sperm and in response the female releases approximately 200 eggs. Called amplexus can last 1 to 24 hours.
 - After the eggs are fertilized, the mass of eggs are encased in a sticky transparent jelly-like substance.
 - This allows protection and nourishment.
 - The mass of eggs are then attached to an aquatic plant.
 - The embryos develop into a tadpole.



Life Cycle of frog/toad

- Eggs: 6 to 21 days 
- Tadpoles: About 6 to 9 weeks, the tadpoles start to absorb their tails and grow legs and arms. 
- Froglet: By 12 weeks, the tadpole has a tiny tail stub and will soon leave the water. 
- Frog: Between 12 to 16 weeks, the froglet totally becomes an adult frog. 
- Many live between 2 to 40 years!



Ecology:

- Why are amphibians good prey?
 - They have no fur, scales, or feathers for the predator to have to deal with.
 - People eat the legs.
- Worldwide trend indicates that the populations of amphibians are declining.
- Environmental threats
 - Decreased habitat
 - Water pollution
 - Air pollution
 - Human population increases
 - Fungal infections
 - Introducing invasive species that are amphibian predators