Kingdom Plantae

Botany

Kingdom Plantae

- Are plants are multicellular and eukaryotic
- Cell walls contain cellulose
- Autotrophic
- Both asexual and sexual reproduction
- Examples: Mosses, ferns, conifers, flowering plants

Kingdom Plantae

- Most plants consist of three main parts:

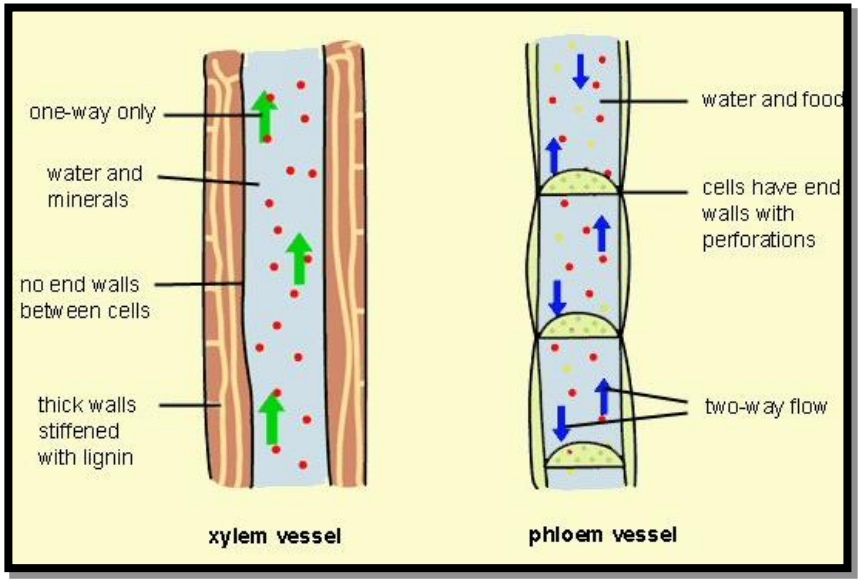
1. **Roots**
   - Penetrate soil to anchor plant
   - Obtain water and dissolved nutrients

Kingdom Plantae

2. **Leaves**
   - Provide surface area to collect sunlight for photosynthesis
3. **Stems**
   - Structure and support
   - Vehicle for the transportation of water and nutrients

Xylem & Phloem

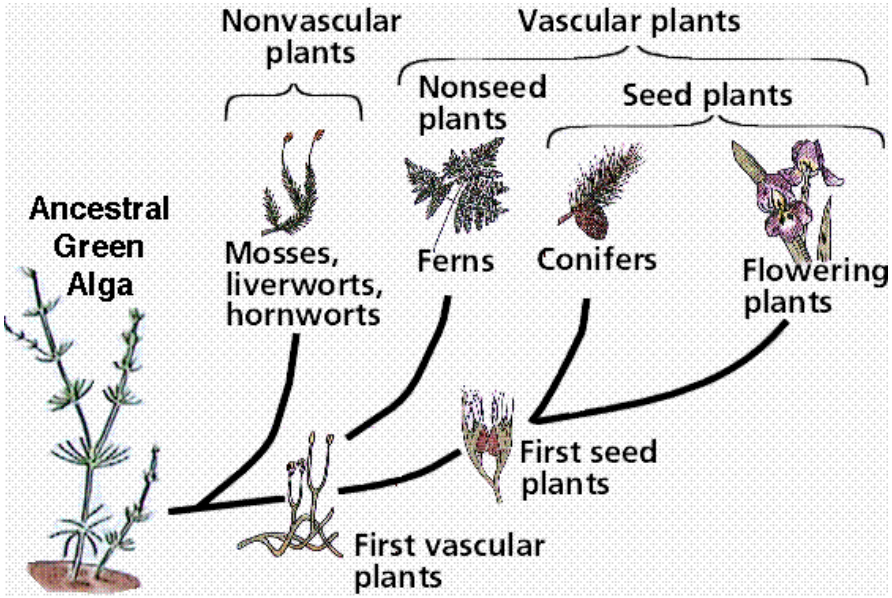
- **Vascular tissue** is a collection of specialized cells which move water and nutrients throughout the plant
- **Xylem**: transports water and nutrients up the plant
- **Phloem**: transports glucose down stem to the roots



Classification of Plants

- Most plants have vascular tissue
- Classified as such:

1. **Vascular Plants**
   - Flowering plants, ferns
2. **Non-vascular plants**
   - Mosses, liverworts



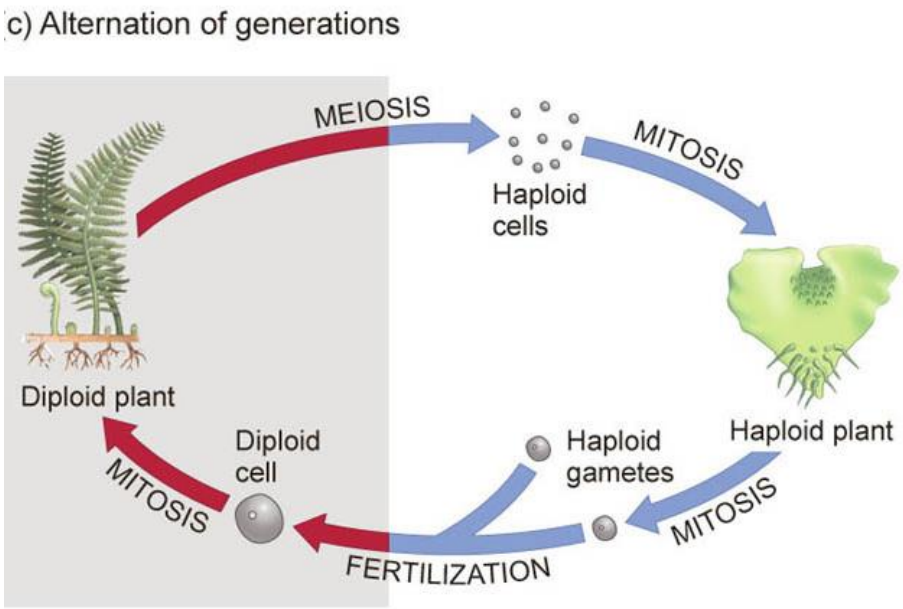
Plant Lifecycle

- Life cycle of plants consists of two generations which alternate
- Stages alternate between a haploid and diploid stage
  - **Diploid (2n)**
    - Each cell contains 2 copies of every chromosome
    - Humans diploid number is 46 (2 x 23)
    - Somatic body cells
  - **Haploid (n)**
    - Each cell contains one copy of every chromosome
    - Human gamete cells contain 23 chromosomes

Alternation of Generations

- Cycle consists of two generations:

1. **Sporophyte Generation**
   - Spore producing
2. **Gametophyte Generation**
   - Gamete Producing



Sporophyte Generation

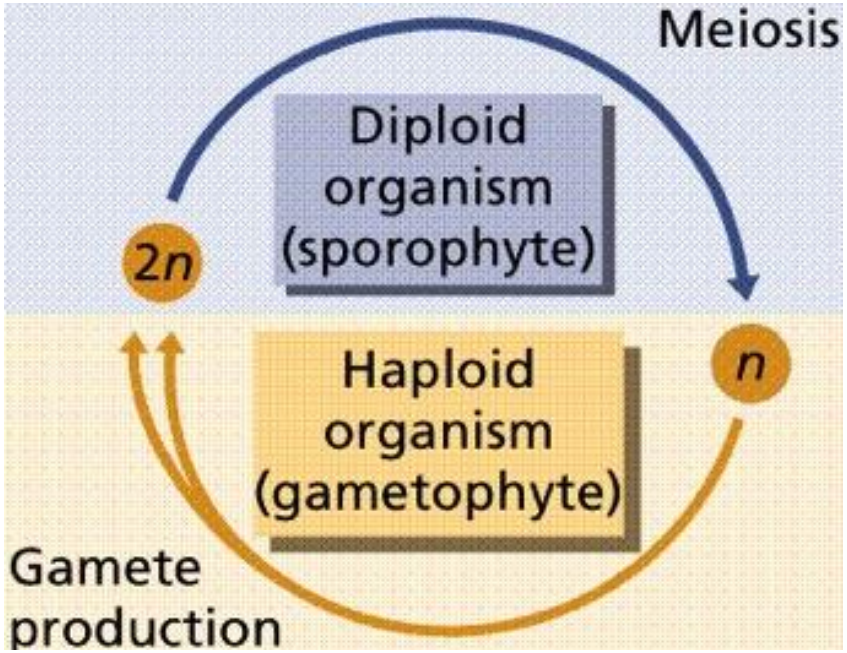
- The **diploid generation**
- Through meiosis **sporophytes** produce haploid **spores**
- Haploid spores develop into a plant body
- Asexual reproduction

Gametophyte Generation

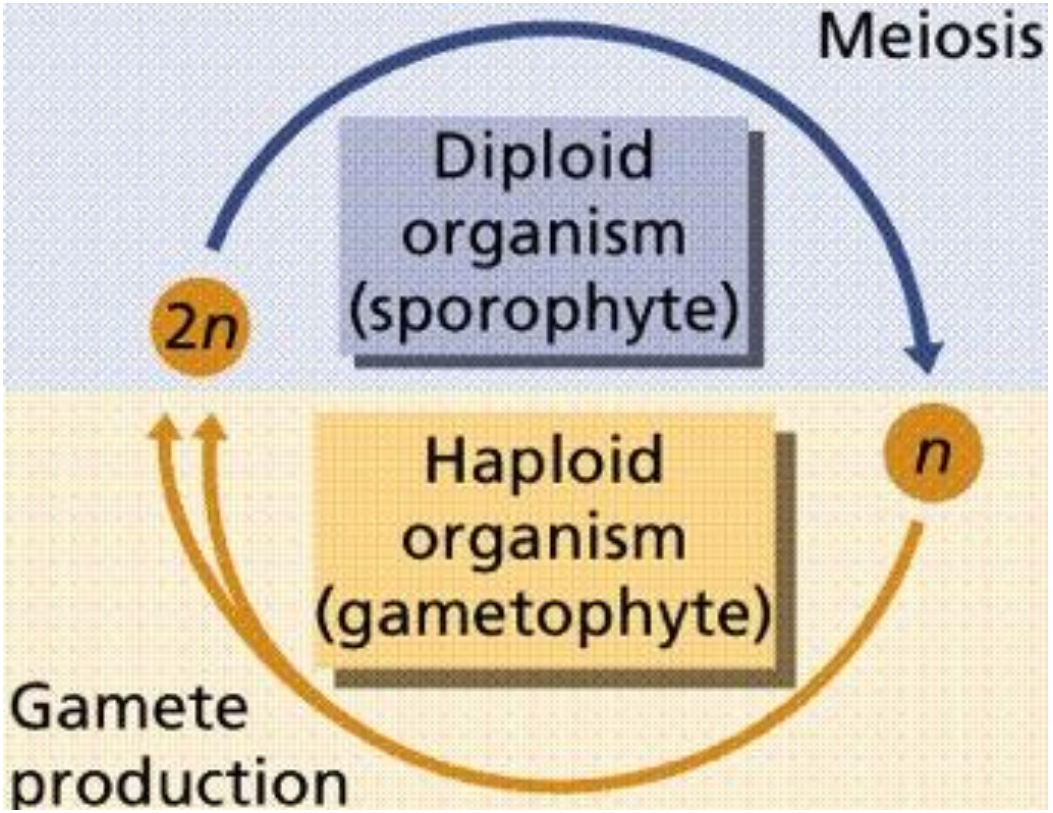
- **Haploid** generation
- Plant body is called a **gametophyte**
- Produces **gametes**
- Gametes (male and female) fuse to form sporophyte – cycle repeats
- Sexual reproduction

Alternation of Generations

- All plants contain a sporophyte and a gametophyte generation
- However, in all cases, one generation is more dominant then the other
  - Non-vascular: Gametophyte
  - Vascular: Sporophyte



Alternation of Generations



Classification of Plants

Vascular vs. Non-Vascular Plants

Classification of Plants

- Remember that plants are classified based on the presence or absence of vascular tissue

1. **Non-Vascular Plants - Bryophytes**
   - Mosses, liverworts, hornworts
2. **Vascular Plants - Tracheophytes**
   - Seedless
     - Ferns
   - Seeded
     - Gymnosperms (Cones)
     - Angiosperms (Flowering)

Bryophytes

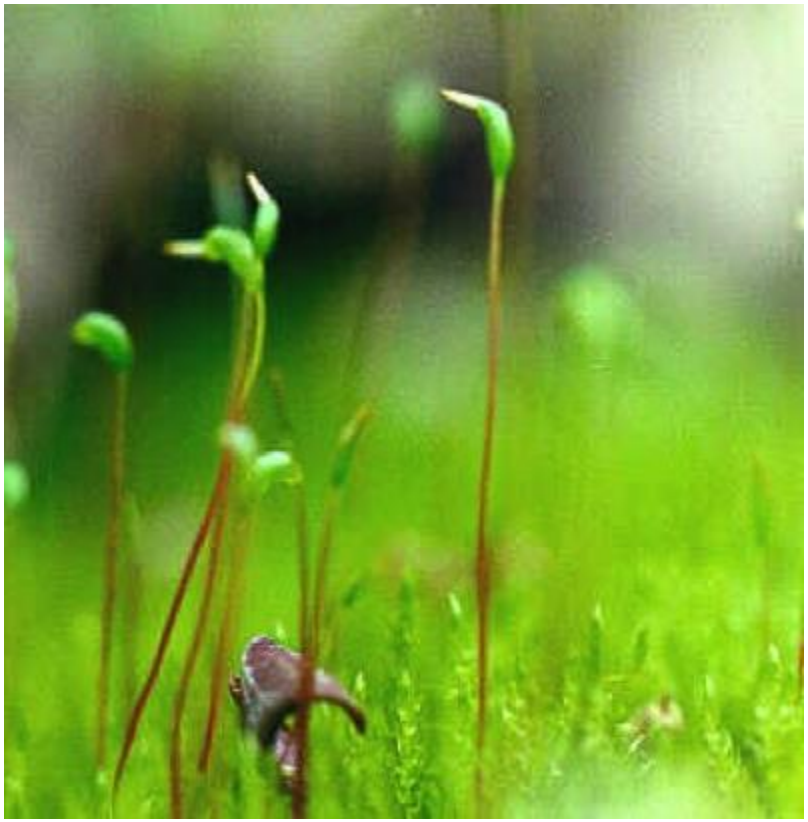
Moss, Liverworts, Hornworts

Phylum Bryophyta

- Bryophytes are non-vascular
- They do not possess true roots, stems, and leaves
- Small in size - adaptation
  - Lack an internal support system - why?
  - Uptake and transport of water and nutrients occurs through **osmosis** and **diffusion**
- Presence of water VIP – why?

Bryophyte Lifecycle

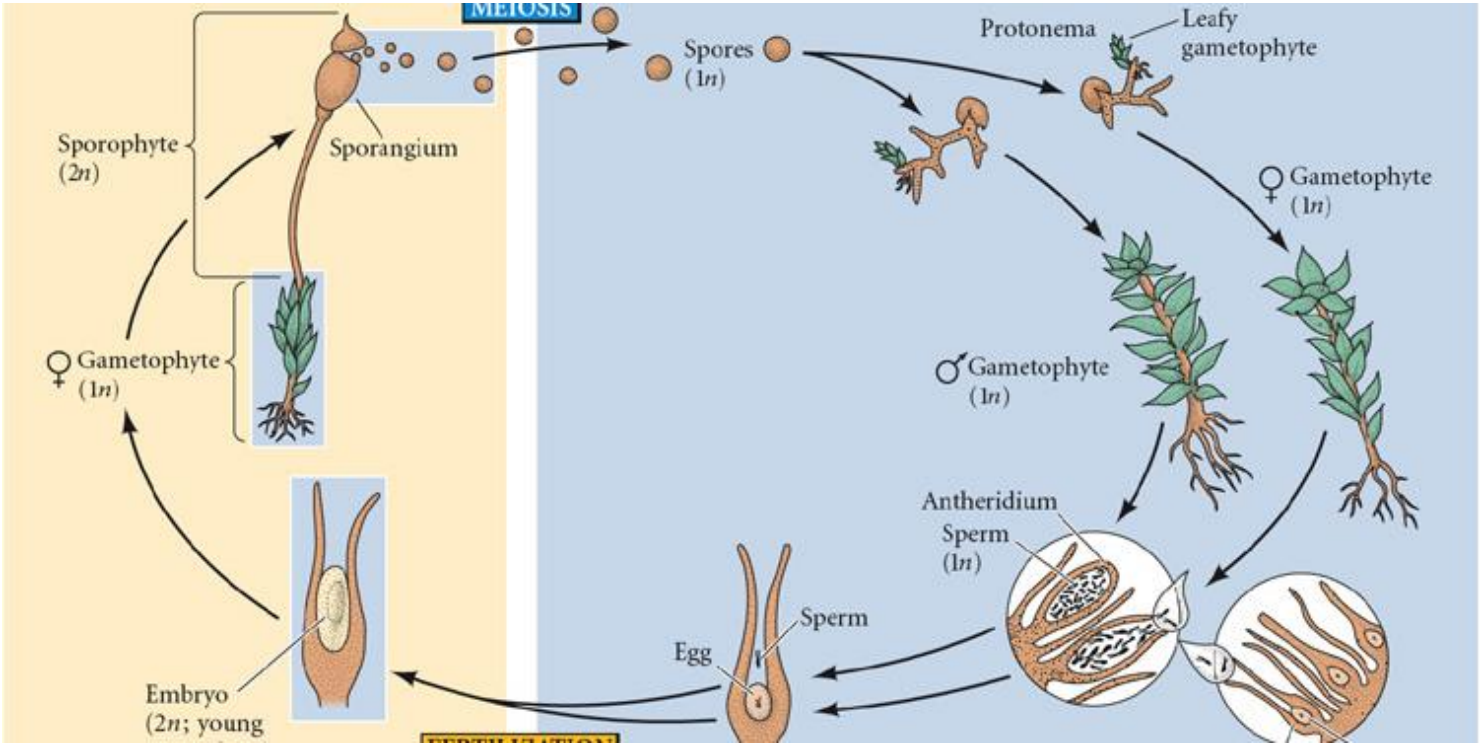
- Dominant generation is the gametophyte (n) generation
- Reproduction depends on the presence of water to allow sperm to swim to egg



Bryophyte Lifecycle – The Process

1. Gametophyte produces sporophytes
2. Sporophyte capsules produce spores via meiosis
3. Spores release, develop into male and female gametophyte
4. Male develops an antheridium – produces sperm. Female develops an archegonium – produces egg
5. Sperm swim to fertilize egg
6. Zygote produced – undergoes mitosis to produce a new sporophyte

Bryophyte Lifecycle



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Examples of Bryophytes

Moss

Example of Bryophytes

Hornworts

Examples of Bryophytes

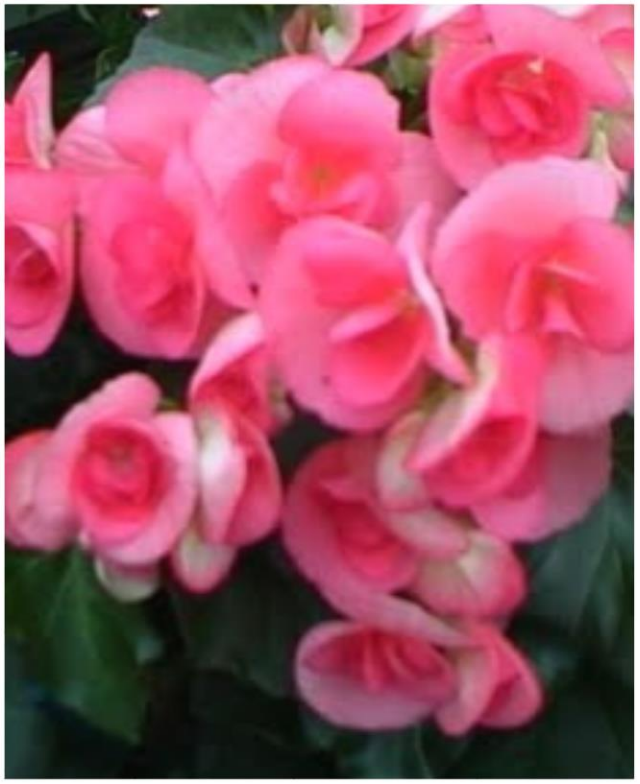
Liverworts

Tracheophytes

Ferns, Conifers, and Flowering Plants

Phylum Tracheophyta

- Possess vascular tissue – Xylem and Phloem
- Posses true roots, stems, and leaves
- Larger in size compared to Bryophytes
- Not restricted to moist environments
- Distributed all over the Earth's surface
- Complex group



Phylum Tracheophyta

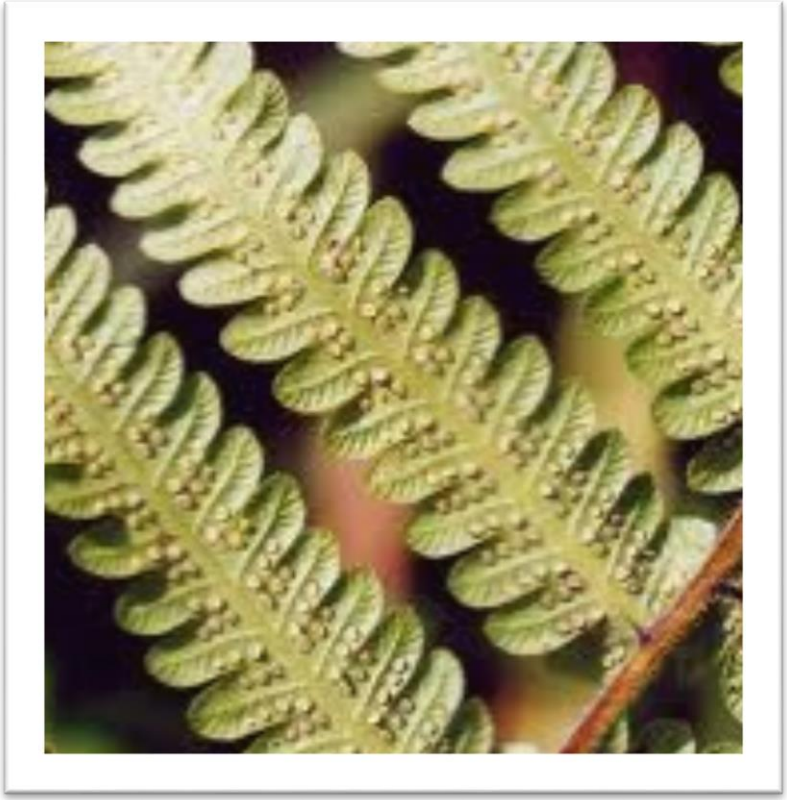
- Divided into three major groups:
  1. **Ferns - Pterophytes**
     - Seedless
  2. **Gymnosperms**
     - Produce seeds in cones
  3. **Angiosperms**
     - Seeds produced in flowering plants

Ferns

- Most primitive of vascular plants
- Possess roots, stems, and leaves
- Rely on the presence of water for sperm to travel to egg

Fern Life Cycle

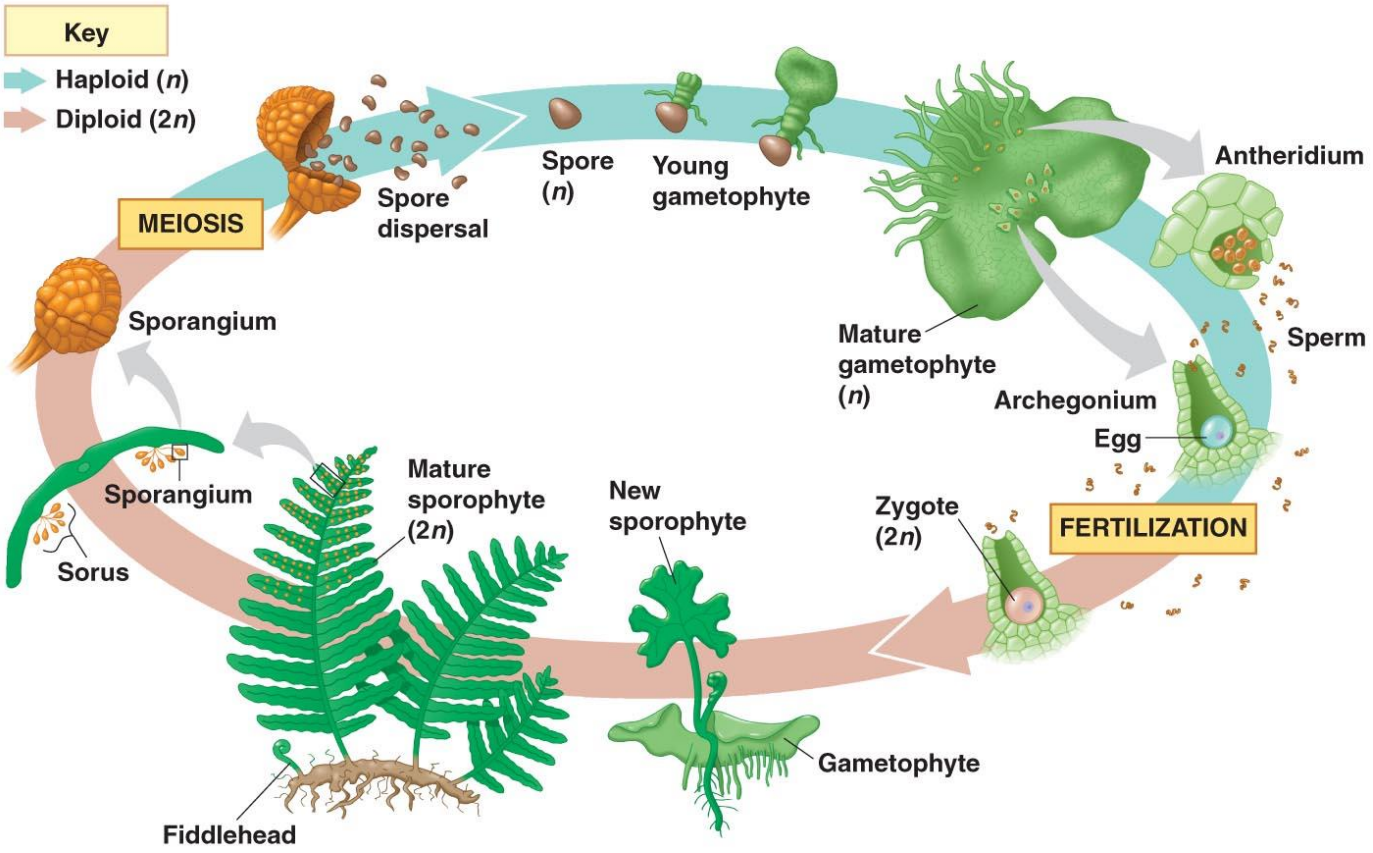
- Dominant generation is the **sporophyte generation**
- The plant you see
- Water necessary for the delivery of sperm to egg



Fern Life Cycle – The Process

1. **Sporangium** produces haploid (n) spores which produces a **prothallus** – the **gametophyte**
2. Prothallus has both male (**antheridia**) and female (**archegonia**) organs
3. Sperm swim to egg
4. Fertilization occurs, embryo grows into a **sporophyte** (2n)
5. Sporophyte matures – roots and fronds develop
6. Underside of fronds produce **Sori** – which produce **spores** via meiosis

Fern Life Cycle



Gymnosperms

- Have roots, stems, and leaves
- Vascular tissue
- Have seeds exposed on cones
- Most are coniferous trees
  - Pine, Spruce, Cedar

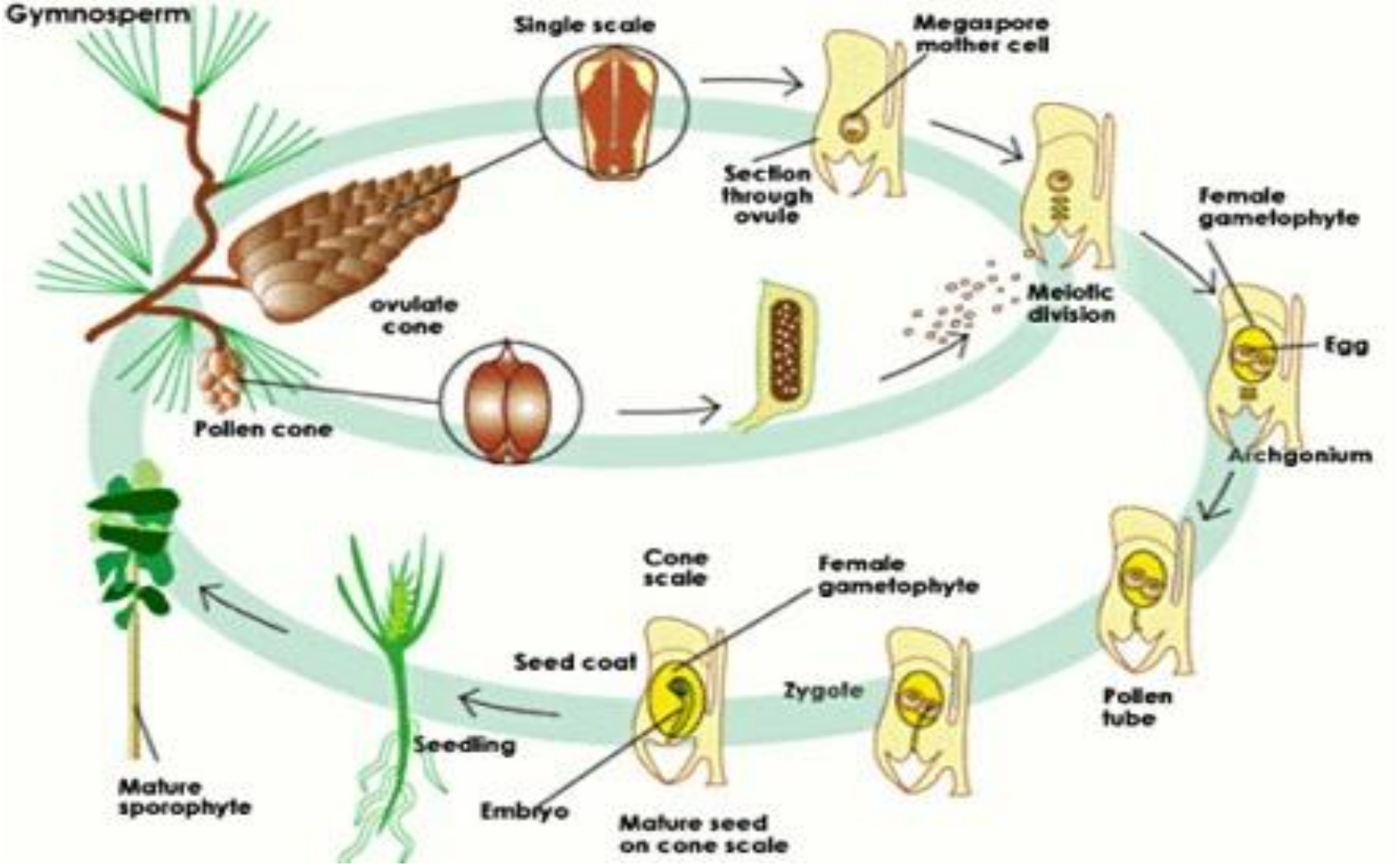
Gymnosperms

- Separate male and female cones produce gametes
  - Female cones produce ovules that develop in archegonia
  - Male cones produce microspores that develop into pollen grains
- Pollen distributed by wind
- Developing embryo protected by the female cone

Gymnosperms

- Do not require moisture for reproduction
- Adaptations for cold, dry habitats
  - Needle-like leaves
  - Bark
  - Keep leaves all year round – start photosynthesis early

Gymnosperm Life Cycle

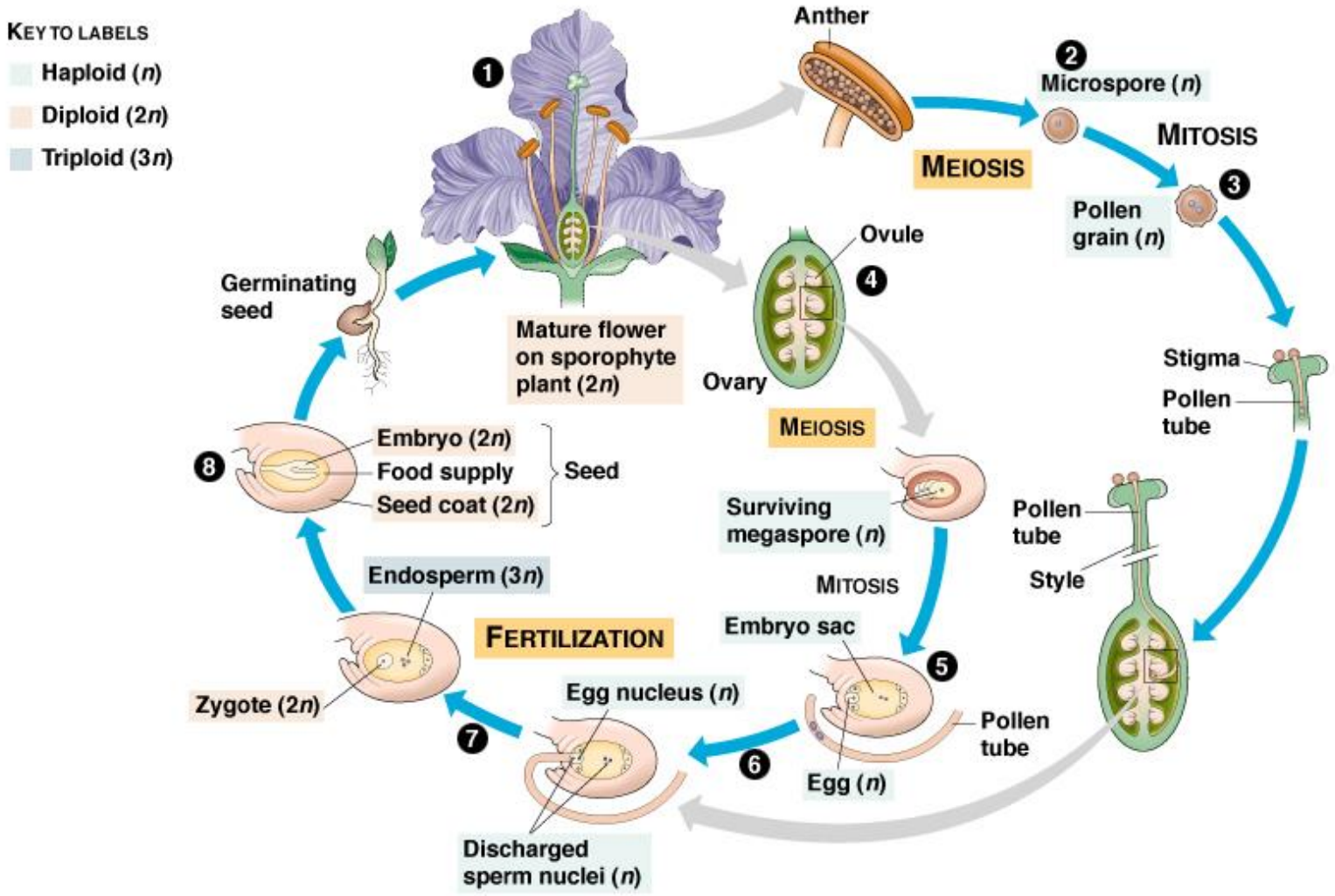


Angiosperms

- Enclosed seeds, kept in the body of a fruit
- True roots, stems, and leaves
- Most flowers have both male and female sex organs
  - Sperm protected by pollen
  - Egg protected by the ovule
- Embryo protected within the seed-fertilized ovule
- Seed enclosed within the fruit - ovary

Angiosperm Success

1. Animals and plants assist in pollination
2. Possess structures specific to attracting certain animals – colors, the emission of scents, and food
3. Seeds are protected with a seed coat with a stored supply of food – endosperm
4. Fruits function in the dispersal of seeds
5. Dispersal via wind
6. Development of specialized tissues which help them survive heat, cold, and droughts



Trachoephyte Adaptations for Life on Land

1**. Water Conservation -** cuticle or cutin present on leaves.

2**. Gas Exchange** - pores called stomata found on the bottom of leaves.

3. **Internal Transport -** contains vascular tissue

4**. Internal Support** - vascular tissue

5. **Water Absorption** - system of roots is present

6. **Reproduction** - water is not required for movement of sperm to egg except in the case of ferns. In gymnosperms and angiosperms, sperm is contained inside a pollen grain that is moved by wind and insects.

Kingdom Animalia

- Zoology is the study of animals
- Multicellular and eukaryotic
- Heterotrophs
- Most are motile, some are sessile
- Many have specialized tissues for specialized functions
  - Muscle
  - Nerve

Kingdom Animalia

- Simpler forms reproduce asexually
- Higher forms reproduce sexually
- Two main types
  1. **Vertebrates**
  2. **Invertebrates**

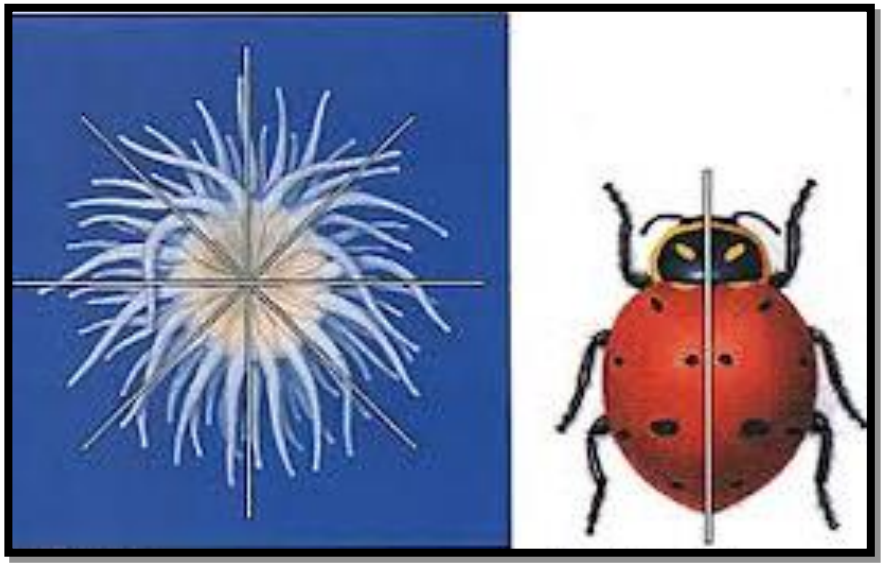
Characteristics of Animals

1. **Body organization**
   - Cells to organ systems
2. **Germ Layers**
   - Embryonic tissue which develops into specialized tissue
3. **Body symmetry**
   - Body plan
4. **Digestive system**
   - Direction and consumption of food
5. **Body cavities**
   - Development of organ systems
6. **Reproduction and Development**
   - Varies among simpler to more complex species

Symmetry

- Refers to the body plan of animals
- Three types:

1. **Asymmetry**
2. **Radial Symmetry**
3. **Bilateral Symmetry**



Asymmetry

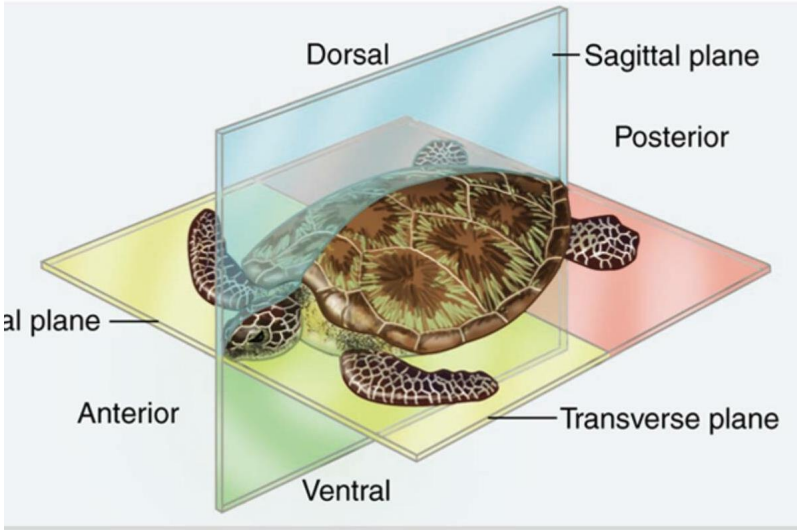
- Having no symmetry
- Body cannot be cut into mirror halves
- Lacking symmetry
- Example:
  - Sponges

Radial Symmetry

- Animal can be cut into mirror halves by passing a plane through the central axis in any direction
- Can receive stimuli equally from all directions in its environment
- Example:
  - Hydra

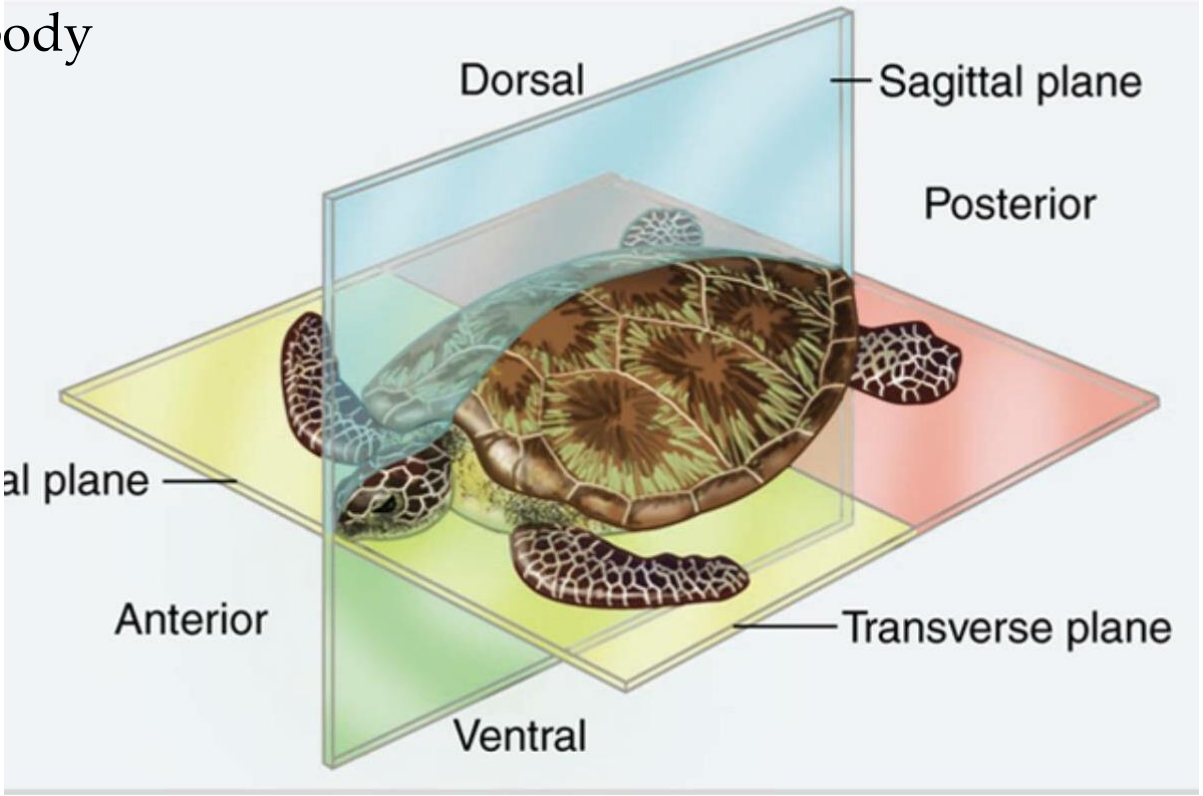
Bilateral Symmetry

- Can be divided into mirror halves only a single plane
- Bilateral animals have a true head region, which tend to concentrate nerve cells
- **Cephalization**
  - The concentration of nerve tissue in the anterior end
  - Allows for rapid processing of stimuli



Bilateral Symmetry

- Bilateral symmetry allows for the division of the body into regions:
  1. **Anterior**
  2. **Posterior**
  3. **Ventral**
  4. **Dorsal**
  5. **Lateral**



Digestive System

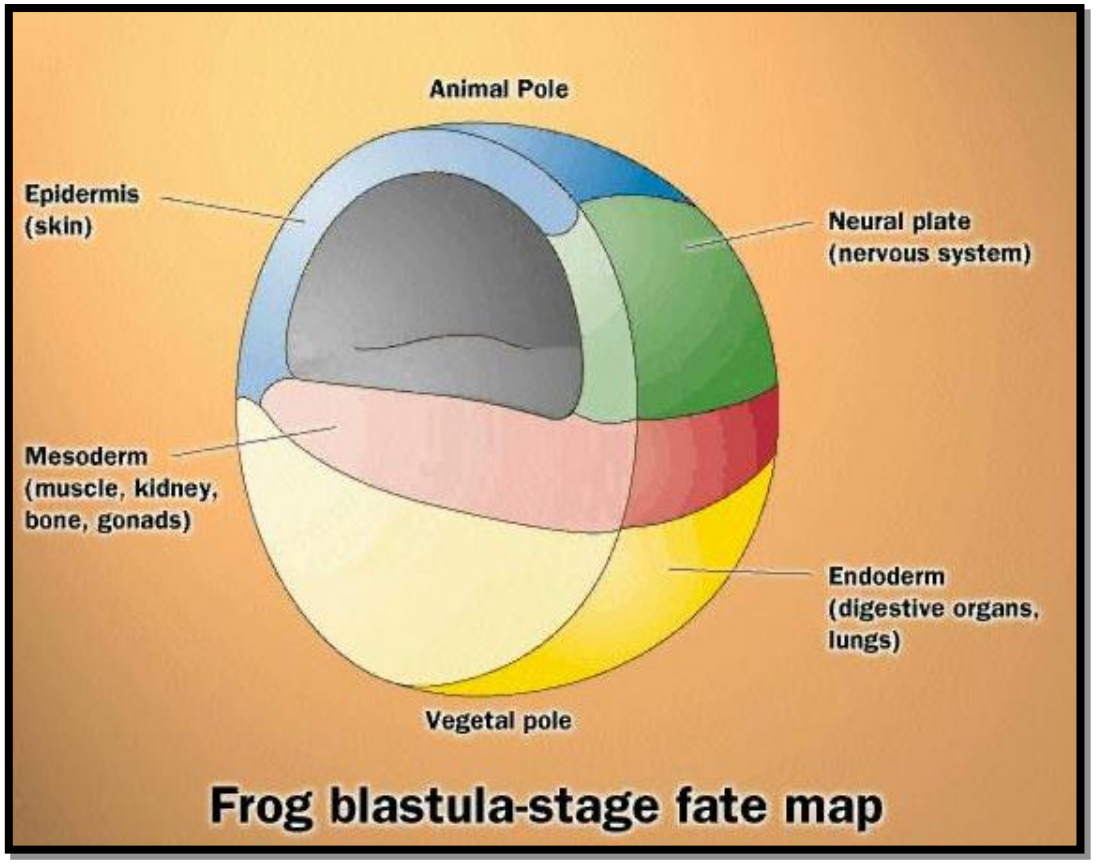
- **Incomplete Digestive System**
  - One opening to the gut
  - Two way traffic – food and waste enter and leave the same opening
  - Ex: Cnidarians
- **Complete Digestive System**
  - Two openings to the gut
  - One way traffic – food enters one way, waste exists another
  - Ex: Chordates

Germ Layers

1. **Endoderm**
   - Inner layer
   - Forms lining of gut or digestive tract
2. **Mesoderm**
   - Middle layer
   - Forms the middle organs – circulatory, reproductive, urinary, and muscular systems
3. **Ectoderm**
   - Outer layer
   - Gives rise to the skin and to the nervous system

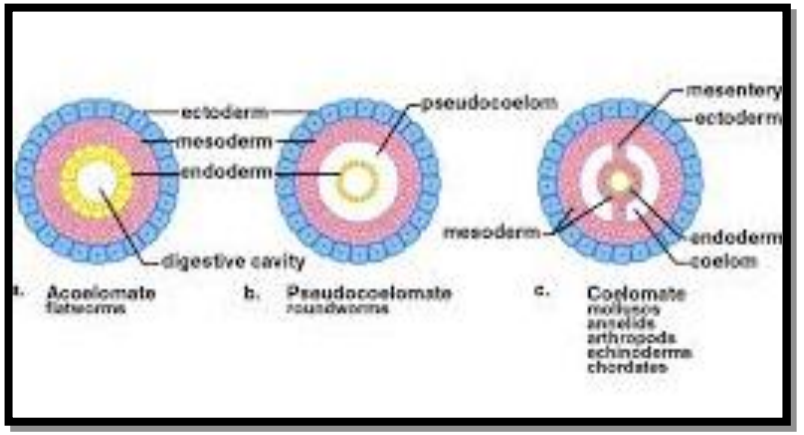
Germ Layers

- Animals contain embryonic cell layers
- Each layer is responsible for producing various tissues and structure in the adult animal
- There are three layers:
  1. **Endoderm**
  2. **Mesoderm**
  3. **Ectoderm**



Body Cavities

- A **Coelom** is a fluid filled cavity between the digestive tract and the body wall, lined with mesoderm
- Presence or absence incredibly significant in the classification of animals with respect to body plan

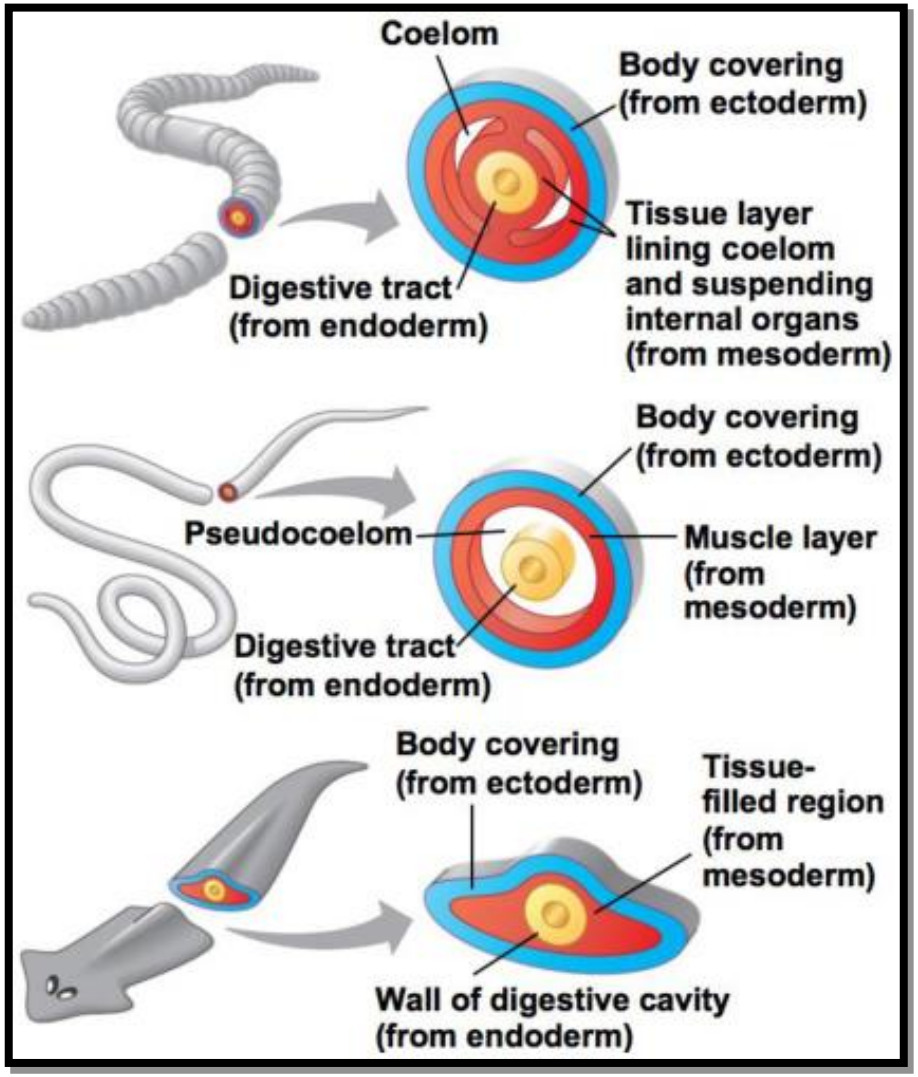


Importance of a Coelom

1. Space for internal organs to be suspended and remain unharmed
2. Space for internal organs to develop and expand
3. Cavity contains fluids which assist in internal transports and nutrient/gas exchange

Types of Coelomates

- **Acoelomates**
  - Lacking a coelom
  - Ex: - **Poriferans**
- **Pseudocoelomates**
  - Presence of a false (partial) coelom
  - Incompletely lined with mesoderm
  - Ex: **Nematodes**
- **Eucoelomates**
  - True coelom
  - Lined with mesoderm
  - Ex: **Chordates**



Reproduction and Development

- Both asexual and sexual, some use both
- **Fertilization** – fusion of sperm and egg
  - **External**
  - **Internal**
- **Development** – series of changes an embryo goes through to become an adult
  - **Internal**
  - **External**

Invertebrates

- Animals without backbones
- Enormously successful both ecologically and evolutionary
- 97% of the animal kingdom

Keep in mind…

- As we move through each Phyla, we move from simple to complex
  - Symmetry
  - Body cavities – absent & present
  - Asexual and sexual reproduction
  - Tissue layers
  - Immobile to mobile
  - Development of body systems

Phylum Porifera

- “Pore Bearing”
- Aquatic and Sessile
- Simplest and most primitive animal
- Has no organ systems
  - Cells arranged loosely in a gelatinous matrix
- Asymmetrical
- Acoelomates
- Asexual reproduction (Budding) and sexual reproduction (External fertilization and Hermaphrodites)

http://www.youtube.com/watch?v=RmPTM965-1c

Phylum Cnidaria

- Aquatic and radially symmetrical
- Sessile and motile
- Composed of two germ layers: ectoderm and endoderm
- Simple nervous system
  - **Nerve Net –** ring of nerve cells, synapses in both directions, no myelin sheath
- Specialized muscle and digestive systems
  - Incomplete digestion

Phylum Cnidaria

- Acoelomates
- Sexual and asexual reproduction
- Have two basic stages
  1. Medusa
  2. Polyp
- Examples – Hydra, Sea Anemones, Jellyfish

http://www.youtube.com/watch?v=RYVHK2vM1_Y

Phylum Platyhelminthes

- Flatworms
- Parasitic and nonparasitic
- Bilateral symmetry
- Simple nervous system – made of lateral nerve cords, area of cephalization, development of eye spots
- Simplest form of an excretory system
  - **Flame Cells –** excretory cell which opens, via ducts, to the outside of the body

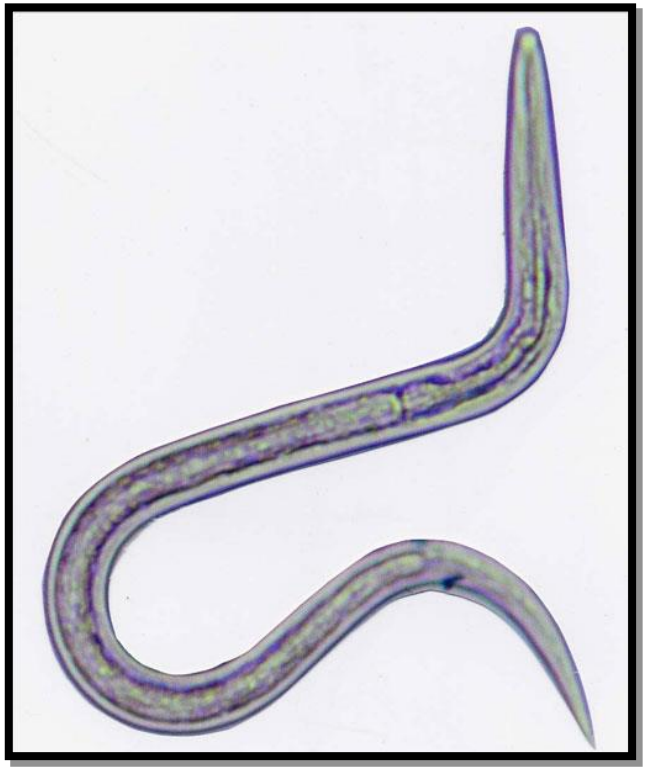
Phylum Platyhelminthes

- Three germ layer – possess mesoderm
- Acoelomate
- Asexual reproduction (regeneration) and sexual reproduction (Hermaphroditic)
- Incomplete digestions
- Examples: Planaria and Tapeworms

http://www.youtube.com/watch?v=w0QzSYQGsnA - Planarian
http://www.youtube.com/watch?v=bb32g02IIs8 - Tapeworm

Phylum Nematoda

- Roundworms
- Bilateral Symmetry
- Three cell layers
- Pseudocoelomates
  - Possess a body cavity filled with fluid
- Digestive system is complete – has two openings – a tube within a tub
- Possess a distinct nervous system and excretory system



Phylum Nematoda

- Separate sexes, very few hermaphrodites
- Sexual reproduction
- Parasitic
  - Eggs hatch, juvelines released
  - Burrow through intestinal wall, into veins, lymph nodes, carried to heart and lungs
  - Pass through to trachea, swallowed, mature in stomach
- Examples: Pinworms and Hookworms

http://www.youtube.com/watch?v=dB0cL3PcYZI - Roundworm in Cat Intestine
http://www.youtube.com/watch?v=4p0kC1Q3iOE - Roundworms (Ascaris)

Phylum Annelida

- Segmented worms
- First phyla in which a true coelum is present - Eucoelomates
  - Tube within a tube
  - Lined with mesoderm
- Complete digestive system
- Closed circulatory system – presence of vessels
- Developed excretory systems – presence of nephridia - excretory tubules

Phylum Annelida

- Presence of sense organs and a primitive brain – including a nerve cord
- Sexual reproduction – hermaphrodites and separate sexes
- Bilateral symmetry

http://www.youtube.com/watch?v=9ZHTerOJYMA - Earthworms
http://www.youtube.com/watch?v=uO4lkv-jLRs - Giant Earthworm
http://www.youtube.com/watch?v=cKUAroimQrk - Leeches

Phylum Mollusca

- Soft bodied
- Mostly marine
- Show incredible diversity – from clam to giant squid
- Bilateral symmetry
- 3 germ layers
- True coelom
- Many developed organ systems
  - Nervous system with sensory organs
  - Excretory system
  - Respiratory system
  - Circulatory systems (Open and closed)

Phylum Mollusca

- Sexual reproduction, some hermaphrodites
- Internal and external fertilization
- Complete digestion
- Examples: Clams, Oysters, Squid, Octopi

http://www.youtube.com/watch?v=IWAnliNc6wk - Vampire Squid
http://www.youtube.com/watch?v=qp2S5PXpH6s - Octopus
http://www.youtube.com/watch?v=lwAqhThd_EQ - Giant Octopi

Phylum Arthropoda

- Live in all environments
- Possess an eXoskeleton made of chitin
- Most molt
- Possess jointed appendages, body segments fused
- Bilateral symmetry
- Developed nervous system, circulatory systems, digestive systems, musculature system
- True coelom
- Three cell layers

Phylum Arthropoda

- Possess highly sensitive sensory structures
  - Antennae
  - Hair
  - Eyes
- Sexual reproduction some hermaphrodites
- Many display metamorphosis
- Examples: Insects, Lobster, Crab

http://www.youtube.com/watch?v=-jNNvjJkLoc - Arthropods

Phylum Echinodermata

- Spiny-skinned
- Radial symmetry
- Coelom present
- Three cell layers
- Distinct organ systems
- Possess an endoskeleton
- Possess tube feet used for locomotion
  - Works similar to hydraulics
  - Water vascular system

Phylum Echinodermata

- Separate sexes, few hermaphrodites
- Asexual and sexual reproduction

- Complete digestive system
- Examples: Starfish, Sand dollar, sea urchins

http://www.youtube.com/watch?v=cec4YPXBnXk - Starfish
http://www.youtube.com/watch?v=D3W4OCnHyCs - Echinoderms

Arthropod Success

Why are they successful?

Arthropod Success

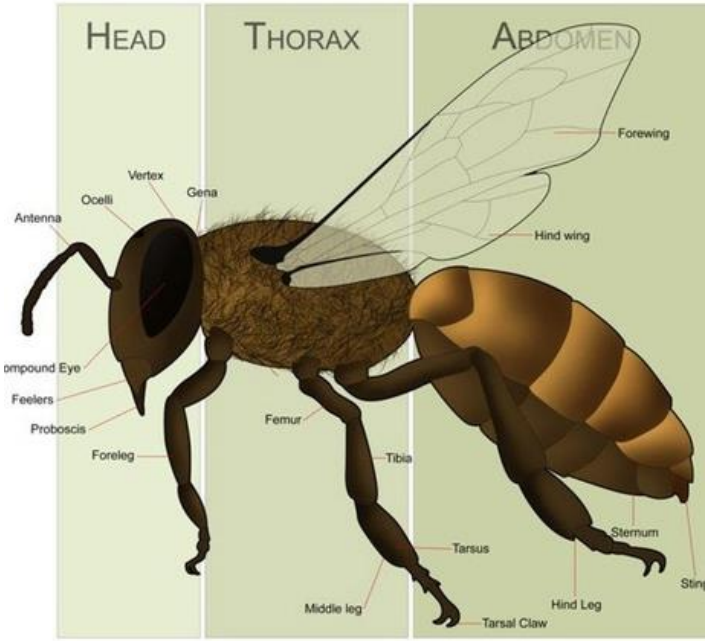
1. **Exoskeleton**

- Made of chitin
- Protection
- Flexible and lightweight
- Waterproof covering
- Must shed to grow
- Site for muscle attachment

Arthropod Success

2. **Segmentation and appendages**

- Body divided into sections which are fused
- Site for muscle attachment
- Independent movement
- Sensory attachment
- Regions are:
  I. **Head**
  II. **Thorax**
  III. **Abdomen**



Arthropod Success

3. **High developed sensory organs**

- Compound eyes and antennae
- Ability to touch, smell, hear, maintain balance, and chemical reception
- Keenly alert to their surrounding environment

Arthropod Success

4. **Behavior Patterns**

- Some display caste systems
  - Bees and ants
    - Workers – Infertile Females, only do work around the hive
    - Drones – fertile males
    - Queen – fertile male
- Some live in colonies
- Some use mimicry

Arthropod Success

5. **Methods for obtaining nourishment**

- Many eat plants
- Many eat other invertebrates
- Some feed off blood of members of other kingdoms

Phylum Chordata

Vertebrata

Three Basic Traits

1. Have a strong, flexible, rod-like structure called a **notochord**
   - Dorsal surface
   - Embryo's have notochord, replaced is most adults by a backbone
2. Presence of a **dorsal nerve cord**
   - Develops into the brain and spinal cord
3. Have **gill slits** at some point in development

Class Agnatha

- Jawless fish
  - Examples: Lampreys and Hagfish
- Covered with a slimy skin
- Lack paired fins
- Snake-like locomotion
- Aquatic – respiration via gills
- Do not possess an **operculum**
  - Gill covering

Class Agnatha

- Notochord retained during adulthood
- Circulation via a 2-chambered heart
  - One atria – One ventricle
  - A single circuit vascular system
  - Heart – gills (oxygenated) – dorsal aorta - body - repeat
- Only internal skeleton is their skull, which is made of cartilage
- Opportunistic feeders

http://www.youtube.com/watch?v=NYRr_MrjebA

Class Condrichthyes

- Cartilaginous fish
  - Examples: Sharks and rays
- Gill respiration, no operculum
- 2-chambered heart
- Paired fins, streamlined bodies
- Presence of teeth in some
- Sharks have a **Lateral Line System**
  - Water sensitive system
  - Runs the length of sharks
  - Mechanical receptor organs detect low frequency vibrations

Class Condrichthyes

- All have internal fertilization, development is variable

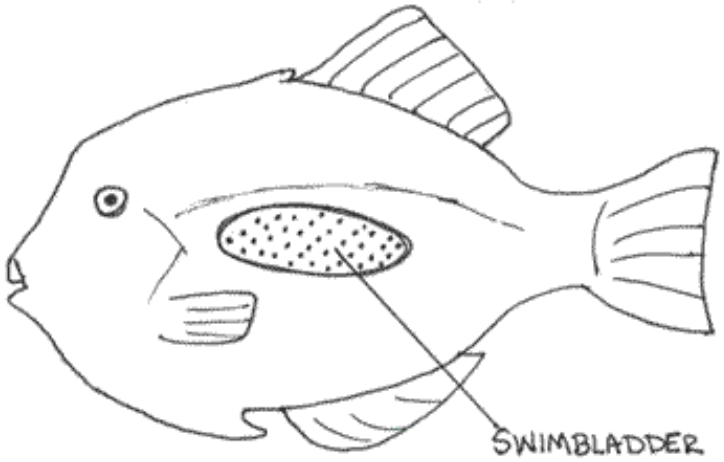
1. **Oviparous**
   - Egg-laying
   - Yolk nourishment
   - Ex: Little Skates (*Raja erinacea*)
2. **Ovoviviparous**
   - Eggs develop within maternal body
   - Yolk nourishment
   - Ex: Stingrays
3. **Viviparous**
   - Live birth, embryo develops within maternal body
   - Placental nourishment
   - Hammerheads

Class Osteichthyes

- Bony fish
- Endoskeletons made of ossified material
- Posses gills covered with an operculum
  - **Counter-current Exchange**
  - Water flow is opposite the direction of blood flow in gills
- Scaled bodies
- 2-chambered heart
- External fertilization

Class Osteichthyes

- Presence of **swim bladders**
  - Used for buoyancy
  - Bones and tissue more dense than cartilaginous fish
  - Gas expands and compresses to adjust with depth of environment

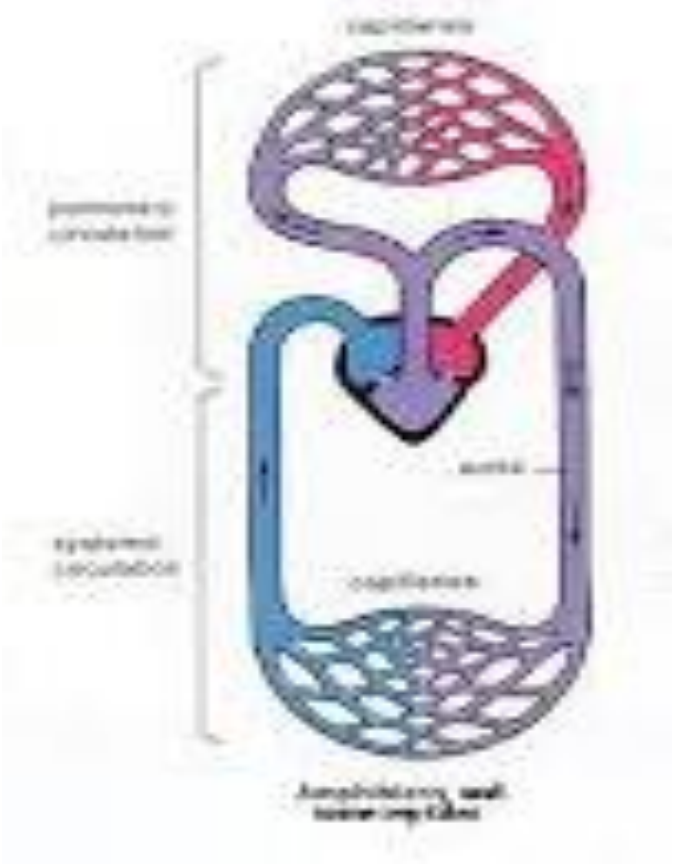


Class Amphibia

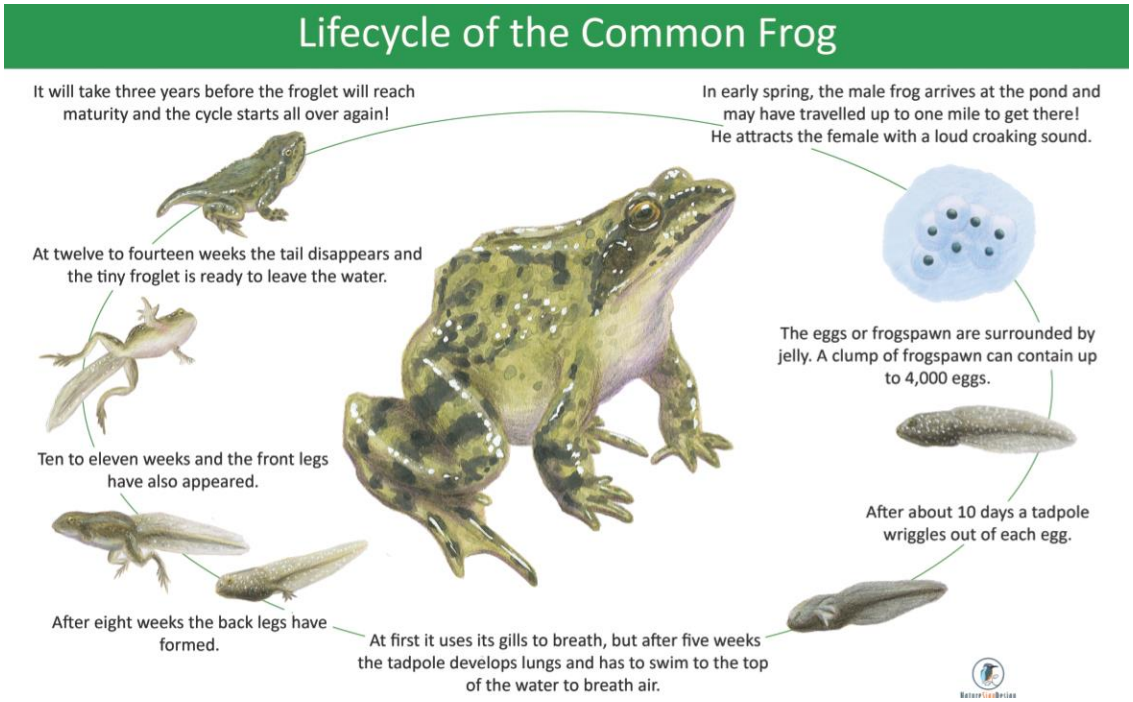
- Transitional group
  - Examples: Toads, Frogs, Newts, and Salamanders
- Born in fresh water (with gills), change into adults (with lungs)
  - Except for those external gilled salamanders – Mudpuppy's
- External and internal fertilization
  - Mostly external in frogs/toads
- Mainly oviparous where eggs to be laid in water
- **Ectothermic (Poikilotherms)**

Class Amphibia

- **3-chambered hearts**
  - Double circulation system
  - Pulmonary and systemic circuit
  - Two Atria (Left and Right) and One Ventricle
    - Atria receives, Ventricle Sends
  - Incomplete partition of the ventricle, so there is mixing of oxygen rich and oxygen poor blood as its pumped to its proper location
- Mucous covered skin, must be kept moist, very thin which allows for gas exchange



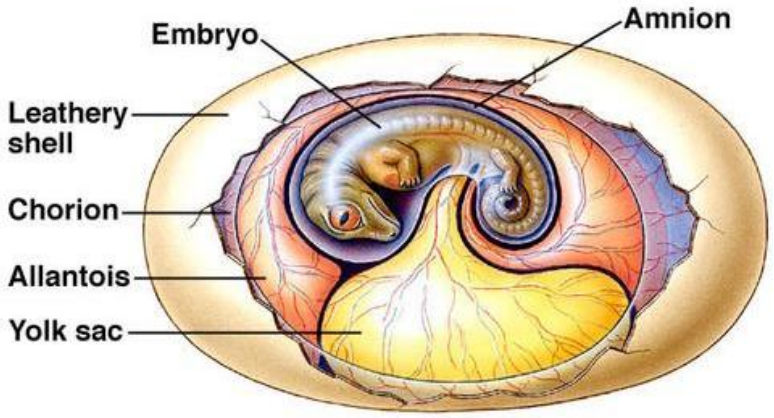
Class Amphibia



http://www.youtube.com/watch?NR=1&v=DDabzEJoa_A&feature=endscreen&safety_mode=%20true&persist_safety_mode=1&safe=active

Class Reptilia

- Fully terrestrial vertebrate – no aquatic larval stage
- No gills, respiration via lungs
- Internal fertilization
- External development in a shelled egg – **amniotes**
  - Leathery shell for protection and water loss
  - Chorion and Allantois permit gas exchange
  - Yolk sac – energy and nutrition requirements
  - Amnion – inner membrane for support



Class Reptilia

- Ectothermic
- 3- chambered hearts
  - Little mixing of blood
  - Crocodiles have 4 (like us!)
- Thick, scaly skin made of **keratin,** prevents water loss
- Better adapted to movement on land
- Many reptiles use mechanical actions to chew and crush food
- Examples: Crocodiles, snakes, turtles, lizards

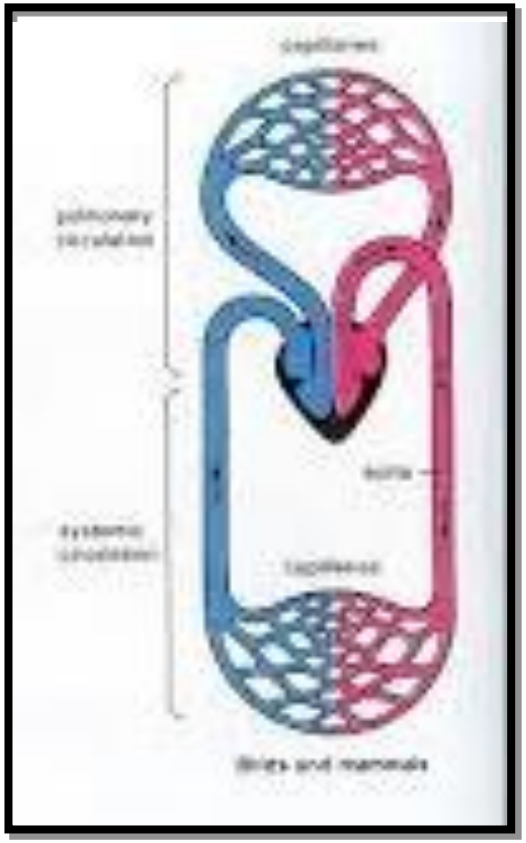
http://www.youtube.com/watch?v=jTnrm338_KY&safety_mode=true&persist_safety_mode=1%20&safe=active

Class Aves

- Hollow strong bones for flight
- Large sternum for muscle attachment for flying
- Feathers make birds unique
- Respiratory and circulatory systems are incredibly efficient
- Birds require high metabolisms to allow for flight
- Digestion is rapid and efficient
- Endothermic (Homeotherms)
- Acute vision and hearing
- Internal fertilization, caring for young

Class Aves

- **4-Chambered Hearts**
  - Two Atria and Two Ventricle
  - Completely separate pulmonary and systemic systems - no mixing of oxygen rich and oxygen poor blood
  - Separate halves
  - Left Atria receives oxygen rich blood from the lungs, Left Ventricle send it out to the body
  - Right Atria receives oxygen poor blood from body, Right Atria sends it to the lungs



Class Mammalia

- What makes a mammal?
  - Air breathing, presence of hair, mammary glands, motherly care via the nourishment of milk
- Variety of teeth forms for variety of diets
  - Incisors, canines, pre-molars, and molars
- Well developed brains
- 4 Chambered hearts

Class Mammalia

- Most are viviparous, except for monotremes
  - Duck-billed platypus, echidna's
- Marsupials are pouched viviparous
  - Embryo's hatched young
- Placental mammals

Class Mammalia

- ***Monotremes*** show external development in eggs (ex: Platypus)

- ***Marsupials*** have minimal internal development, most development takes place in a pouch on the mother after birth (ex: kangaroo's)

- ***Placental*** mammals show internal development with a placenta present (ex: humans)