AMPHIBIA

Amphi: Two

First group of vertebrate living in terrestial environment.

- Life on land is a major theme of remaining vertebrate groups, which form a clade the **superclass Tetrapoda.**
- **Amphibians and amniotes** (including non-avian reptiles, birds and mammals) are **the two major extant brances of tetrapod phylogney which orginates in the Devonian period.**
- Amphibians are **ectothermic primitively quadrupedal tetrapods** with **glandular skin**.
- Many amphibians depend on freshwater streams or pools for their reprduction

- Movements from water to land is perhaps the most dramatic event in animal evalution **because it involves the invasion of physically dangerous habitats.**
- Life orginated in water. Animals are mostly water in composition and all cellular acitivites occur in water.
- Nevertheless, organisms penetrated the land, carrying their watery composition with them.
- Living on land required modification of almost **every organ system**, aquatic and terrestrial vertebrates retain many structural and functional similarities.

Dry Skin

Lung respiration

Amniotic egg

Movement

Sense organ

Denovian Origin of Tetrapods

As a result of the drought at the end of the Devonian, some of the most primitive groups of Teleostei, the Dipnoi (lung fish), have evolved.

From Water to Land in Ontogeny and Phlyogeny

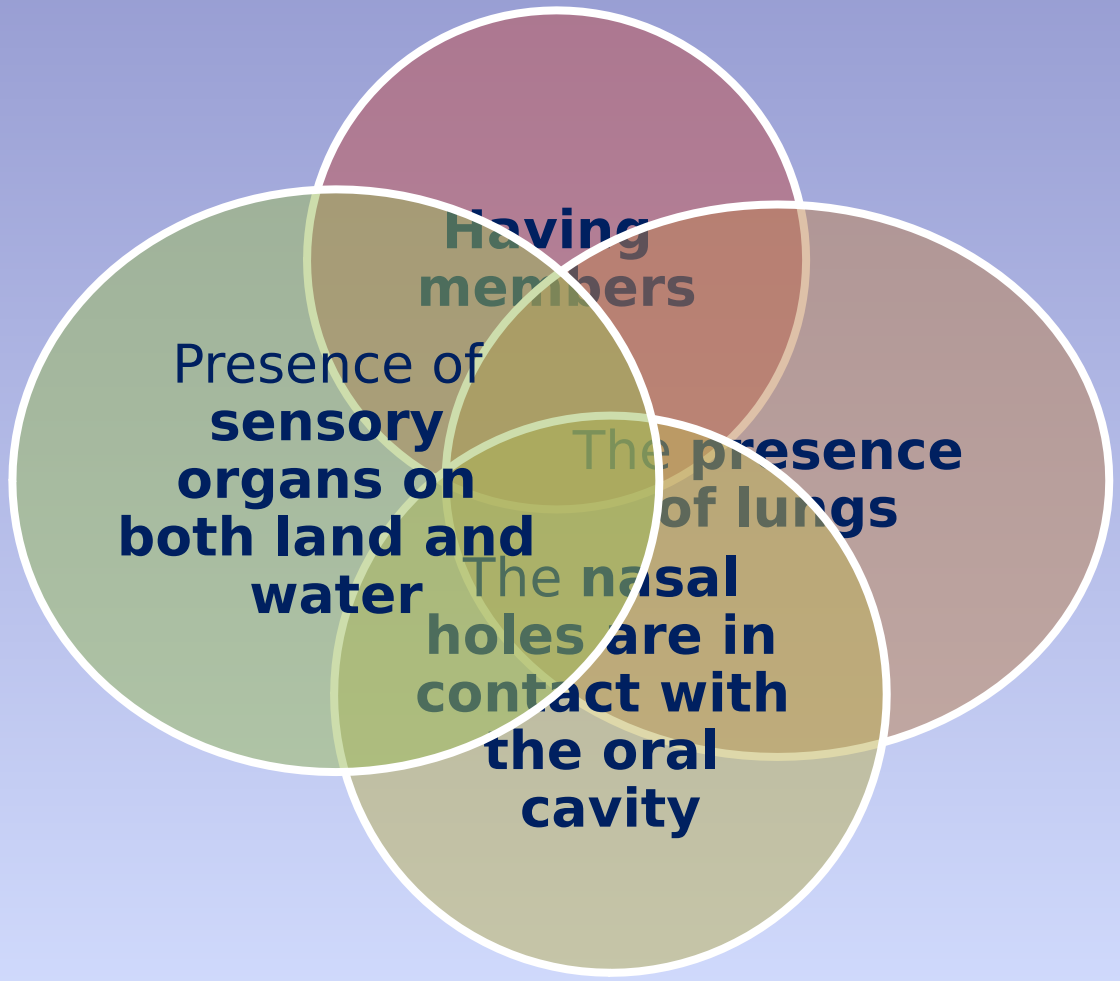
- The evolutionary transition from water to land occured over millions of years.
- A long series of alterations cumulatively fitted **the vertebrate body plan for life on land.**
- Amphibians include the only living vertebrates that have a transition from water to land in both their ontogeny and phylogeny.
- Even after 350 millions years of evolution, **amphibians remain semi-terrestrial**, hovering between aquatic and land environments.

Changes from Water to Land

1. **Skin:** A layer of hard epidermis surrounded by a keratin sheath instead of a soft epidermis
2. **Amniotic Egg:** Egg surrounded by embryonic membranes such as amnion, chorion and allontois. It protects against drying and mechanical impacts and contains replacement nutrients.
3. **Respiration:** Pulmonary respiration
4. **Circulation:** two systems: the systemic system that provides the circulation of the body and the pulmonary system that provides the circulation of the lungs.

5. **Movement:** Lobe fins are replaced by articulated members. Walking, running, climbing and adapting to flying.
6. **Sense Organs:** The sense of vision (eyelids) and the hearing organ is well developed.
7. **Excretion System:** Specialized to use water in the most economical way. Birds and reptiles throw away ammonia in the form of uric acid and mammals out in the form of urea.

Different Features From Fish



Characteristics

- There are **plenty of glands in their skin**. These secretions provide a suitable environment for skin **breathing, keeping the skin hydrated continuously** .
- **Two pairs of members for swimming and walking.**
- **4-5 or fewer fingers, and some members become rust.**
- Their mouths are **quite wide**, **both have small teeth**. **Nose holes are two**.
- Eyelids are **mobile**.
- Most of the skeleton is in **bone structure**.
- **The ribs are not attached to the sternum** when available.

- Their hearts are three-part, with two atriums and a ventricle. They have two different circulations, **body and lung circulations**. Their skins are rich in capillaries. **The red blood cells are oval and core.**
- Respiratory organs are gill in the period of larval stage; skin, lung or oral cavity in adult.
- Body temperature varies depending on the environment. Also called ectotherm-poikiloterm animals.
- 10 pairs of nerves come out of the brain.
- In their development, metamorphosis stage is seen, the larval period passes through the water.
- Their sex are separate, female and male.
- Fertilization occurs internal or external.
- It is mostly ovipar.

MORPHOLOGY

Apoda

(Non-member Amphibia)

- The body structure look like the earthworm and the members become dull.
- They show a ring structure and have small flakes under the skin.

Urodela (Tailed Amphibia)

- The body is long and round, there is **no specific head and neck part.**
- **A long tail** is available.

- **Anura (Frogs)**
- The head and body are joined; **no specific neck area or tail** was formed.
- The front members are short and the back members are long.
- During the breeding season, the first finger turned to the pillow-shape structure in males.
- **They have got third eyelids** that are transparent from the upper and lower eyelids **(Protection)**
- Timpanal membrane are located behind the eyes.
- Some of them have got small tubercles at the front and back members (**used for nesting and digging soil).**
- Small disc-shaped tubercles are present on all fingers of leaf frogs (Hylidae)

SKIN AND COLOUR

- Since they spend a part of their lives on land, they consist of **two layers: epidermis and dermis**. **Their skin is naked and always moist.**
- The epidermis consists of the **stratum germinativum (lower part)** and the **stratum corneum (upper part).**
- **Straum corneum** is under the control of the **pituitary and thyroid glands** and **has a protective role.** Sometimes some of the dead cells occur in the accumulation of **keratinised structures** (**horny teeth, skin on the reliefs**).

- The dermis is **made of connective tissue**. **Mucus, venom glands, color cells, nerve and blood vessels are located in this layer.**

- Skin must be **moist** for the **skin respiration** .
- **Mucus secretion**; prevents water from entering the body, plays a role in **regulating body temperature**.

- The skin is molted at regular intervals.
- The venom glands protect these animals from their enemies.
- The venom glands of some amphibians can often cause effects such as **nerves, visoconstriction, break up the blood cells and phantasmata**.
- Some have their own odor. This helps males and females to find each other during the breeding season.

- They adapt to the color of the environment by showing very different colors.
- Color occurs physical events such as refraction of light, distribution, scattering and chemical events, which also formed by **chromatophore cells.**
- Pigment cells (chromatophore) play a role in color change. There are 3 types of chromatophore cell layers: **melanophore, guanophore and liphophore.**
- Colour changing depends on the amount of intermedine which is secreted from the back of the **pituitary gland.**

SKELETON SYSTEM

- It serves to keep the soft parts of the body upright, to protect the organs, to connect the muscles that provide movement.
- In the larval stage, the skeleton is composed of the cartilage whereas it is the bone structure is in the

1. **Axial skeleton:** It consists of the head, spine, breastbone and ribs.
2. **Appendicular skeleton:** It consists of a chest strap, anterior legs, a hip strap, and hind legs.

- The first vertebra that connects the spine to the skull is called **ATLAS.**
- While in tailed amphibians have 100, non-members have 200 cartilage spin; **the frogs have up to 10 ossified vertebrae**.
- **The sternum is the first time seen in Amphibia.**

- The frogs have clavicula, coracoid, scapula and suprascapula bones from the midline of the chest strap.
- Clavicula, coracoid and scapula bones are connected to each other where there is a glenoid pit. The humerus bone of the forearm makes joints

MUSCLE SYSTEM AND MOVEMENT

- Smooth muscle, Striated muscle Heart muscle.
- The muscles in the dorsal part are very well developed
- There are **no skin muscles**. Muscles in the extremities are better developed.
- The **horizantal septum,** which separates the **ventral and dorsal body muscles**, shifts towards the back and causes the muscles to shrink.

DIGESTION SYSTEM

- Mouth - esophagus – stomach - small intestine - large intestine – cloac - anus
- The upper jaw has very thin teeth.
- Their mouths are wide. They have got small teeth either only the upper jaw or in both jaws.
- They have got movable tongue.
- Aquatic amphibians don’t need oral glands.
- In terrestrial amphibians, there is a large amount of mucus glands, especially on the tongue.
- In terrestrial amphibians, intermaxillary glands and vomer teeth that release glue secretion are found in the mouth of the mouth.

- There is **a glottis** (in the begining of pharynx) in the form of a small hole.
- Glottis opens to larynx and prevents nutrients from entering the lungs.
- A short esophagus and then the stomach.
- The mucus glands, lining the inner surface of the stomach, consist of a single cell.
- The small intestine is separated from the stomach by the ploidy syphincter.

CIRCULATION SYSTEM

- Their hearts are three-part, with two atriums and a ventricle.
- They have two different circulations: the body and the lung (pulmonary).
- Heart is got the clean blood from lungs and venose blood from body

RESPIRATORY SYSTEM

- They breathe through the **gill, lung, skin and oral cavity.**
- They have got gills during the embryos and larval stages.
- Tailed amphibian larvae swallow large nutrients; frog larvae are also fed with plankton. Thus, internal gills are formed in them.
- In aquatic salamanders, the gills retain their presence throughout the life and breathe like fish (gill respiration).

- **The lungs are simple sac.**
- In aquatic species, the inner surface of the lungs is flat and has a **hydrostatic function in respiration.**
- In terrestrial species, **the alveoli caused by twisting of the inner surface causes the respiratory surface to increase.**
- The air passes through the nostrils into **the nasal cavity and into the oral cavity with internal nostrils.**
- It is transmitted to the bronchi and lung through glottis and trachea with **simple swallowing movements.**
- The upper of **trakea** expands in frogs and become the **form of larynx.**
- **Larynx is bigger in males.**
- Sound is made by wires in the region of the larynx

NERVOUS SYSTEM

Central, environmental and autonomic nervous systems are examined in three parts.

1. C.N.S: It is composed of brain and spinal cord. Brain;

Telencephalon (forebrain): Coordinating olfaction

Diencephalon (intermediate brain)

Mesencephalon (midbrain): Coordinating vision

Metencephalon (posterior brain-cerebellum)

Myelencephalon (hindbrain): Coordinating hearing and balance

2. P.N.S: It consists of afferent (sensory) and efferent (motor) nerves.

Afferent nerves stimulates C.N.S;

Efferent nerves C.N.S transmit orders to the relevant parts.

3. **A.N.S:** It involuntarily controls the functioning of the

SENSE ORGANS

- **Sense of Touch:** Skin; the skin is sensitive to light.
- **Olfactory Organ:** Nostril; the **"Jacobson organ (Vomeronasal organ)"**, which is responsible for odor, first appears in amphibians.
- **Vision:** Organ of vision is one of the most important organs. **Eyelids** and **lachrymal glands** are available. They have got two eyelids (in the upper and below). There is also **a third eyelid** that covers the eye in danger.
- **Hearing:** Hearing organs vary. **There is no middle ear in salamanders**.
- **Frogs have both inner ear and middle ear (tymphanum)** located on both sides of the head. No external ear (ear hole and auricle)
- **Line Lateral System:** Similar to the fish's line lateral system. This system is found in the larval stage of all

UROGENITAL SYSTEM EXCRETORY AND REPRODUCTIVE SYSTEMS

- Frogs have got a pair of kidney. The kidneys are **mesonephric or opisthonephric**.
- **Urea** is the main nitrogenous waste.
- **Their bladder is called allantoic.**
- In some toads, **the glomeruli are blunted and prevent water loss.**
- **Waste and excess water pass through ureter to the bladder as urine.**
- **Passes into cloaca and exists out the vent.**

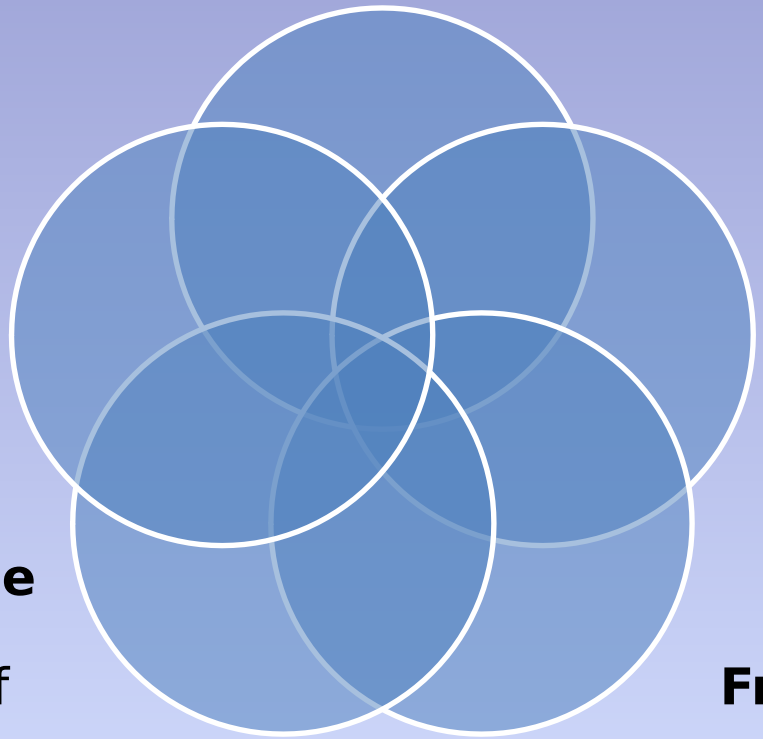
REPRODUCTIVE SYSTEM

- Seperate sexes (male and female)
- Fertilization mostly **external in frogs and toads**; **internal in most slamanders and caecilians.**
- **Predominantly oviparous**; but some ovoviviparous or viviparous.
- Eggs moderately yolk with jelly-like membrane covering.
- Aquatic larva often present with metamorphosis to a more terrestrial adult form

Changes in the Larval During Metamorphosis

The mouth expands and the keratin jaws are replaced by real jaws.

Dorsal and tail fins are absorbed.



Gills disappear, gill slits close and **lungs occur**.

Small intestine is shortened (larval stage of herbivorous, carnivore in adult stage).

Front legs start appearing.