

Wrap up from yesterday

You should:

- Have a working knowledge of how to construct a classification bracket diagram
- Have a working knowledge of how to use and construct a dichotomous key

**DICHOTOMY – A division between two things that are opposed**

Preparing Your Own Dichotomous Key for Wildflowers using physical characteristics.

Figure 3

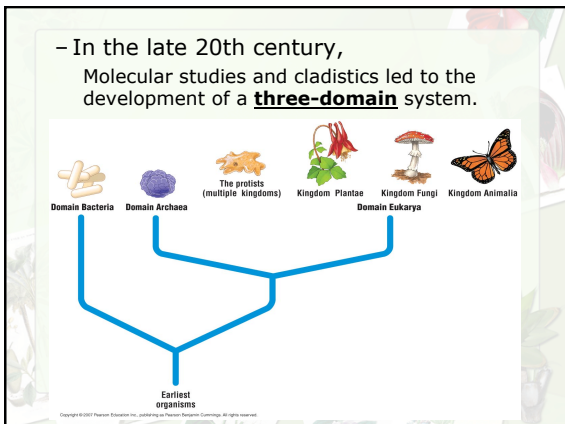
**Dichotomous Key for Wild Flowers**

1a	Having numerous small petals	<b>Clover</b>
1b	Lacking numerous small petals	Go to 2
2a	Having 3 separate petals only	<b>Arrowhead</b>
2b	Having more than 3 separate petals	Go to 3
3a	Having 3 inner petals surrounded by 3 leaf-like structures	<b>Trillium</b>
3b	Having 5 or 6 petals	Go to 4
4a	Having 5 petals	<b>Violet</b>
4b	Having 6 petals	Go to 5
5a	Having 6 petals that form bell-like shape	<b>Bellwort</b>
5b	Having 6 petals arranged in a flat circular shape	<b>May apple</b>

Key No.	Description	Common Name
1a	Has a Heart Shaped Leaf	Go to 2a
1b	Does not have a Heart Shaped Leaf	May Apple
2a	Leaf does not have serrated edge	Go to 3a
2b	Leaf has a serrated edge	Violet
3a	The 3 leaves of the plant are distinct	Go to 4a
3b	The 3 leaves of the plant are not distinct, overlap	Arrowhead
4a	The flower has 6 broad petals	Go to 5a
4b	The flower has more than 6 small petals	Clover
5a	The 6 flower petals are heart shaped	Trillium
5b	The 6 flower petals are not heart shaped	Bellwort

**How life is organized...**

D Domain  
K Kingdom  
P Phylum  
C Class  
O Order  
F Family  
G Genus  
S Species



### Cladistics

Cladistics is an approach to biologic classification where organisms are characterized based on a shared derived characteristic that can be traced back to the groups common ancestor.

Jellies and Sea stars are:  
 invertebrates  
 marine  
 radial symmetry

Should they be not classified together?

### Cladistics

- Cladistics says that these are shared characteristics, but are not derived characteristics.
- Jellies lack enclosed body cavities, and - are more closely related to sponges.
- Sea stars have multiple tissue layers and enclosed body cavities - are much more closely related to humans than jellies

### Domains

Domains are the broadest, most inclusive taxon

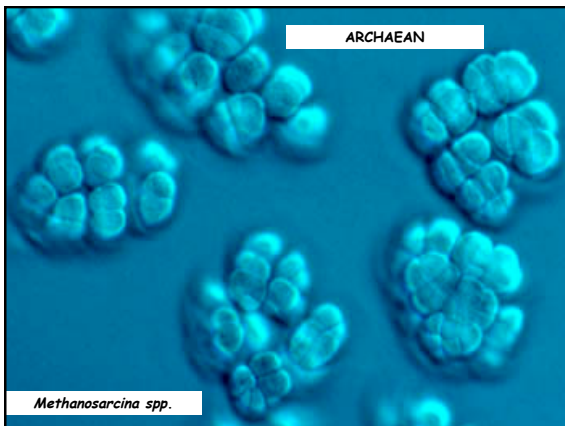
Three (3) domains

- **Archaea and Eubacteria** are unicellular prokaryotes (no nucleus or membrane-bound organelles)
- **Eukarya** are more complex and have a nucleus and membrane-bound organelles

### DOMAIN ARCHAEA

- Probably the **1<sup>st</sup> cells to evolve**
- Live in **HARSH** environments
- Found in:
  - **Sewage** Treatment Plants
  - **Thermal** or Volcanic Vents
  - Hot Springs or Geysers that are **acid**
  - Very **salty water** (Dead Sea; Great Salt Lake)

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## DOMAIN EUBACTERIA

- Found in **ALL HABITATS**
- Important **decomposers** for environment
- **Commercially** important in making cottage cheese, yogurt, buttermilk, etc.

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## Domain Eukarya Kingdoms

- **Protista** (protozoans, algae...)
- **Fungi** (mushrooms, yeasts ...)
- **Plantae** (multicellular plants)
- **Animalia** (multicellular animals)

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## Arranging Life into Kingdoms: A Work in Progress

- Linnaeus designed a **two**-kingdom system of classification,
  - Which was replaced by a **five**-kingdom system in the mid-20th century.
  - Now we use a **six**-kingdom system, which may **change** again!

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## Protista

- 17
- Most are **unicellular**
  - Some are multicellular
  - Some are autotrophic, while others are heterotrophic
  - **Algae**
  - **Aquatic**
  - **Cytoskeleton**



## Fungi

- **Multicellular**, except yeast
- **Absorptive heterotrophs** (digest food outside their body & then absorb it)
- Cell walls made of **chitin** instead of cellulose




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## Plantae

- **Multicellular**
- **Autotrophic**
- **Absorb sunlight** to make glucose – Photosynthesis (**chlorophyll**)
- **Cell walls made of cellulose**



















## Animalia

- **Multicellular**
- **Ingestive heterotrophs** (consume food & digest it inside their bodies)
- **Feed on plants or animals**



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Kingdom	Organization	Type of Nutrition	Representative Organisms
Protista	Complex single cell, some multicellular	Absorb, photosynthesize, or ingest food	    paramecium euglenoid slime mold dino-flagellate
Fungi	Some unicellular, most multicellular filamentous forms with specialized complex cells	Absorb food	    black bread mold yeast mushroom bracket fungus
Plantae	Multi-cellular form with specialized complex cells	Photo-synthesize food	    moss fern pine tree nonwoody flowering plant
Animalia	Multi-cellular form with specialized complex cells	Ingest food	    coral earthworm blue jay squirrel

c. Domain Eukarya Eukaryotes, structurally diverse and organized into the four kingdoms depicted here.

### Preparation of Materials for Final

Step 1 – Go through 40 specimens. Familiarize yourself with what they look like; Make mental notes about their attributes. - Use the Internet

- Identify any distinguishing traits that they may have.
- Recommended to complete by Friday.

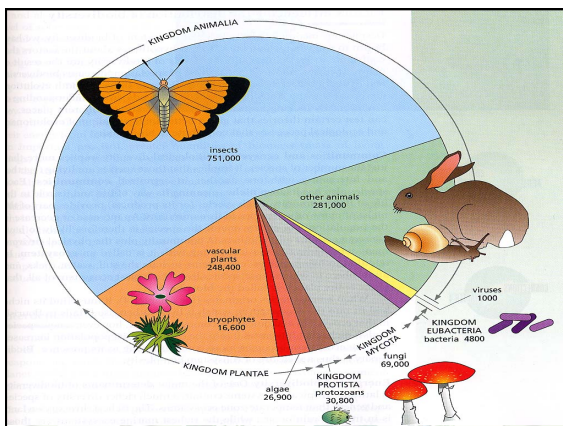
Step 2 - Create a rough draft of your bracket diagram. Final will be completed on C size paper

- Recommended to complete final by Tuesday.

Step 3 – Create a Taxonomic Key / Dichotomous Key by Wednesday. Be ready to practice classifying organisms with your key on Wednesday.

Step 4 – Use your Taxonomic Key to classify up to 4 organism from the specimen list on the day of the Final.

Step 5 – Turn all your material in after you have completed you Practical.



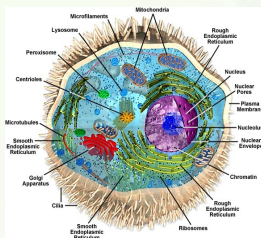
## Welcome to the Animal Kingdom!!!





### What is an animal?

- Eukaryotic
- Multicellular
- Heterotrophic
- Lack a cell wall



### More Animal Characteristics...

- Male and female adult animals make haploid gametes through meiosis
- An egg and sperm fuse to form a zygote
- Early mitotic division leads formation of a blastula
- More embryonic development and folding forms a gastrula
- The gastrula develops into a saclike embryo with one opening..... which may develop into a adult.

### The other option after formation of a single opening embryo is...

- Development into larval stages (larva is an immature form different from adult)
- Larva develops into a adult form after going through a **metamorphosis** (the purpose of metamorphosis to produce a sexually mature adult)

### Animals are grouped into two large categories:

- Invertebrates
  - Lack a vertebral column
- Vertebrates
  - Have a vertebral column

### Survey of Invertebrates

- Phylum Porifera
- Phylum Cnidaria
- Phylum Playhelminthes
- Phylum Nematoda
- Phylum Mollusca
- Phylum Annelida
- Phylum Arthropoda
- Phylum Echinodermata




### Phylum Porifera

- 5000 species of sponges
- Most are **marine**
- Live singly or in clusters
- Reproduction by regeneration of cells
- Individual pieces can develop into another sponge
- Radial **symmetry**


### Radial Symmetry

- Body parts are arranged like pieces of a pie around a central axis.
- Any slice longitudinally will produce a mirror image
- Body structure radiates out of central point

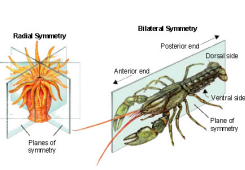


### Phylum Cnidaria

- Hydra, Jellies, Sea Anemones and Corals
- Radial symmetry + specialized cells
- Polyp and medusa body forms
- Carnivorous - use tentacles to capture prey (cnidocytes)
- Gastrovascular cavity - single opening
- Tissues
- Sessile - Substrate attached.





### Bilateral Symmetry



- Animal can be divided by a **single** cut to produce mirror image right and left
- Have distinct body regions (head region goes first)

### Phylum Platyhelminthes

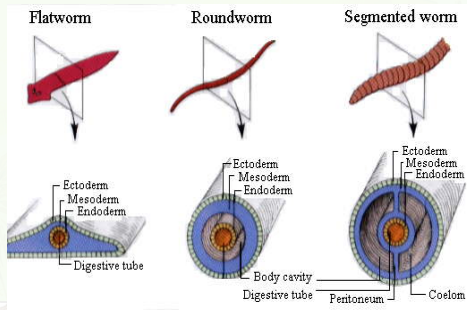
- Leaf-like flatworms
- Bilateral symmetry
- Incomplete digestive tract (**1 opening**)
- Acoelomates
- Start of cephalization
- Examples:
  - Flatworms
  - Flukes
  - Tapeworms

### Body Cavity (Coelom)

- A fluid-filled space between the digestive cavity and the body wall
- Pseudocoelom = internal space in direct contact with the wall of the digestive tract
- Coelom = a complex body cavity completely linked by a middle tissue layer (this suspends the digestive tract and other internal organs from the body wall)

### Three body cavities



## Phylum Nematoda



- Cylindrical (**round**) worms with a tapered tail (nematodes)
- Covered by a tough, nonliving **cuticle**
- Pseudocoelomates
- Complete digestive tract (**2 openings**)
- Numerous
- **Parasites and decomposers**

## Phylum Mollusca

- **Snails, slugs, oysters, clams, octopuses, squid**
- Soft body protected by a hard shell
- Muscular foot + mantle (produces shell)
- Rasping tongue = radula
- Coelomates = heart, reproductive organs, kidney, circulatory systems.



## Body Segmentation

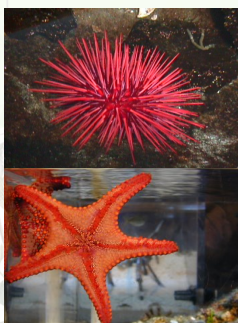
- Sub-division of the body along its length into a series of repeated parts (**Head, Body, Tail**)
- External and internal segmentation (earthworm: external features + coelom division)

## Phylum Annelida

- **Earthworms and other segmented worms**
- Distinct head and tail, other body segments are very similar
- 15,000 species
- Marine, aquatic, damp soil
- Many organ systems



## Phylum Echinodermata



- Sea stars and sea urchins
- Marine
- Lack body segments
- Radial symmetry as adults (bilateral as larvae)
- **Endoskeleton**
- Water vascular system
- Regeneration abilities
- Embryonic development similarities to other animals

## Phylum Arthropoda

- Most numerous of animal phyla ( $10^{18}$ )
- **Crayfish, lobsters, crabs, barnacles, spiders, insects**
- Chitin
- Jointed appendages
- Exoskeleton/Molting
- Distinct body segments : head, thorax, abdomen, nervous system, brain





**Insects are more numerous than all other species combined!**

**Survey of Invertebrates**

- Phylum Porifera
- Phylum Cnidaria
- Phylum Platyhelminthes
- Phylum Nematoda
- Phylum Mollusca
- Phylum Annelida
- Phylum Arthropoda
- Phylum Echinodermata

**Phylum Chordata**

- 4 hallmark characteristics of chordates:
  1. Dorsal, **hollow nerve cord**
  2. Notochord (flexible, longitudinal rod between digestive tract and nerve cord)
  3. Gill structures
  4. Post-anal tail

**Your Inner Fish**

- <http://www.pbs.org/g/your-inner-fish/home/>

**The most diverse Chordates are VERTEBRATES!**

**Invertebrate chordates**

- Tunicates - marine, have only gill slits as adult (larvae exhibit all 4 charact.)
- Lancelets - marine, have all 4 charact., closest living relative of vertebrates

## Hallmark Characteristics of Vertebrates

- Skull : case for the brain
- Backbone composed of vertebrae : case for the nerve cord
- Skeletal parts to support appendages (legs or fins)
- Endoskeleton



## Major groups of vertebrates:

- Class Agnatha
- Class Chondrichthyes
- Class Osteichthyes
- Class Amphibia
- Class Reptilia
- Class Aves
- Class Mammalia



## Class Agnatha

- Lampreys
- Superficially fishlike
- Lack paired fins
- Lack jaw \*\*



## Class Chondrichthyes

- **Cartilaginous fishes**
- Sharks, rays and skates
- First jawed vertebrates (hinged)
- Gills
- Paired forefins and hindfins
- Carnivores

## Class Osteichthyes

- **Bony fishes** - stiff skeleton, scales, paired fins
- Gills
- 2 chambered heart
- ectotherm
- External fertilization
- External development from egg
- \*\*Operculum
- \*\*Swim bladder
- Ray-fined(tuna) and lobe-fined(coelacanth)

## Class Amphibia

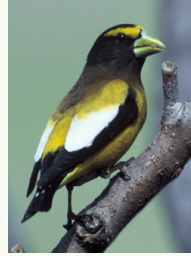
- Wet skin: provides area for gas exchange
- Lungs
- 3 chambered heart
- Ectotherm
- External fertilization and development
- Aquatic (eggs) and terrestrial (adult) adaptations
- Larval stage and metamorphosis (gills-lungs, tail-legs)
- First terrestrial vertebrates
- Important evolutionary connections: first tetrapod



### Class Reptilia

- Snakes, lizards, crocodiles, alligators, turtles
- Terrestrial adaptations : dry skin with scales, egg covering to retain water, amniotic egg
- Lungs
- 3 chambered heart
- Ectotherm
- Internal fert., external development from amniotic egg
- Important evolutionary connections and past: first animals out of water for whole life

### Class Aves



- Strong evolutionary connections between reptiles and birds (Archaeopteryx)
- Lungs and air sacs
- 4 chambered heart
- Endotherm
- Internal fertilization, external development (amniotic eggs)
- Scales (on legs) + feathers
- Body shape

### More bird characteristics

- Lack teeth
- Clawless wings
- Hollow feathers and bones
- Large breastbone for attachment of flying muscles
- High metabolism
- Highly efficient circulatory system

### Class Mammalia

- Most are terrestrial but many winged and some aquatic
- Endothermic
- Lungs
- 4 chambered heart
- Hair
- Mammary glands (Milk)
- Three main groups
  - Monotremes
  - Marsupials
  - Eutherians

### Monotremes

- Egg-laying mammals
  - Lays eggs
  - Incubate in nest
  - Young lick up milk in mother's fur
- Platypus




### Marsupials





### Eutherians

- Placentals - placenta joins embryo with mother's uterus.
  - Embryo is nurtured by maternal blood in placenta
  - Remnants of amniotic tissues
- 95% of living mammals



### Getting started...

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