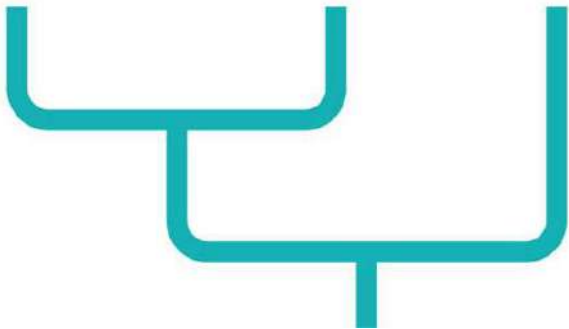




Study of Life Classification



The Amazing Diversity of LIFE!!!!

- **Diversity** of Life

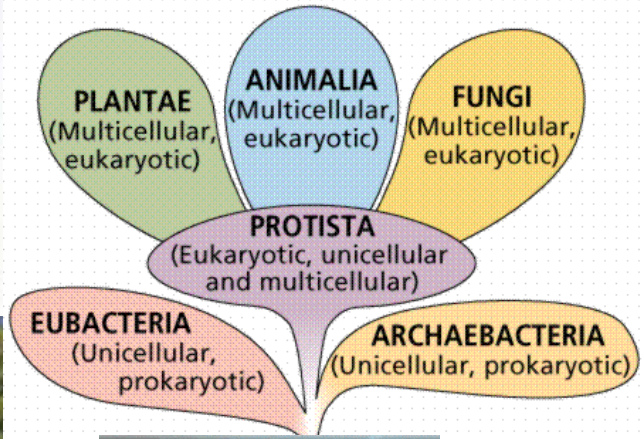
- There are so many different creatures on Earth
- Why are there *differences*?

- **Unity** of life

- All creatures have similarities
- Common characteristics
- Why are they *so alike*?

Coral Reef Wildlife





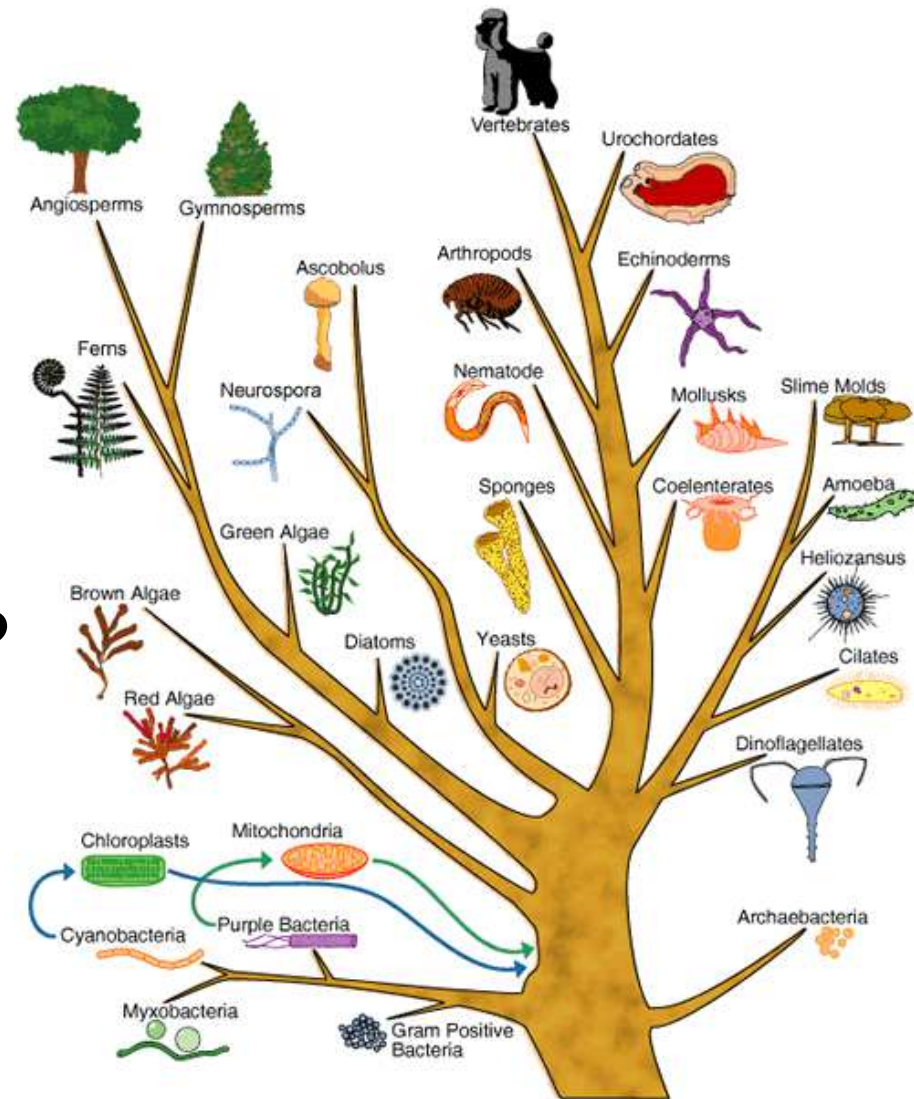
Classifying Life

- The Tree of Life

- Organize creatures by **structure** & **function**

- How they are built
- How they live

- Organize them into groups of closely related creatures



Classifying Life

- 6 Kingdom system

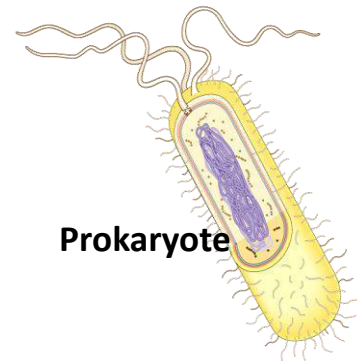
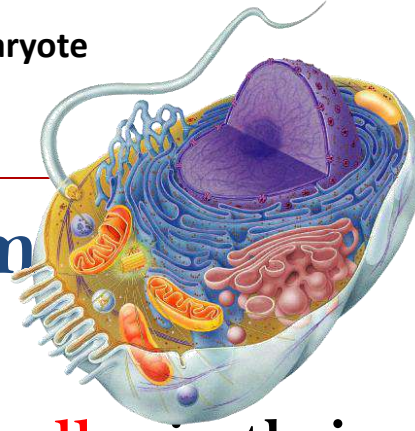
- Prokaryotes

- No separate **organelles** in their cells
 - Ex. Bacteria
 - Ex. Archaeobacteria

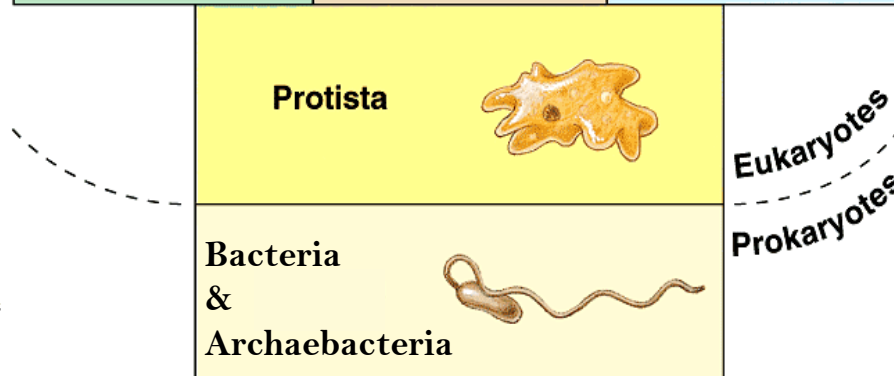
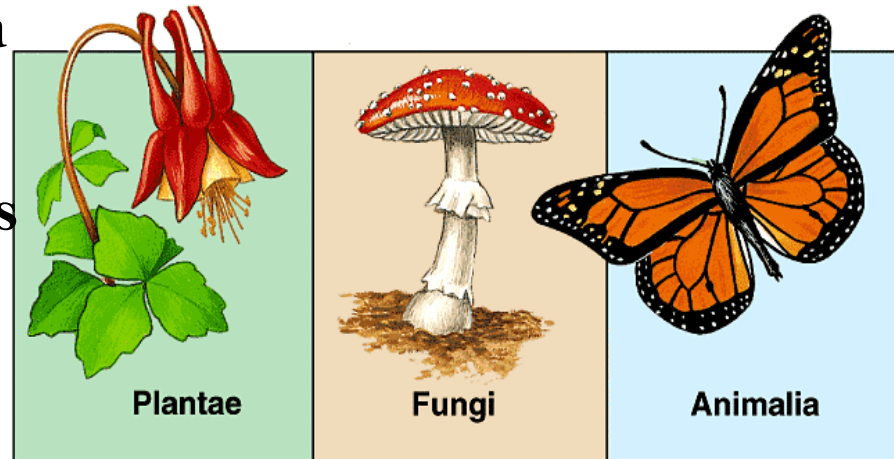
- Eukaryotes

- Separate organelles in their cells
 - Ex. Protists
 - Ex. Plants
 - Ex. Fungi
 - Ex. Animals

Eukaryote



Prokaryote



Prokaryotes

Domain Bacteria



3.8 μm

Kingdom
Bacteria

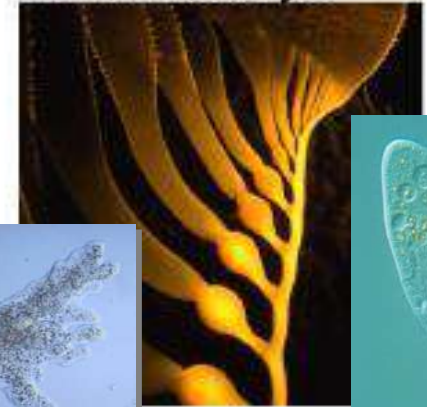
Domain Archaea



1.7 μm

Kingdom
Archaeobacteria

Domain Eukarya



Kingdom
Protist

Eukaryotes



Kingdom
Fungi



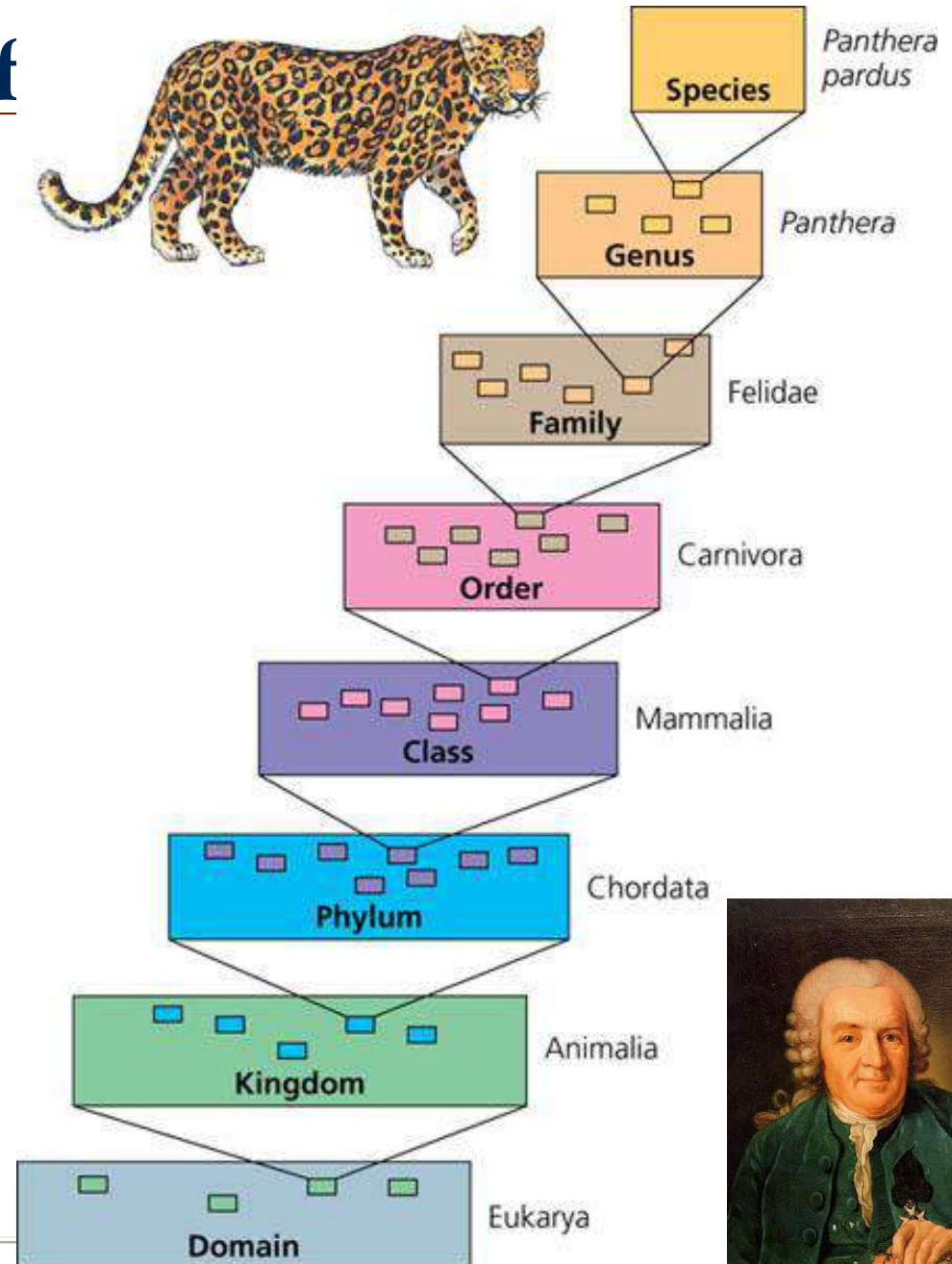
Kingdom
Plant



Kingdom
Animal

Classifying Life

- Kingdom
- Phylum
- Class
- Order
- Family
- Genus
- species



2011-12

Science History Moment

- **Carolus Linnaeus (1707-1778)**
 - “Father of Modern Taxonomy”
 - Swedish botanist
 - Took complex system and simplified
- **Binomial nomenclature**
 - Every organism has two names (in Latin- WHY?):
 - **Genus** name: noun
 - **Species** name: adjective
- **Published: *Systema Naturae* in 1735**
 - Reclassified plants using his binomial system (bi= two, nomial= name, two word naming)



Scientific Names

- **Standard Format**

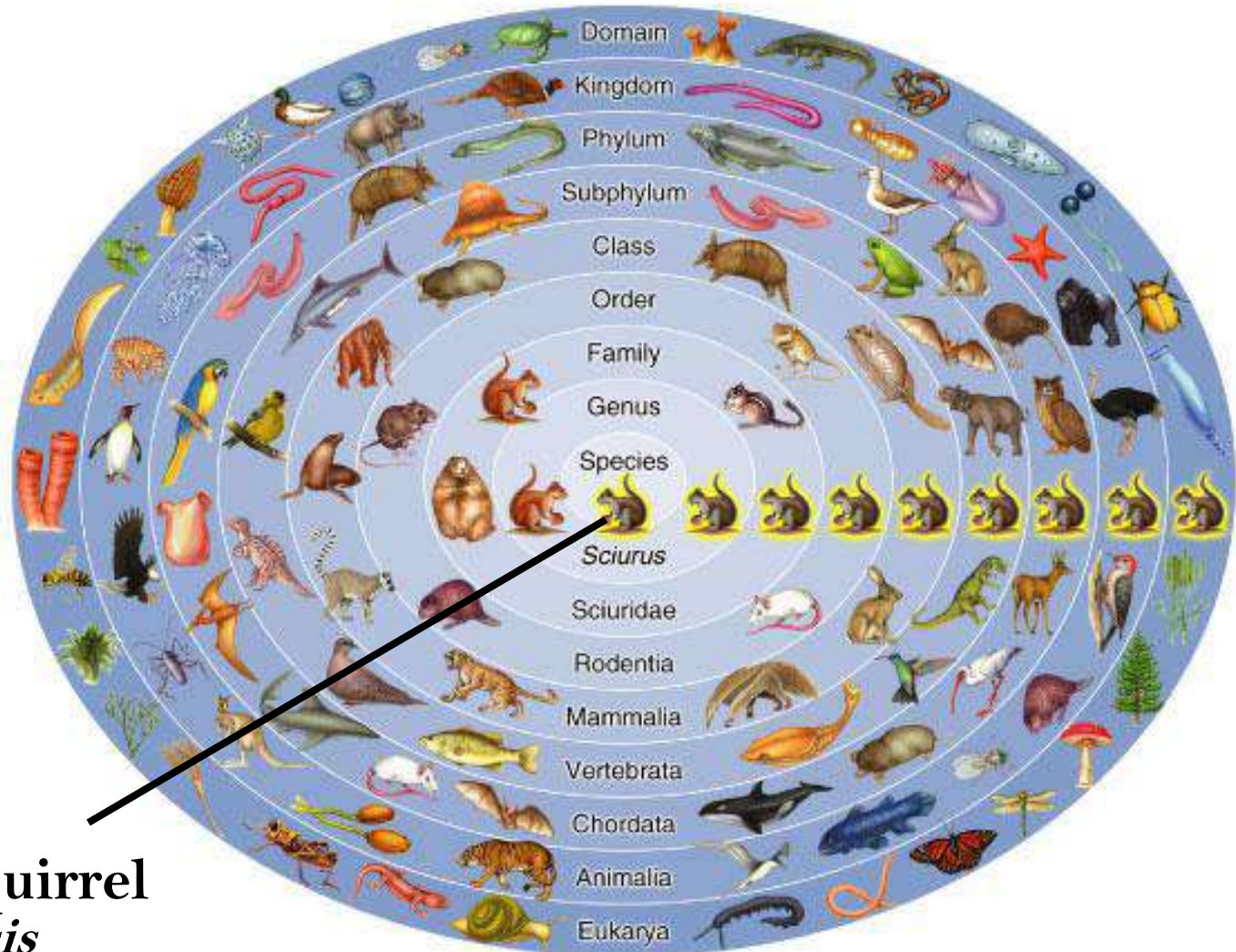
- Every scientific name begins with the genus
- Genus is capitalized
- Species name is lower case
- Scientific name is underlined or in *italics*

- **Examples**

- *Homo sapien*: “wise one” (human)
- *Canis lupus*: wolf
- *Canis familiaris*: family dog
- *Ursus horribilis*: “horrible bear” (grizzly)

Organizing systems

- Making sense out of the differences

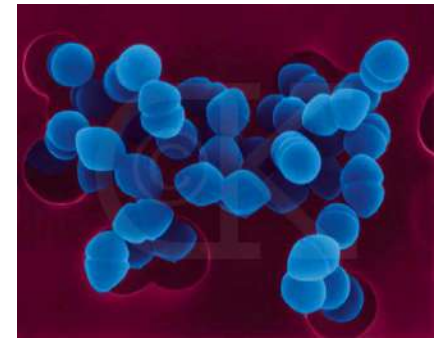
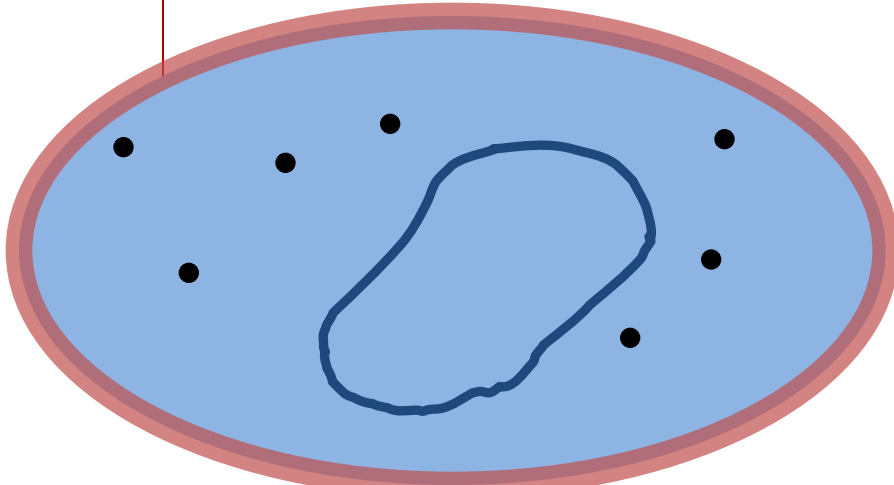
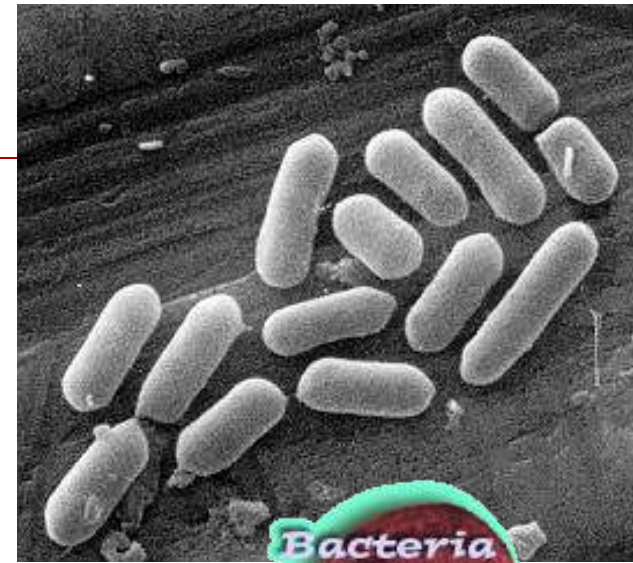


Eastern gray squirrel
Sciurus carolinensis

Prokaryotes

- **Bacteria**

- **one-celled** organisms
- microscopic
- no organelles
 - have **cell membrane**
 - have **DNA**
- most common form of life on Earth
- incredible number of different kinds



Diversity of bacteria

rods and spheres and spirals... Oh My!

Bacillus



Bordetella



Clostridium



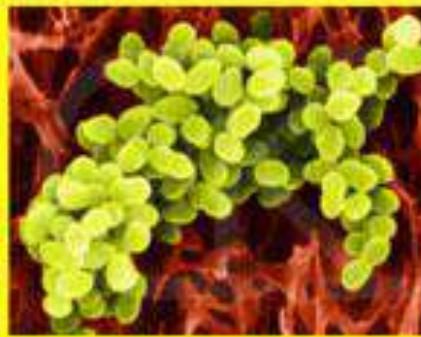
Escherichia



Spirulina



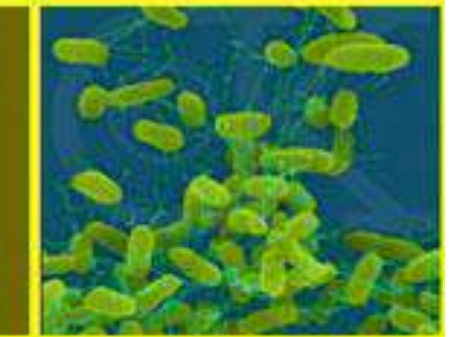
Staphylococcus



Streptococcus

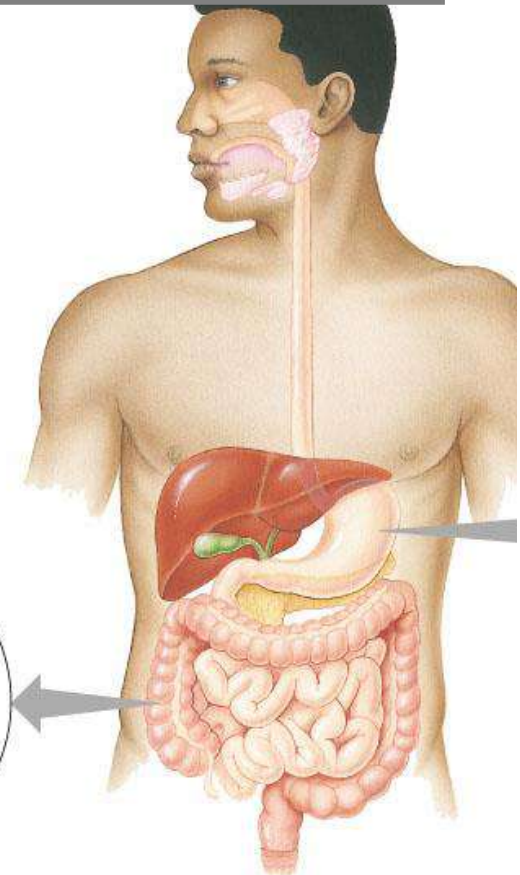
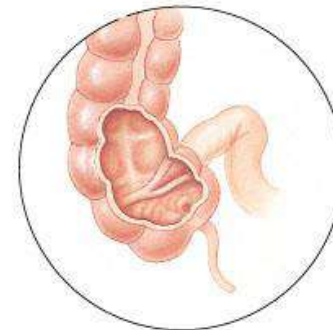
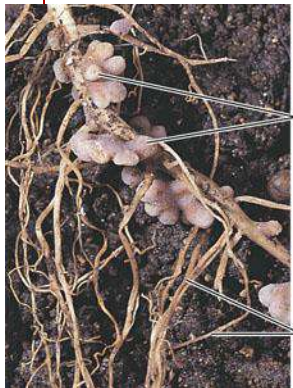


Salmonella



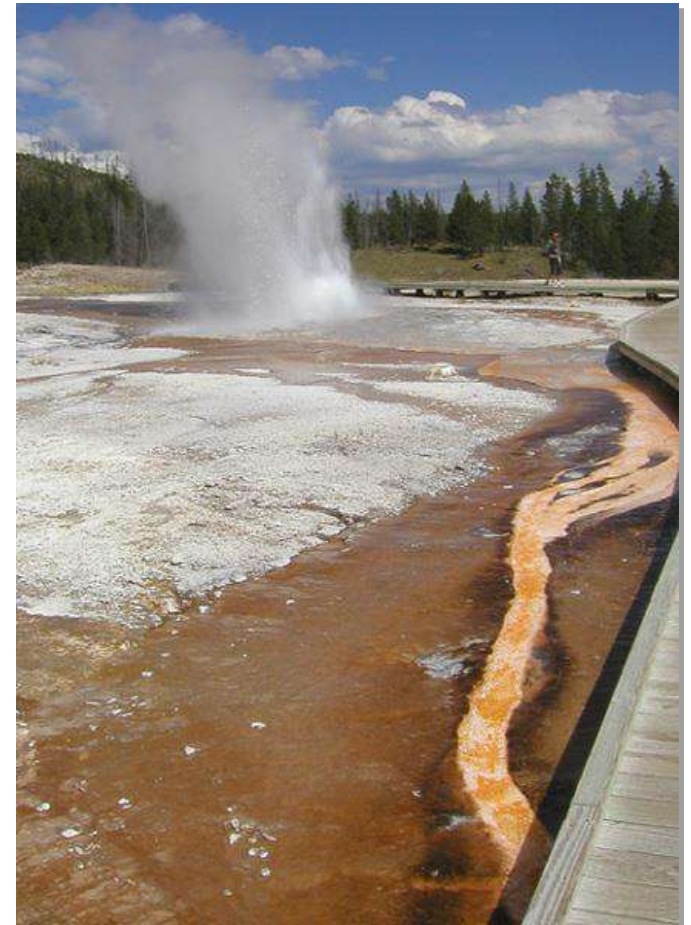
Diversity of bacteria

- Pathogens
 - cause disease (infections)
- Beneficial & necessary
 - help in digestion
 - help plants grow
 - make foods



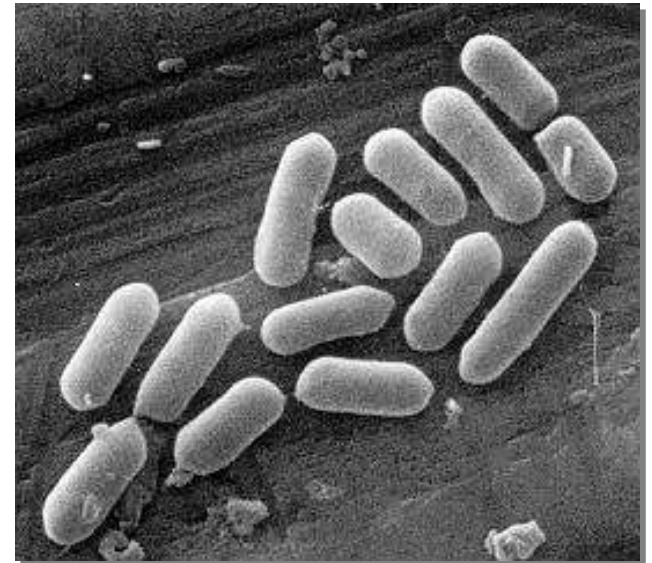
Archaeobacteria

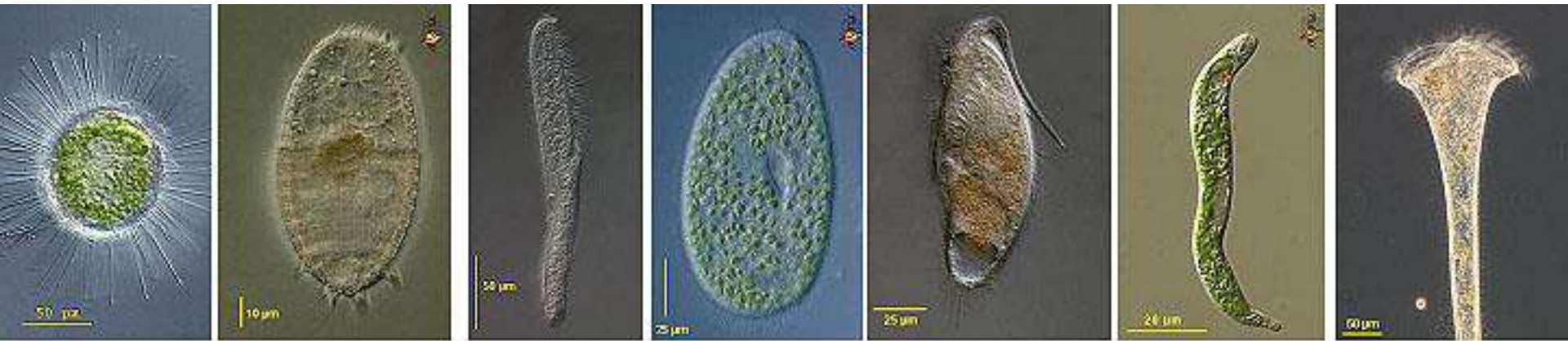
- **Ancient bacteria**
 - live in extreme environments
 - high heat
 - high salt
 - the most ancient creatures living on Earth today



Bacteria are EVERYWHERE

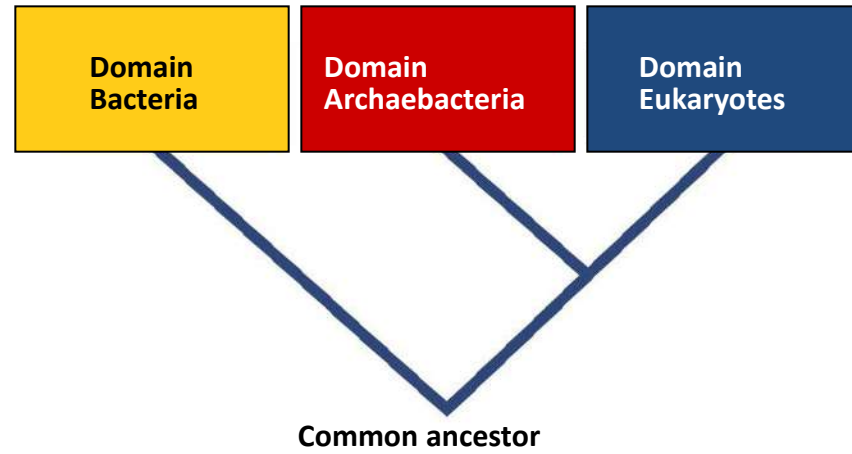
- On plants & animals
- In plants & animals
- In the soil
- In the extreme cold
- In the extreme hot
- On the living
- On the dead





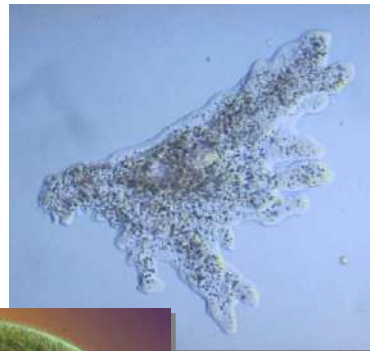
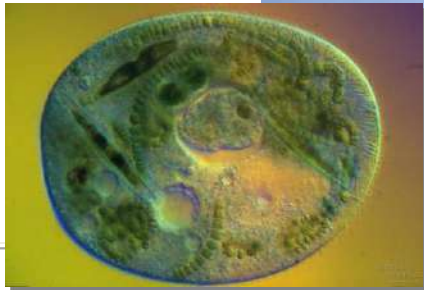
Protists

Simple Eukaryotes



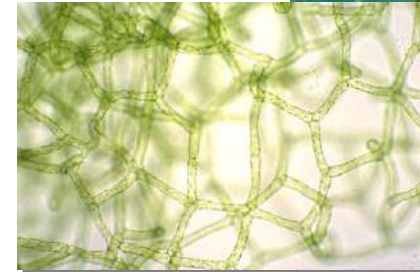
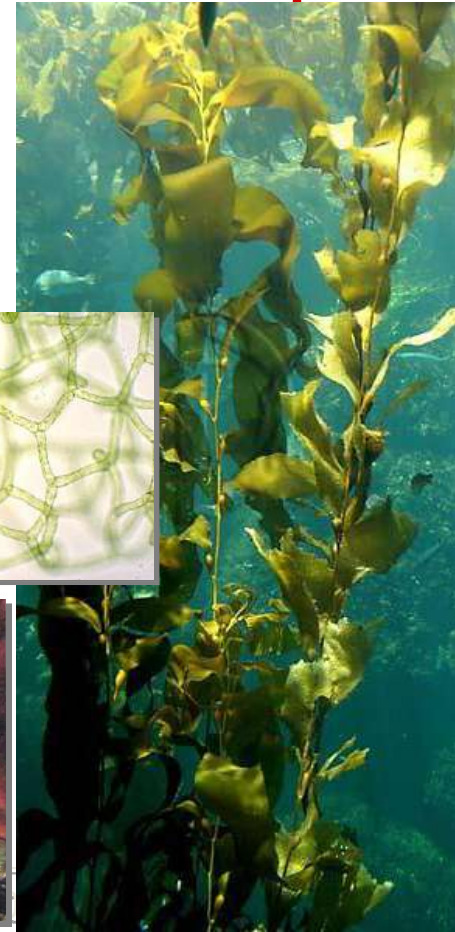
General Characteristics

- **Classification criteria**
 - Eukaryotes
 - Not animal, plant or fungi



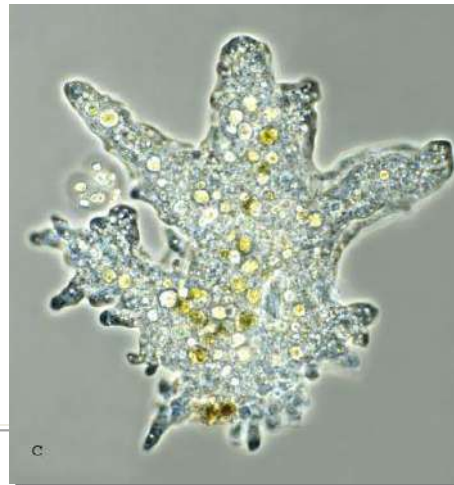
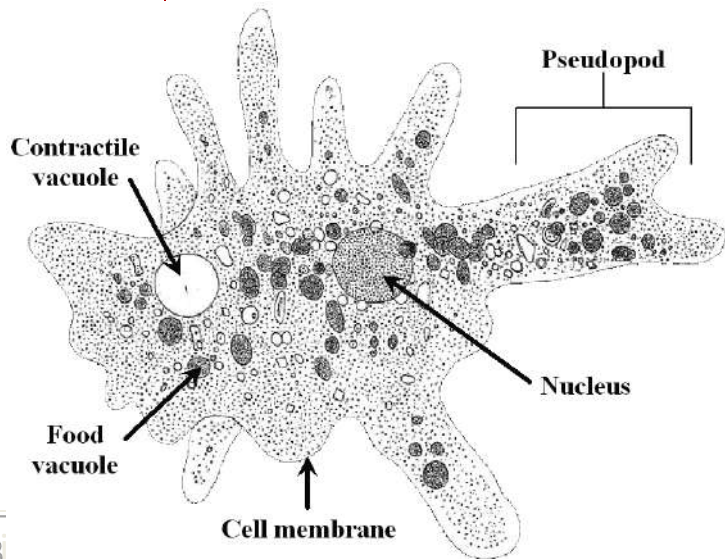
Protozoan Diversity

- A great variety in ways of life
 - One-celled or many-celled
 - **Autotrophs** (photosynthesis) or **heterotrophs** (have to eat)
 - Asexual or sexual reproduction
 - Can be pathogens or beneficial
 - Stationary or mobile



How protists move:

- How protists move
 - Flagellum
 - Cilia
 - Pseudopod



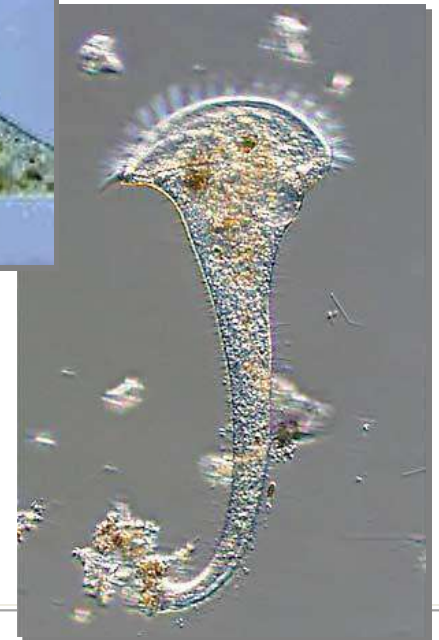
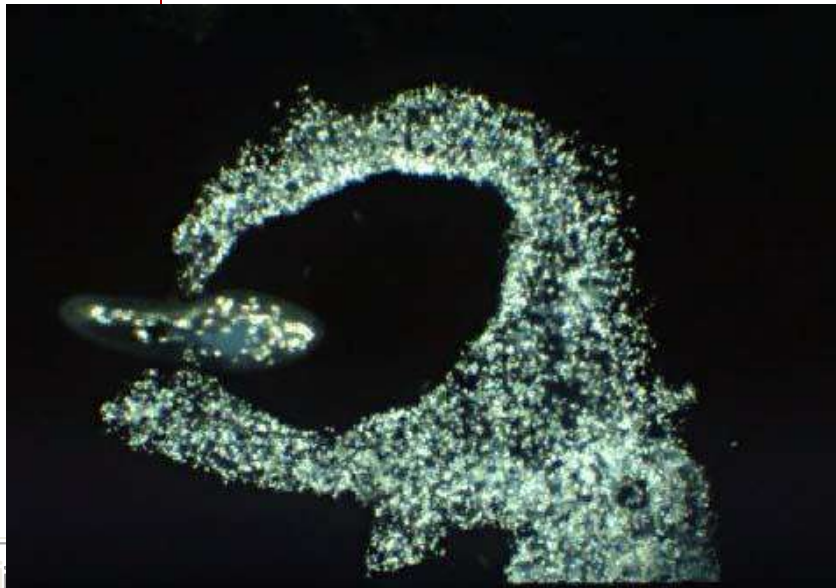
Protist predators

- Animal-like Protists
 - Heterotrophs, predators
 - Amoeba
 - Paramecium
 - Stentor



Paramecium with food vacuoles stained red

Amoeba ingesting a Paramecium



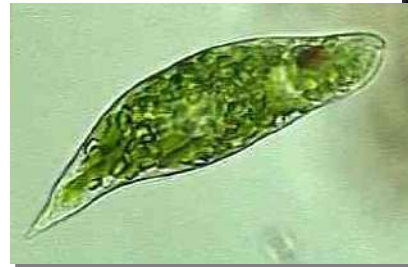
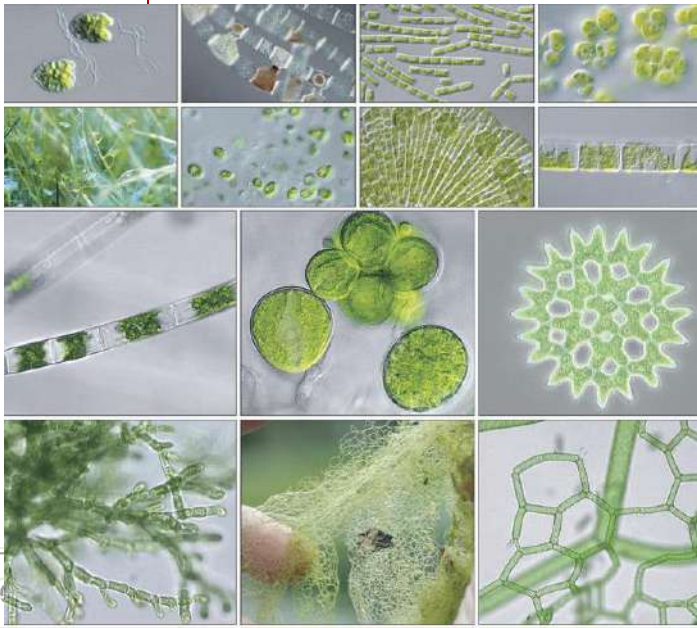
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Protist plants

- Plant-like Protists

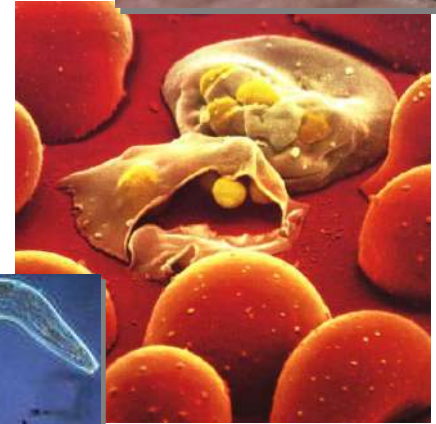
- Autotrophs, photosynthesis

- Euglena
 - Algae
 - Diatoms

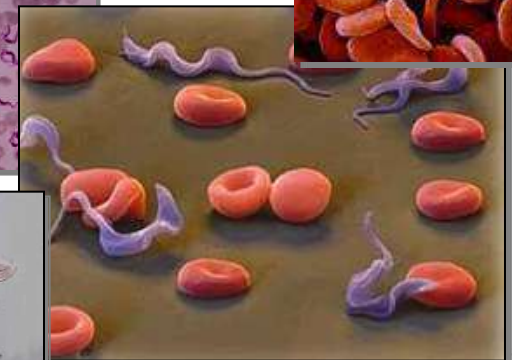
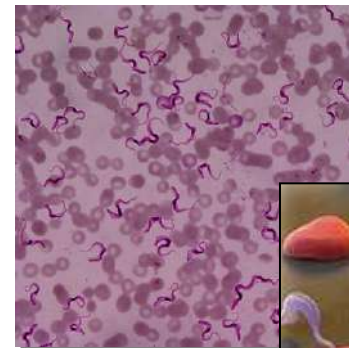


Protist parasites

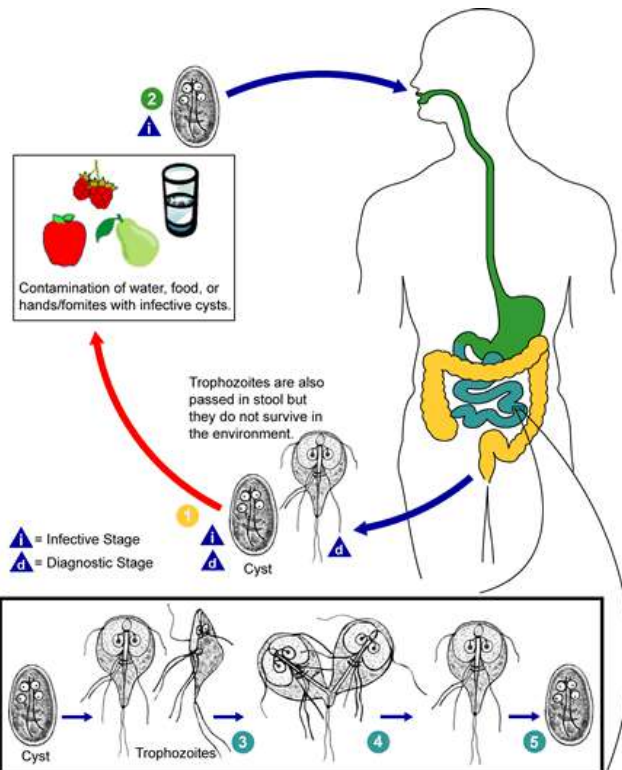
- Parasitic & pathogen Protists
 - Malaria
 - Giardia
 - Trypanosomes



Plasmodium



Trypanosoma



Giardia



Protist diversity

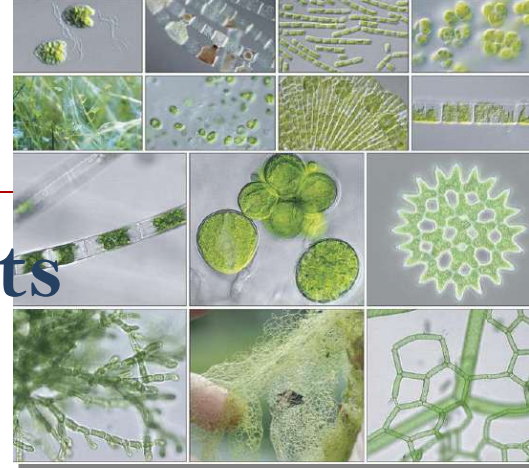
- Beneficial & necessary Protists

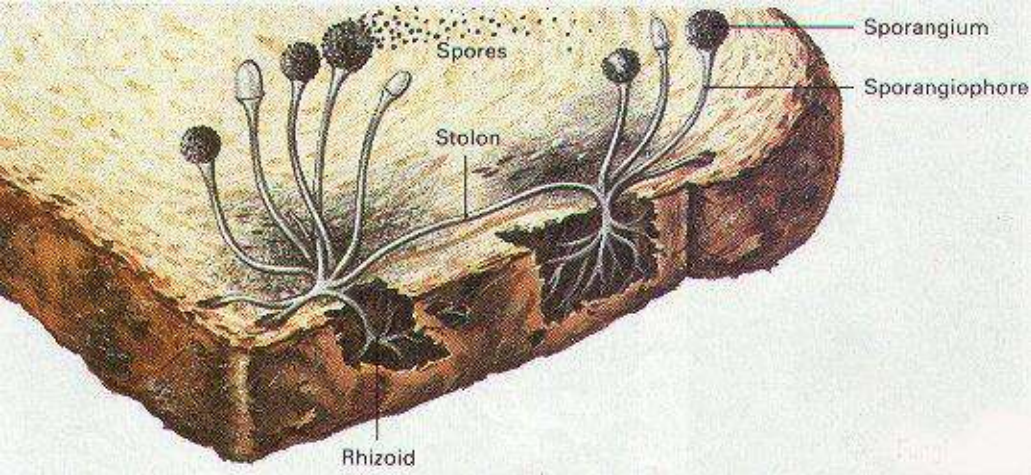
- Phytoplankton

- Small algae + diatoms
 - Much of the world's photosynthesis
 - Produces ~90% of atmospheric oxygen

- Zooplankton

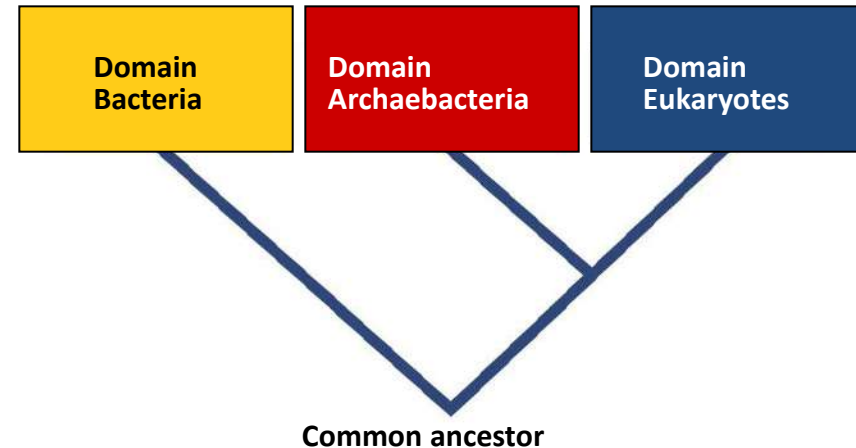
- Heterotrophic protists
 - Key ecological role at base of marine food web





Kingdom: Fungi

Eukaryotes



General characteristics

■ Classification criteria

- eukaryotes

- heterotrophs

 - must feed off of others

- **mostly multicellular**

 - except one-celled yeasts

- cell wall

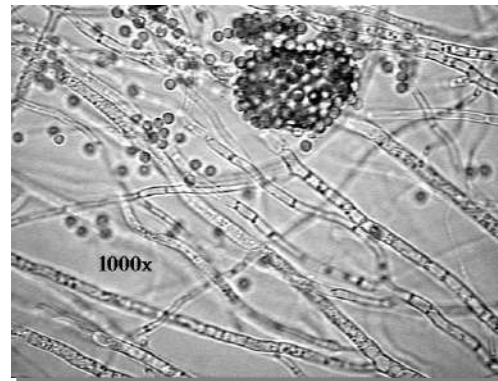
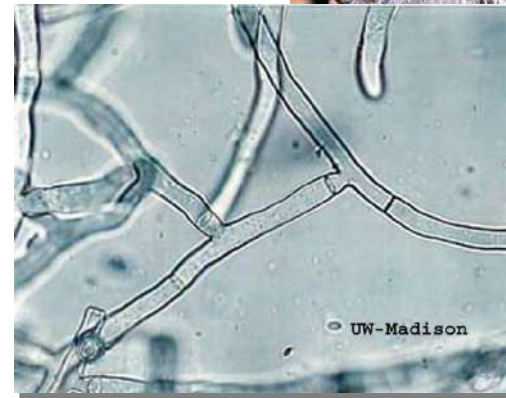
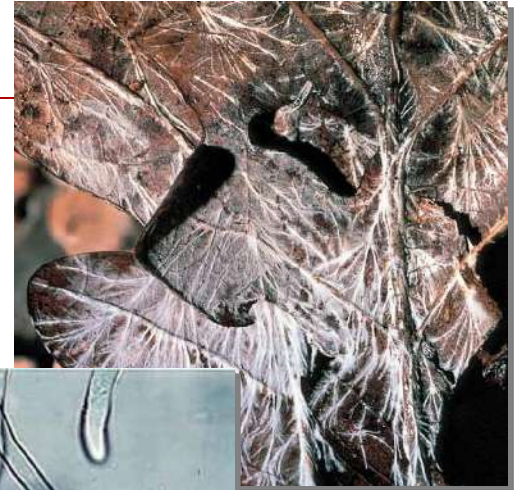


General structure

■ Cells

- long thread-like cells
- multiple nuclei
- cell wall

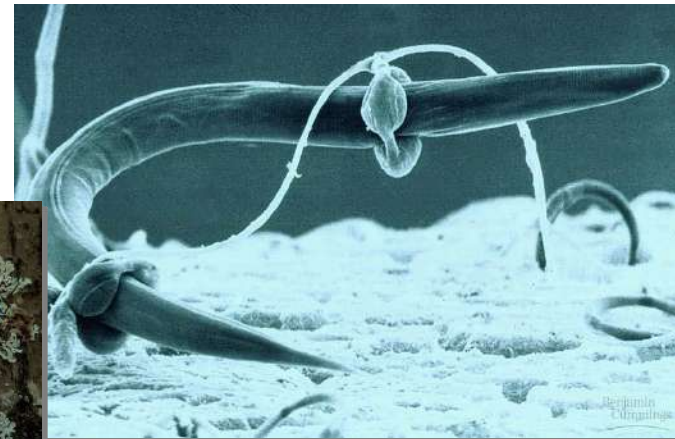
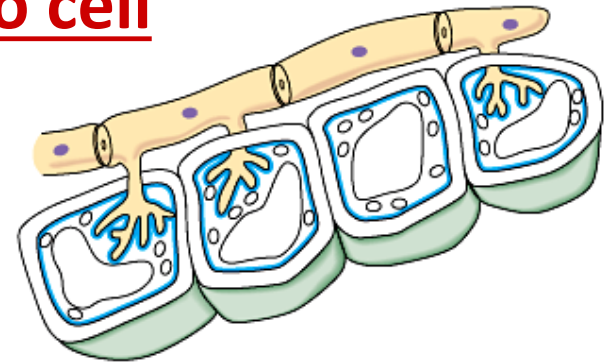
- made from **chitin**
just like crab shells



How do fungi “eat”?

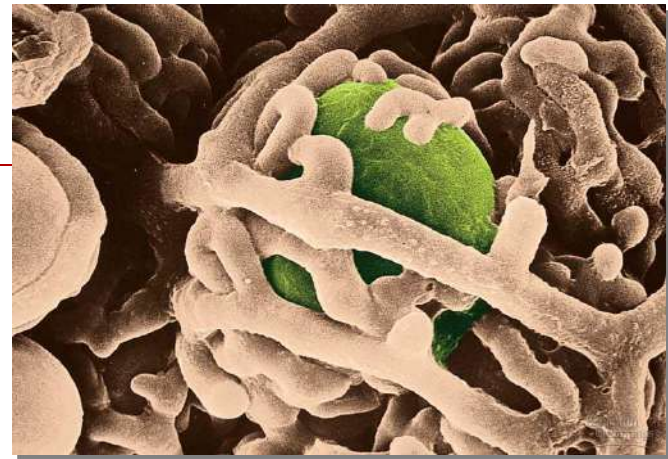
■ Heterotrophs

- secrete digestive enzymes
- absorb digested material into cell
 - predators
 - + paralyzing prey
 - parasites
 - + feeding on living creatures
 - decomposer
 - + breakdown dead remains



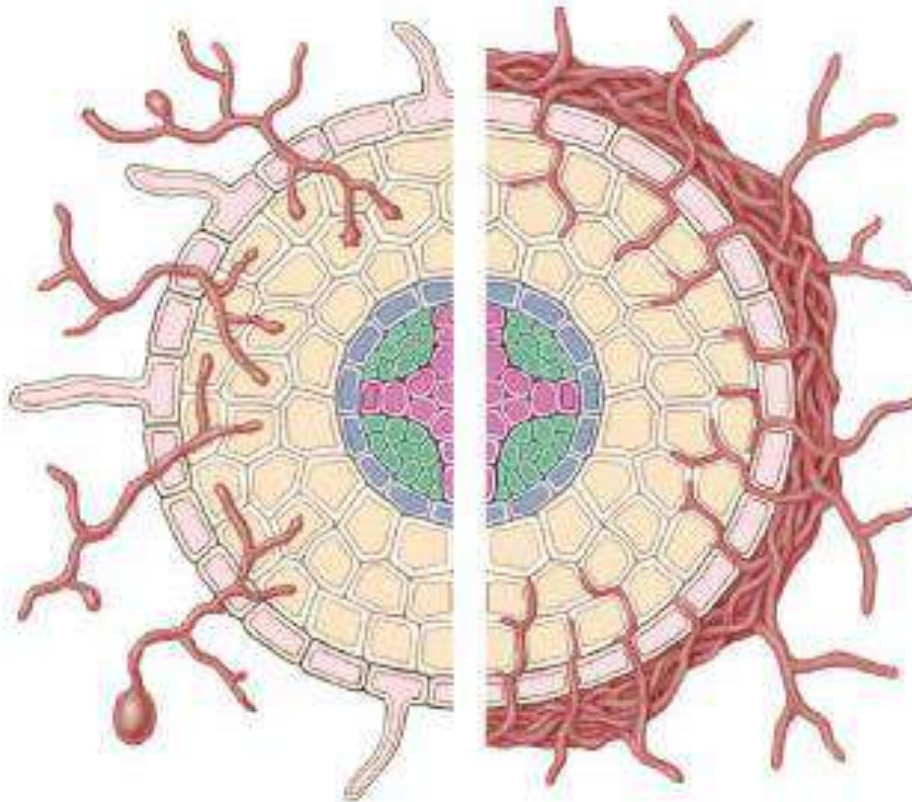
Ecological role

- **Decomposers**
 - recycle nutrients
- **Symbiotic Relationships**
 - **lichen**
 - +fungi + algae
 - +pioneer species in ecosystems
 - + makes soil from bare rock
 - **mycorrhizae**
 - +fungi + plants
 - +enables plants to absorb more water



Mycorrhizae

- Critical role in plant growth
 - extends water absorption of roots



Endomycorrhiza

Ectomycorrhiza

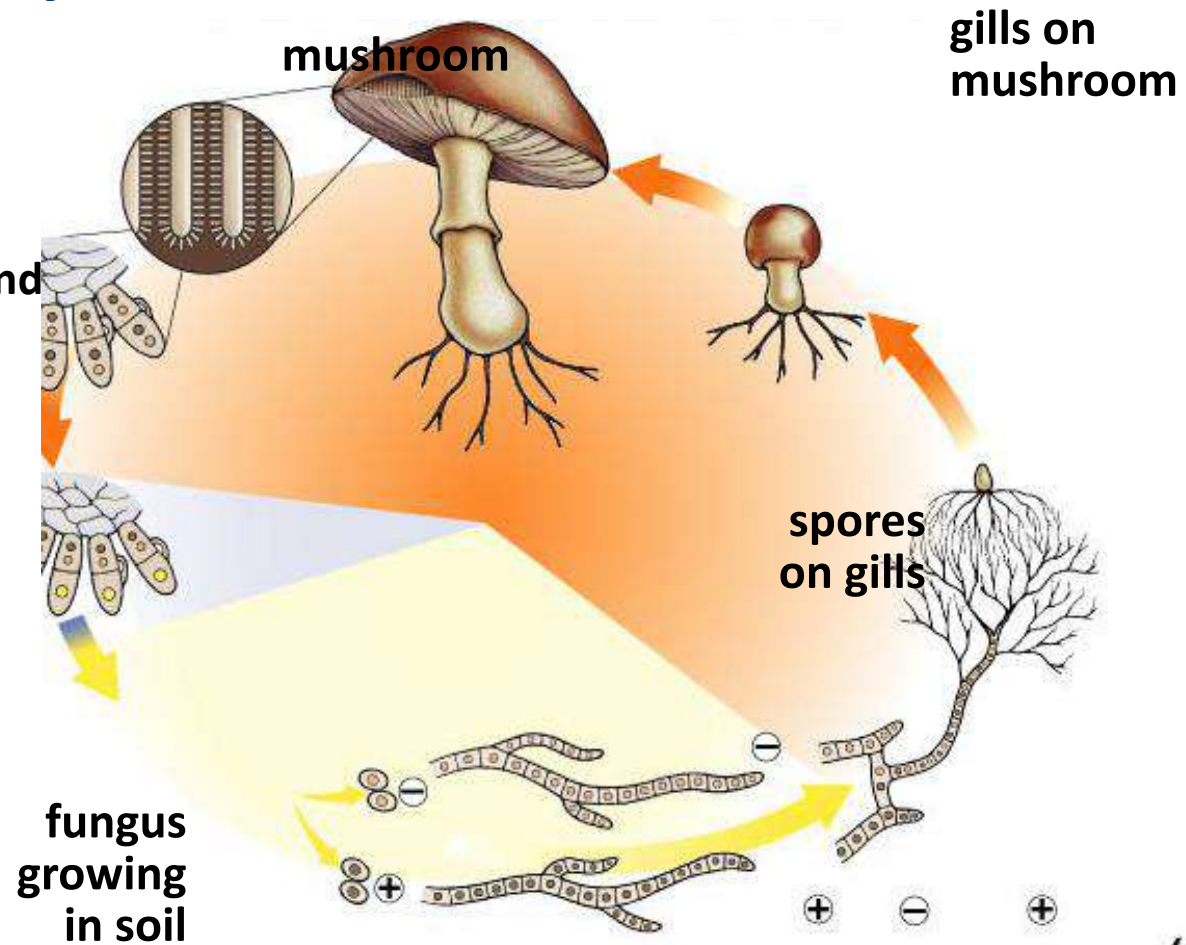
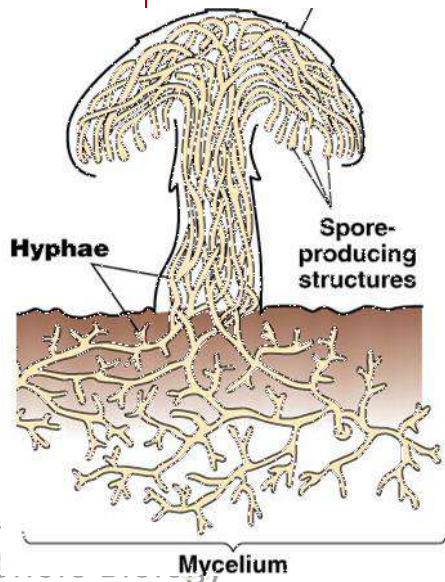
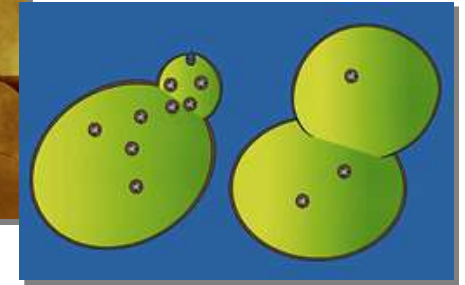
without
mycorrhizae

with
mycorrhizae



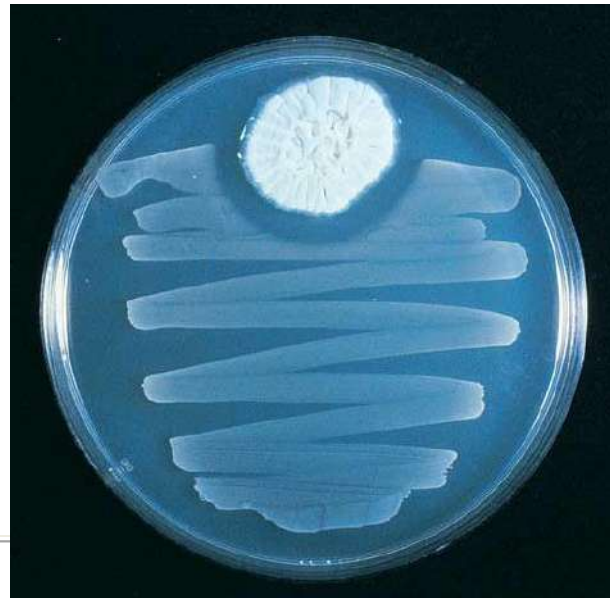
Reproduction

- **Asexual**
 - budding in yeast
- **Sexual**
 - spores
 - spread by wind



Human importance

- Food production
 - bread
 - beer, wine
- Medicine production
 - antibiotics



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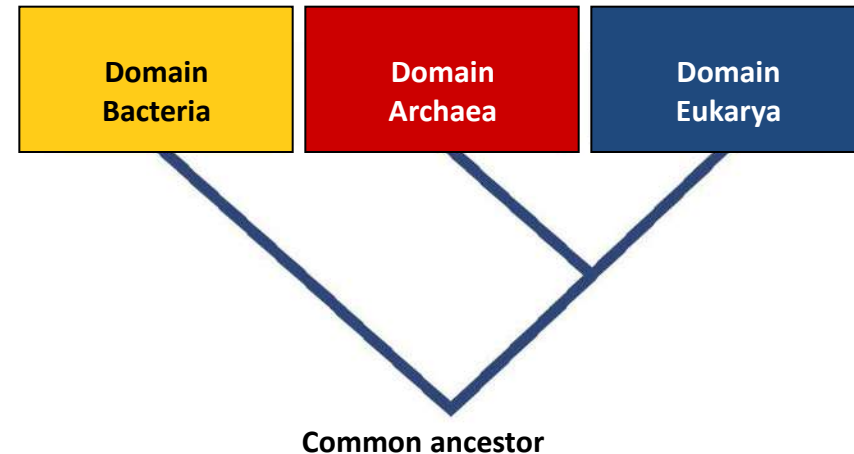
Brain Busters

1. Identify the classifying criteria for fungi.
2. Do fungi cells possess cell walls?
3. What common structural feature do they share with arthropods?
4. If you were a fungus, how would you get your daily nutrition?
5. What is the ecological role of fungi?
6. What is a lichen and define symbiosis.
7. What are mycorrhizae?
8. Describe 2 modes of reproduction that fungi can do.
9. List 3 important uses of fungi by humans.
10. Is it safe to collect and eat mushrooms found in your yard?



Kingdom: Plants

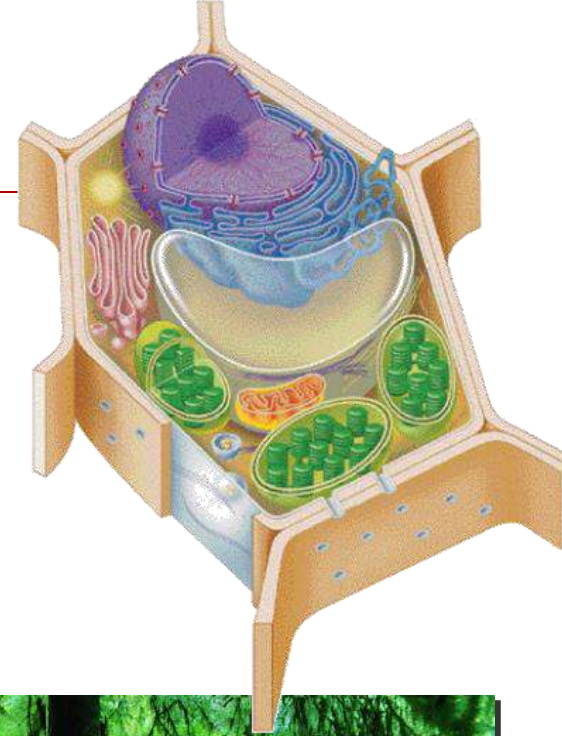
Photosynthetic Eukaryotes



Plants

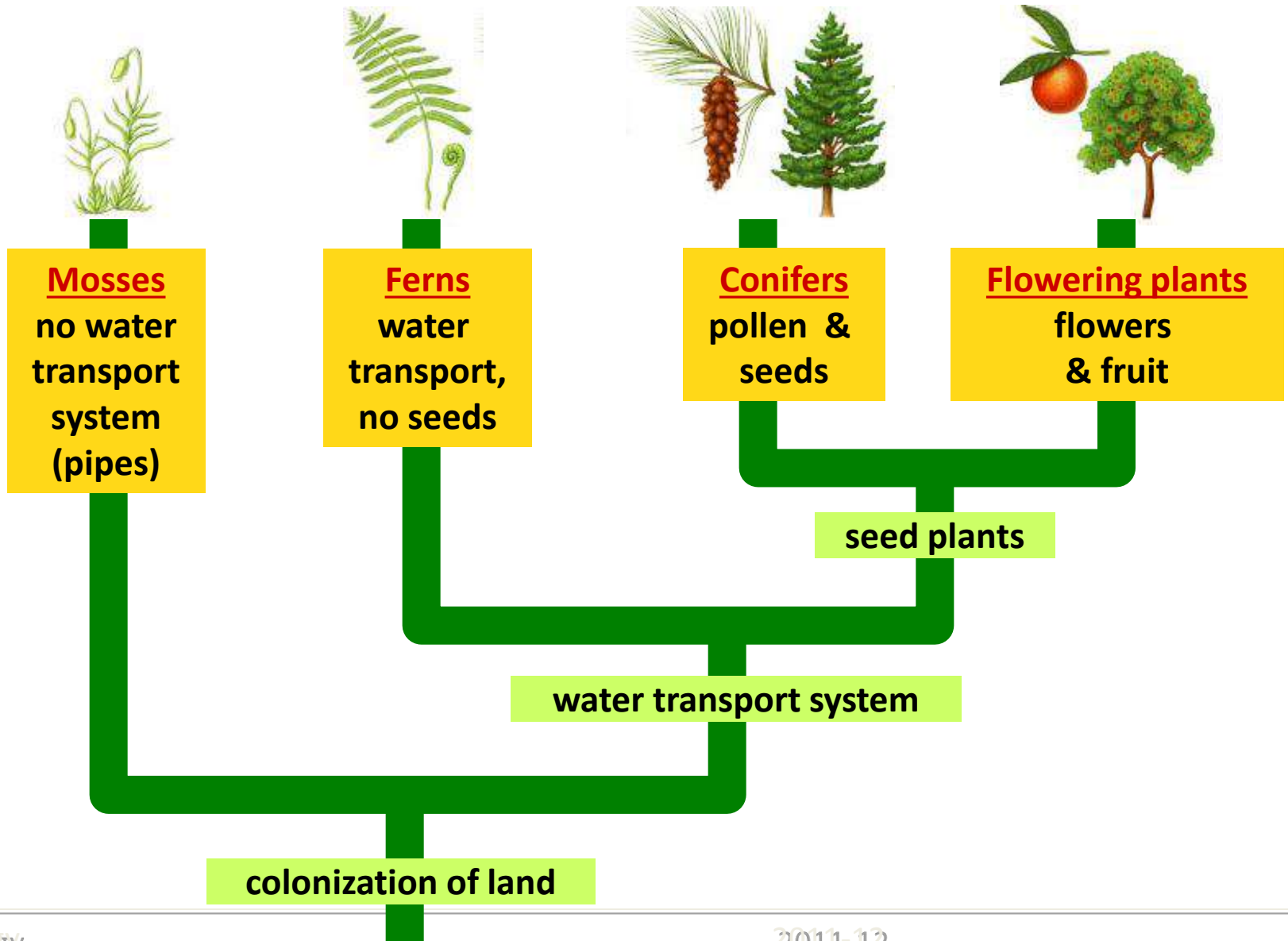
■ General characteristics

- eukaryotes
- autotrophs, photosynthetic
- cell wall
 - cellulose
- not mobile



Benjamin
Cummings

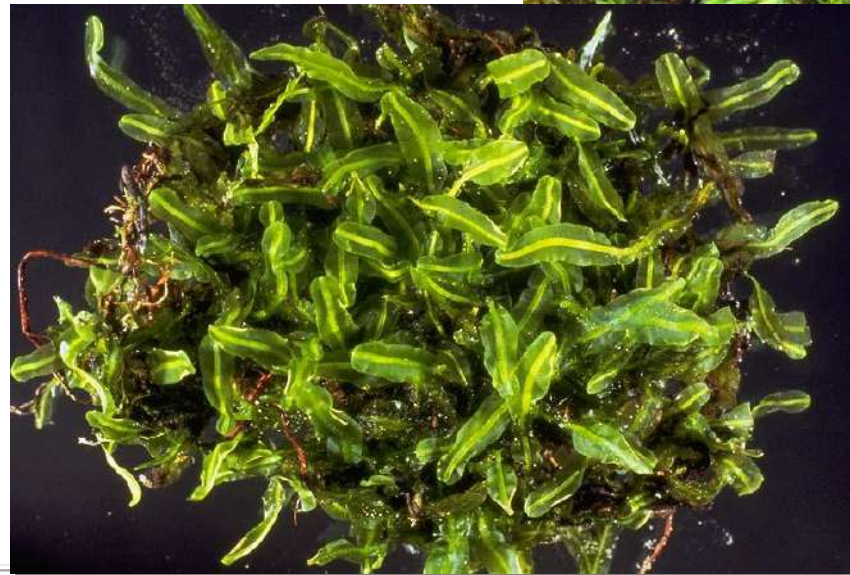
Plant diversity



Mosses: Bryophyta

■ Characteristics

- no water transport system
 - no true roots
- swimming sperm
 - need water to reproduce
- spores for reproduction
 - no seeds



Peat Bog: “peat moss”



Ferns: Lycophyta

■ Characteristics

- water transport system
 - xylem & roots
- swimming sperm
 - need water to reproduce
- spores for reproduction
 - no seeds



Ancient tree fern forests

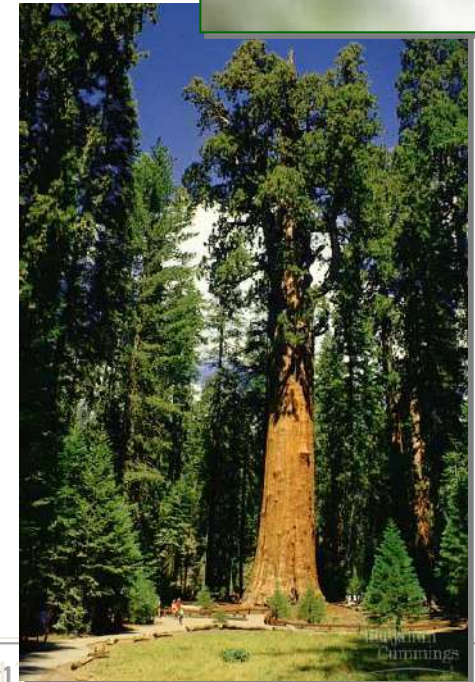


Carboniferous forest – 290-350 mya
Forests of ferns & mosses decayed into deposits of coal & oil

Conifers: Gymnosperms

■ Characteristics

- water transport system
 - xylem, roots
- seeds
 - “naked” seeds in cone (no fruit)
- pollen
 - sperm that doesn't have to swim



Ancient conifers



ginkgo



Benjamin
Cummings

Flowering plants: Angiosperm

■ Characteristics

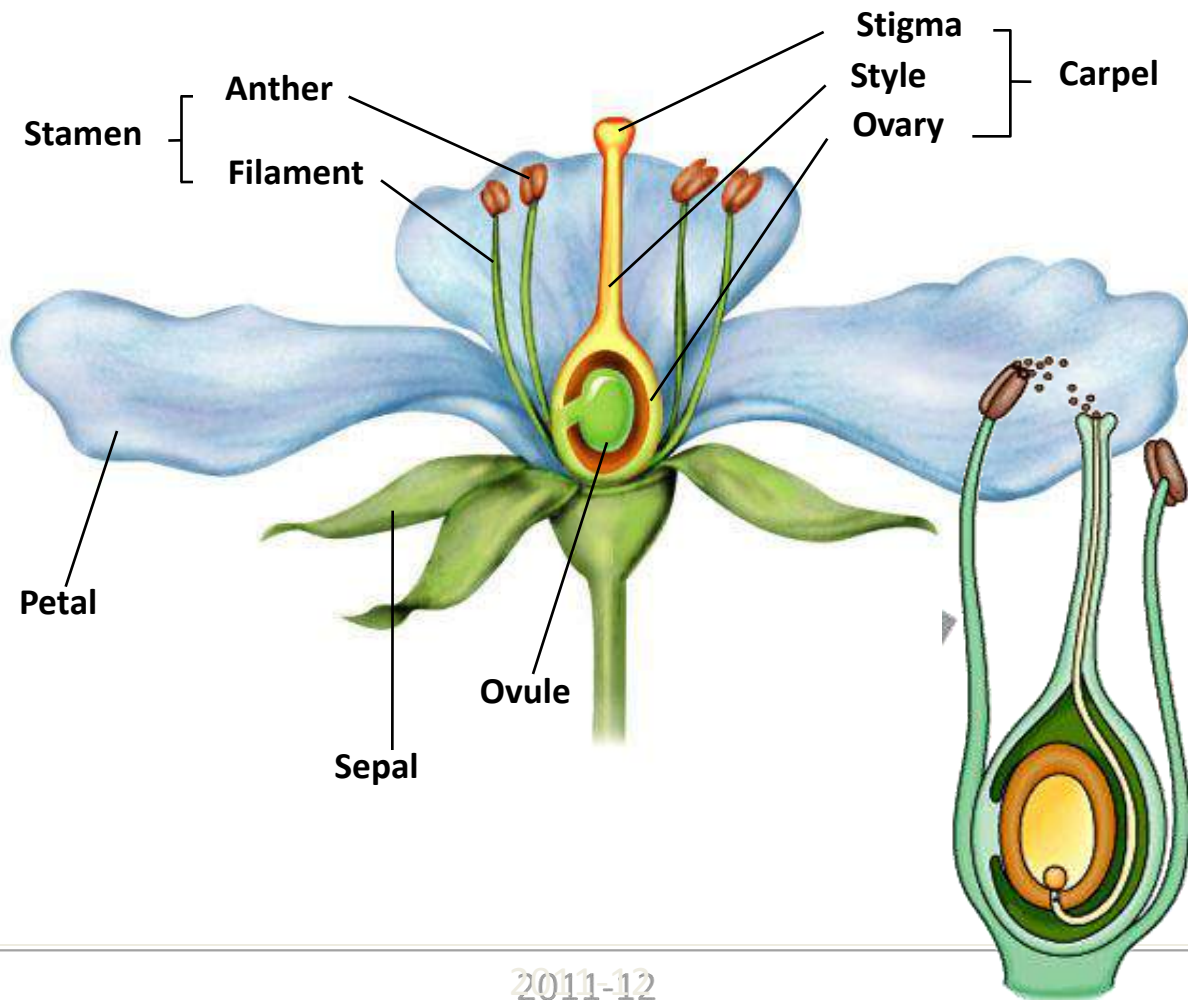
- water transport system
 - xylem, roots
- flower
 - specialized structure for sexual reproduction
- pollen
 - sperm that doesn't have to swim
- seeds within fruit



Flowering plants

■ 4 rings of flower parts

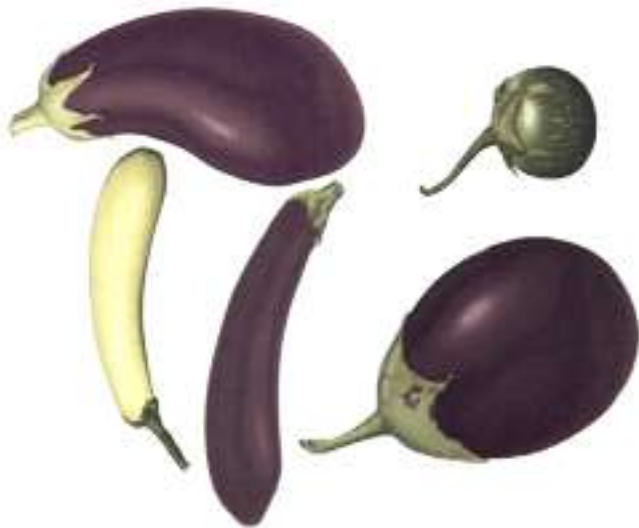
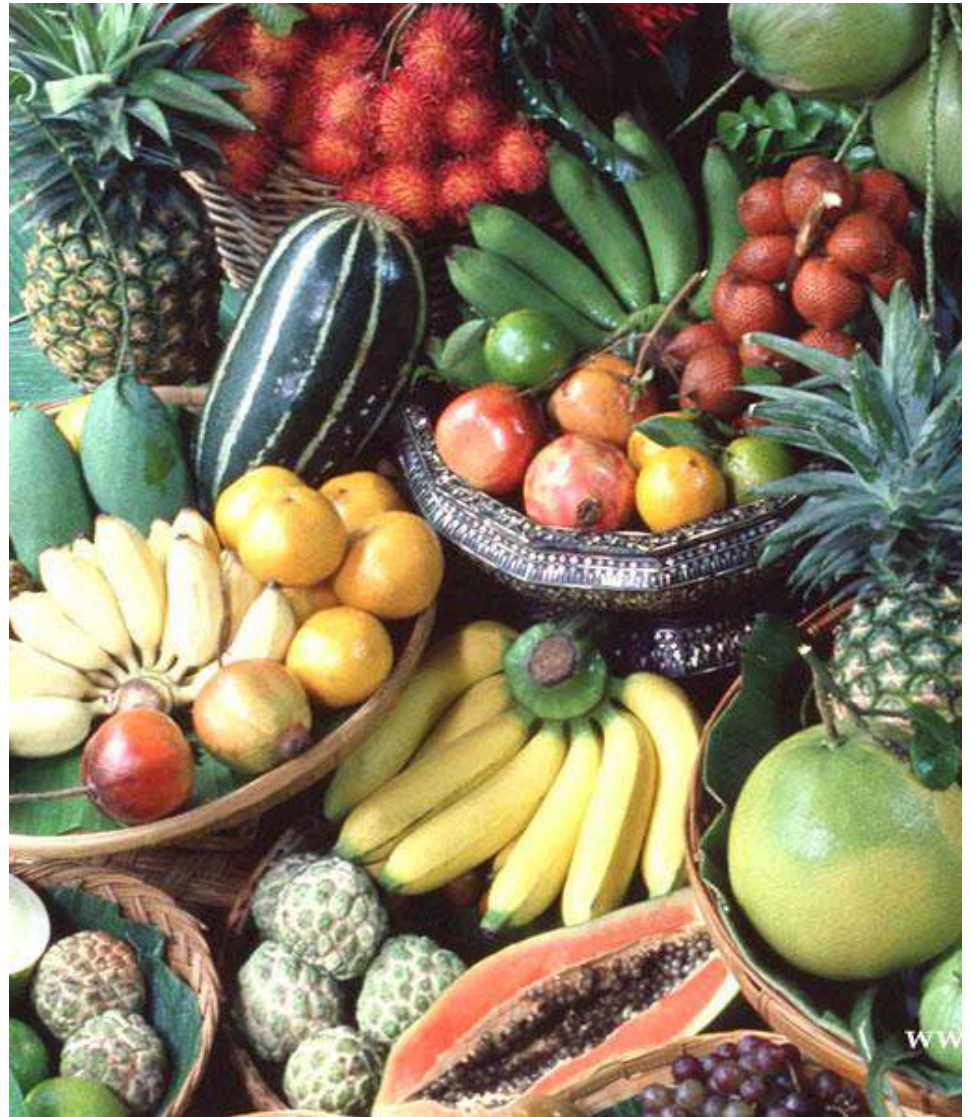
- sepals
- petals
- stamens
- male
- carpel
- female



Angiosperms: flowering plants



Angiosperms: fruiting plants



Angiosper

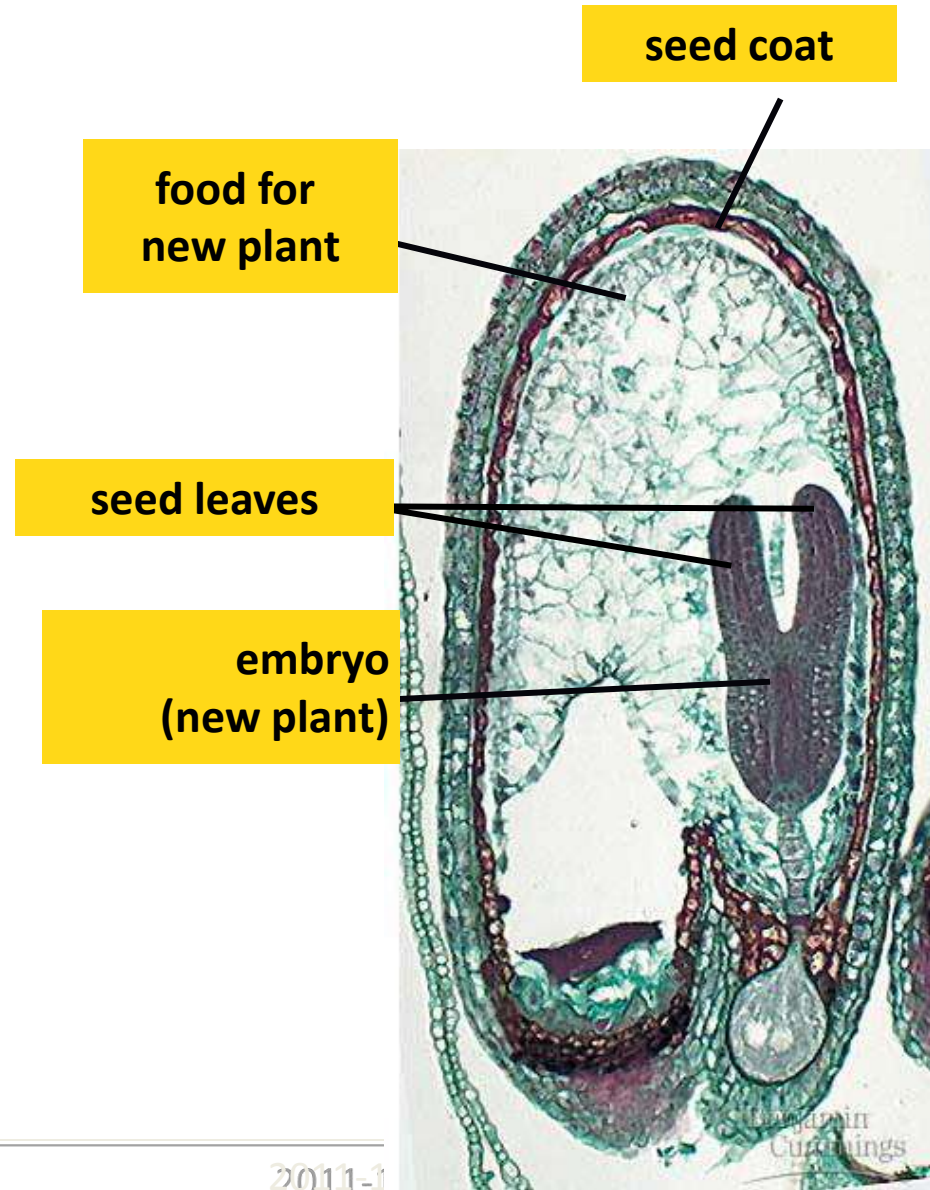


The seed and plant embryo

■ Seed offers...

- protection for embryo (new plant)
- stored nutrients for growth of new plant

“seed” leaves =
first leaves of new plant

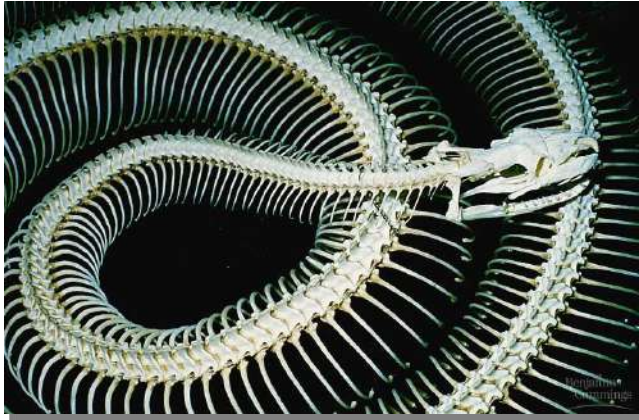


The seed and plant embryo

1. Identify the classification criteria for a plant
2. Identify the four plant categories
3. What are the characteristics of the mosses?
4. What are the characteristics of the ferns?
5. What are the characteristics of the conifers?
6. What is meant by “naked” seeds?
7. What are the characteristics of flowering plants?
8. Identify the function of the fruit.
9. What adaptation allowed plants to grow taller?
10. What is the function of flowers?

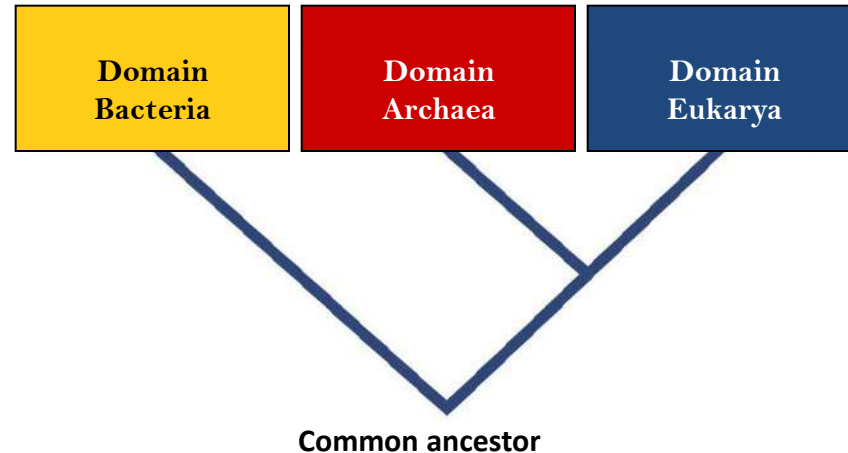
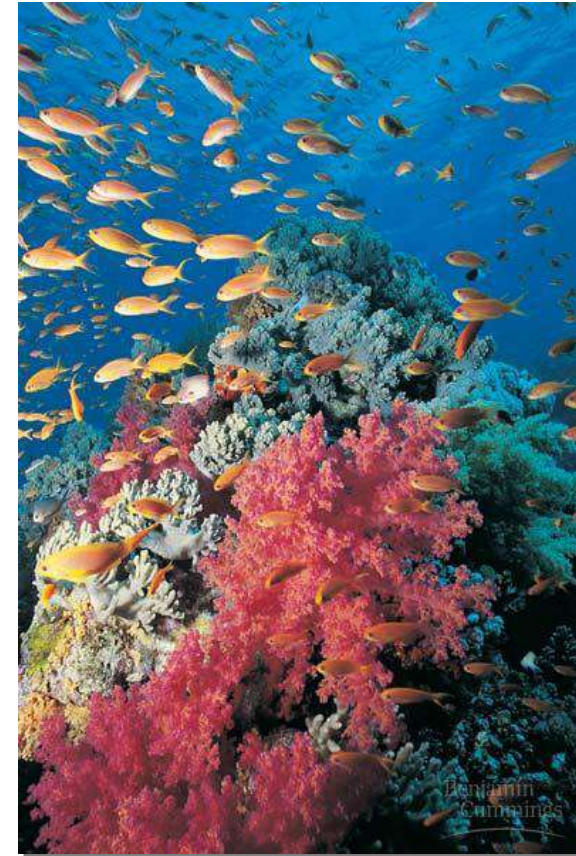


**Any
Questions??**



Kingdom: Animals

Complex Eukaryotes



Animal characteristics

▪ Heterotrophs

- Must ingest others for nutrients

▪ Multicellular

- Complex bodies

▪ No cell walls

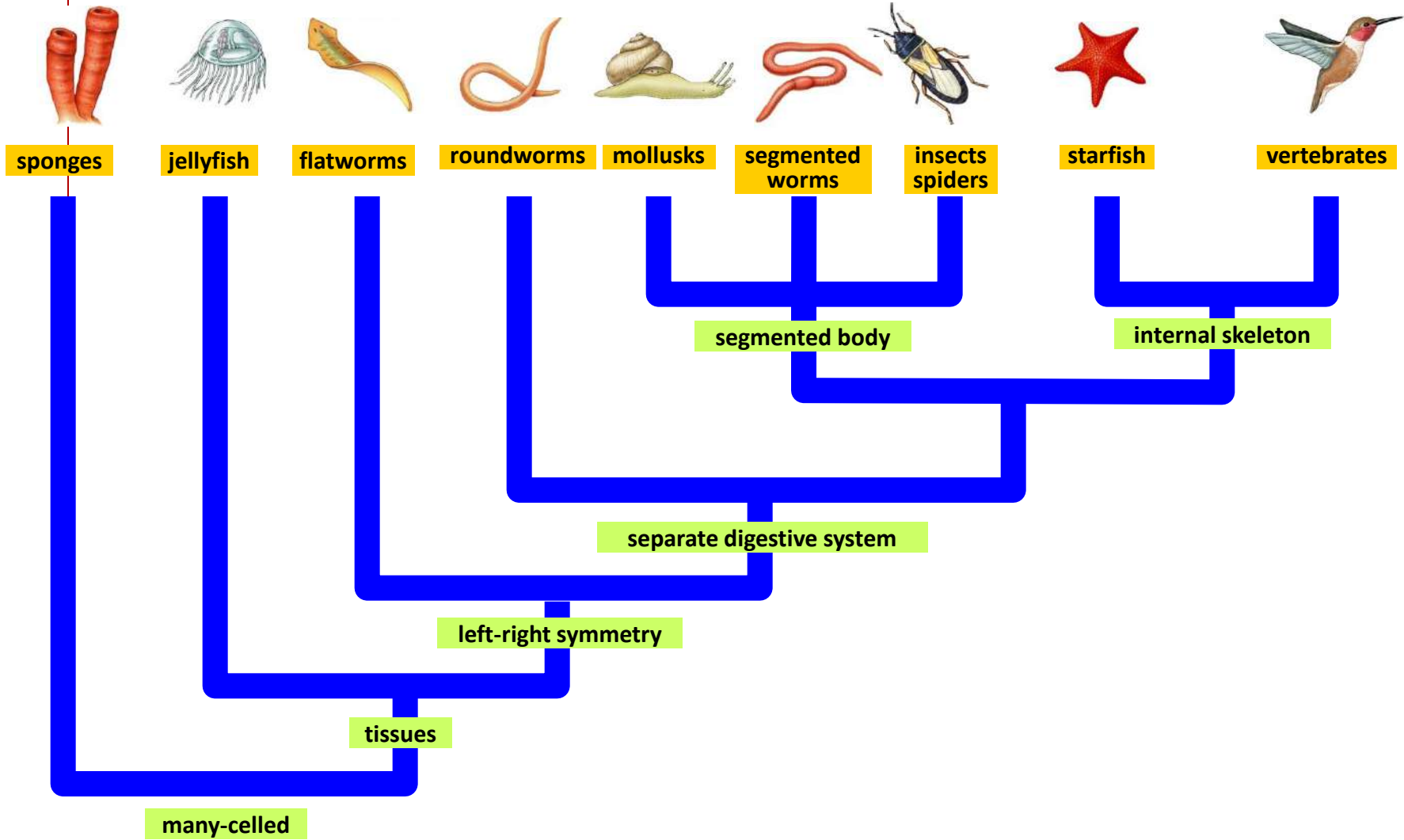
- Allows active movement

▪ Sexual reproduction

- 2 parents needed



Animal evolution

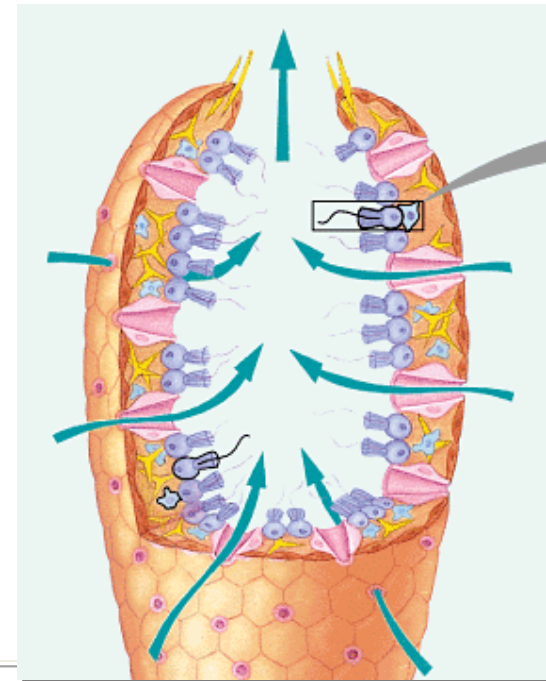
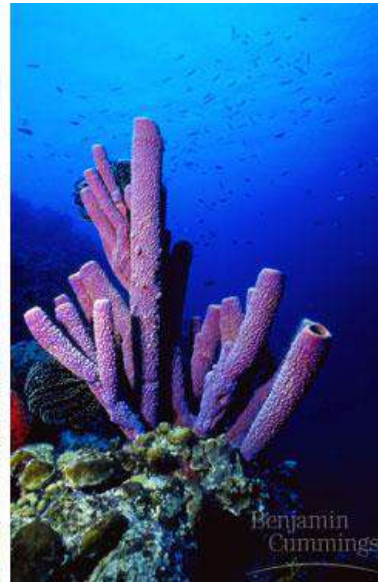
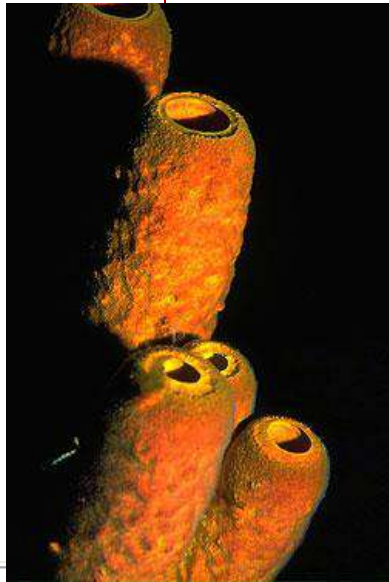
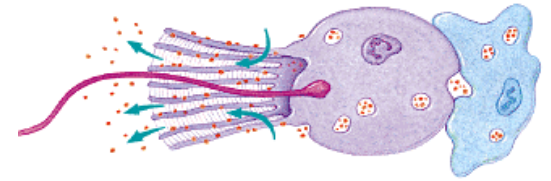


Invertebrates: Sponges/Porifera

▪ Sponges

- No organized tissues or organs
- Food goes in & waste comes out same opening

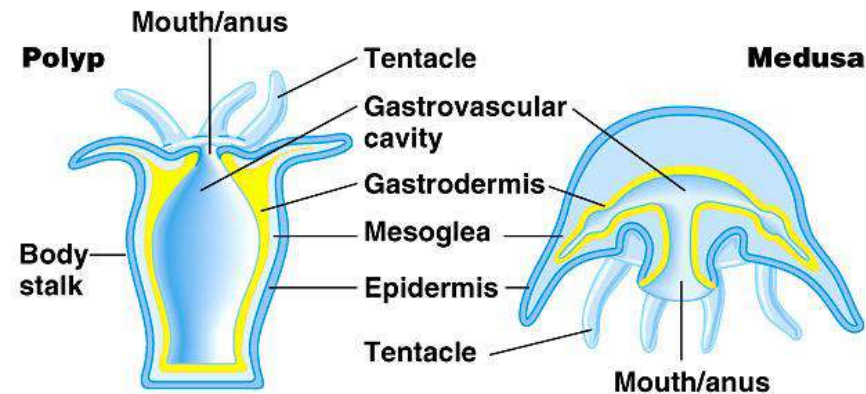
food taken into each cell separately



Invertebrates: Jellyfish/Cnidarians

■ Jellyfish, hydra, sea anemone, coral

- Tissues, but no organs
- Two cell layers
- Predators
 - Tentacles surround mouth opening
 - Digested material absorbed into cells



(a) Sea anemone: a polyp

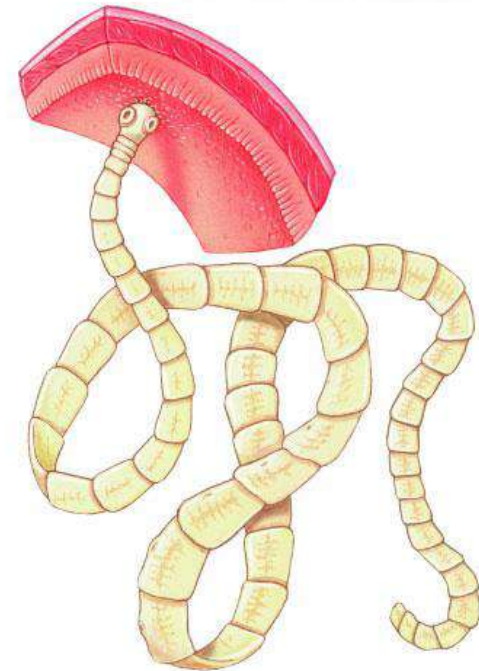
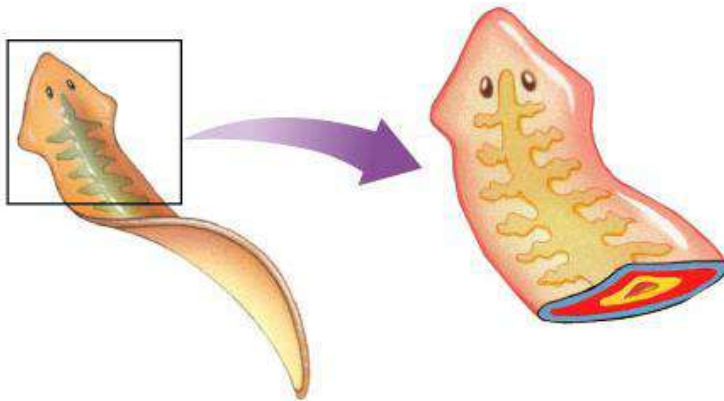


(b) Jelly: a medusa

Invertebrates: Flatworms/Platyhelminthes

■ Flatworms

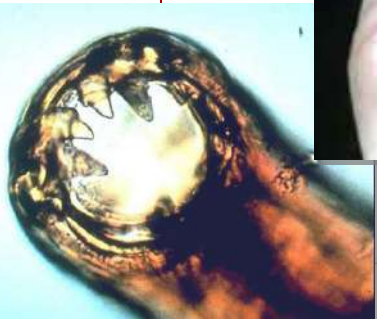
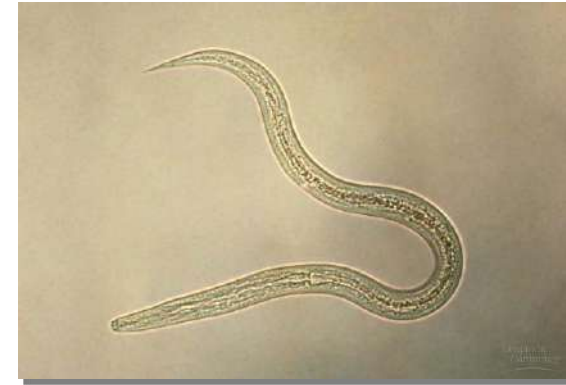
- Tapeworm, planaria
- Mostly parasitic
- Digestive tube
 - Now have separate mouth & anus



Invertebrates: Roundworms/Nematoda

▪ Roundworms

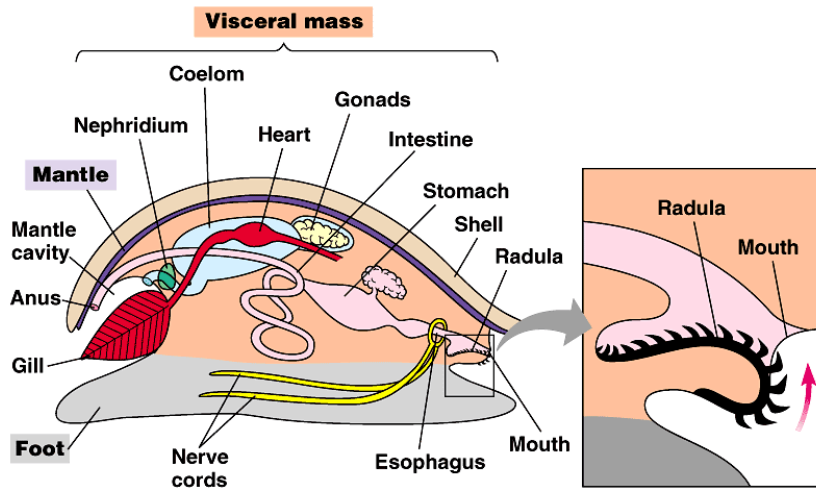
- Digestive tube
 - Have separate mouth & anus
- Many are parasitic
 - Hookworm



Invertebrates: Mollusks/Mollusca

■ Mollusks

- Clams, snails, squid
- Soft bodies, mostly protected by hard shells
- Digestive tube



Invertebrates: Segmented worms/Annelida

▪ Segmented worms

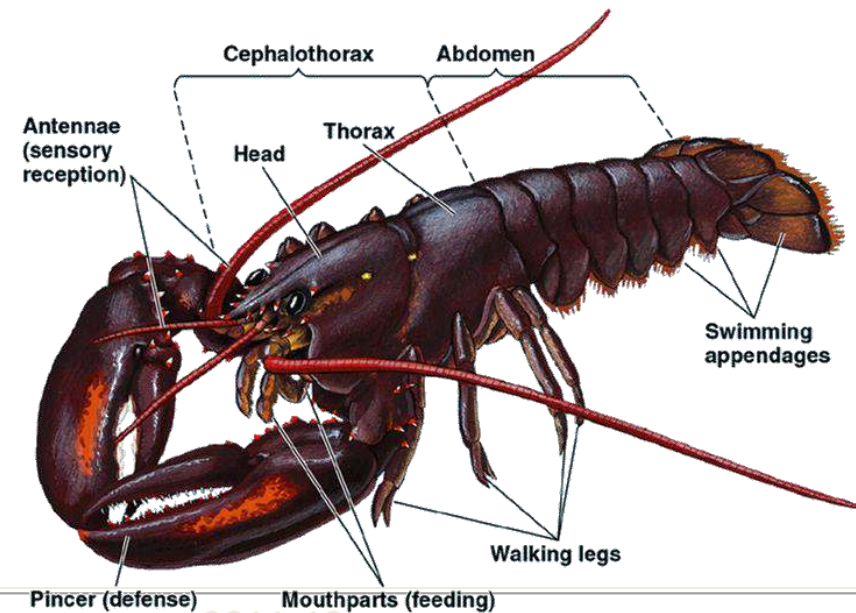
- Earthworms, leeches
- Segments are all the same
- Digestive tube



Invertebrates: Arthropods/Arthropoda

▪ Spiders, insects, crustaceans

- Most successful animal group
- Segmented
 - Allows jointed legs & arms
- Exoskeleton



Invertebrates: Arthropod Classes

Arachnids

8 legs, 2 body parts

spiders, ticks, scorpions



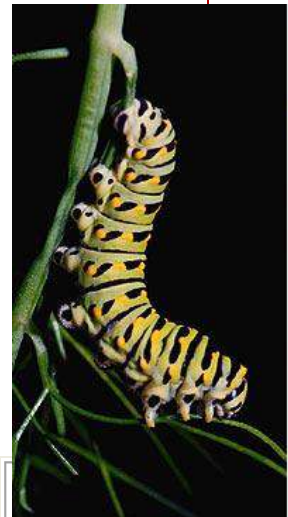
Crustaceans

gills, 2 pairs antennae

crab, lobster, barnacles, shrimp

Insects

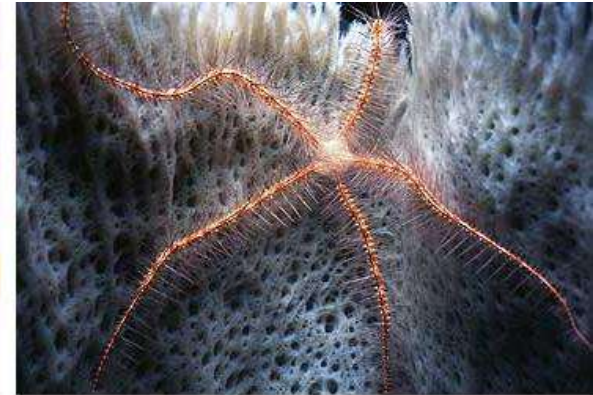
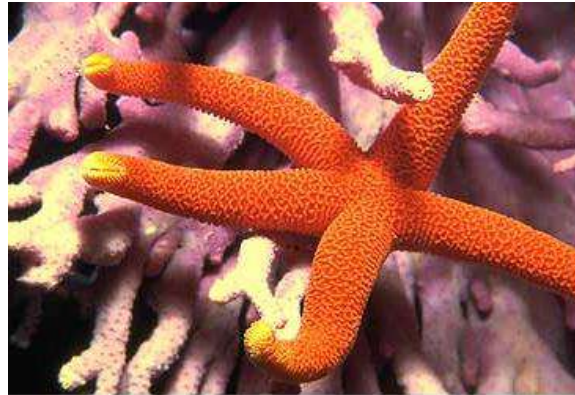
6 legs, 3 body parts



Invertebrates: Echinoderms/Echinodermata

▪ Starfish, sea urchins, sea cucumber

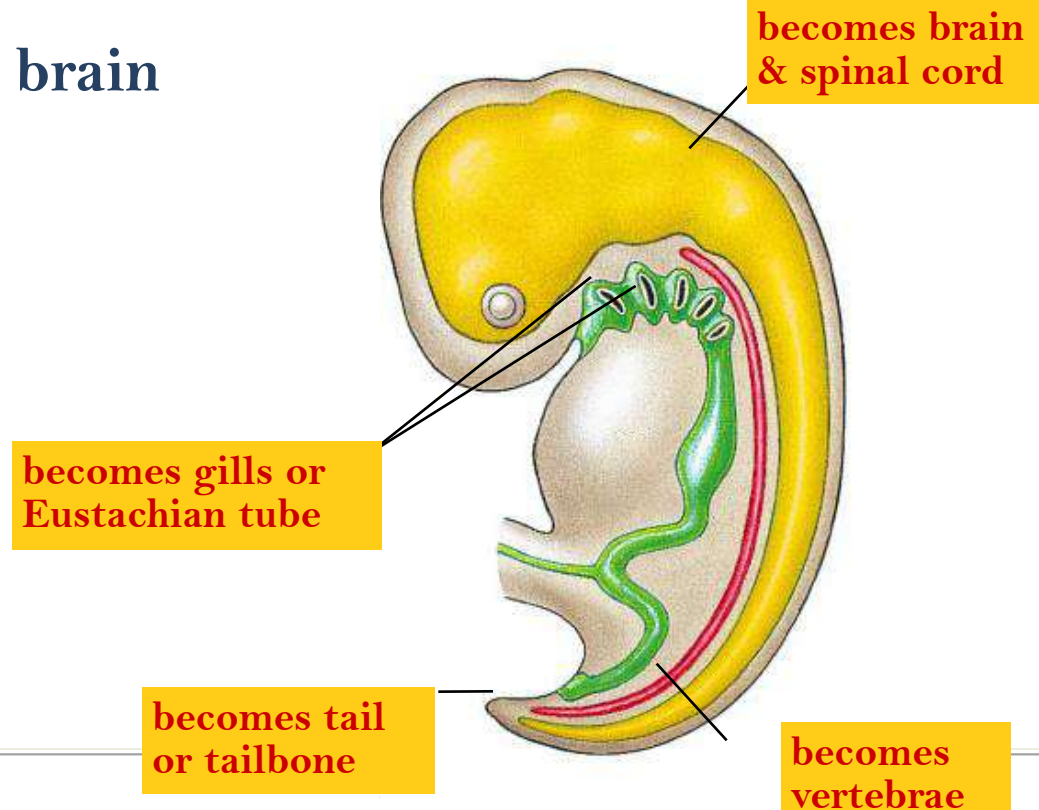
- Radial symmetry
- Spiny exoskeleton



Vertebrates

■ Vertebrates

- Fish, amphibians, reptiles, birds, mammals
- Internal bony skeleton
 - Backbone
 - Skull-encased brain

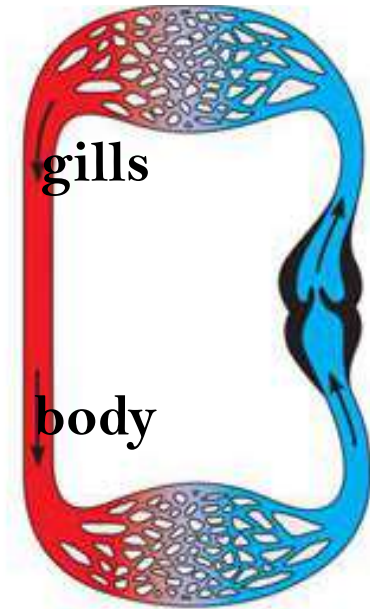


Vertebrates: Fish

salmon, trout, sharks

■ Characteristics

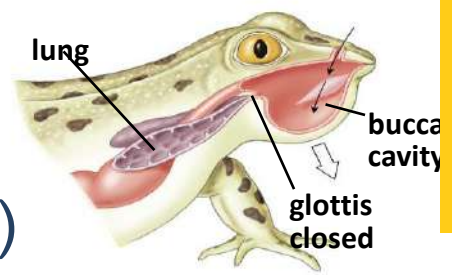
- Body structure
 - Bony skeleton with outside scales
 - Jaws & paired fins
- Body function
 - Breathe with gills
 - Two-chambered heart
 - Cold-blooded
- Reproduction
 - External fertilization
 - External development in aquatic egg



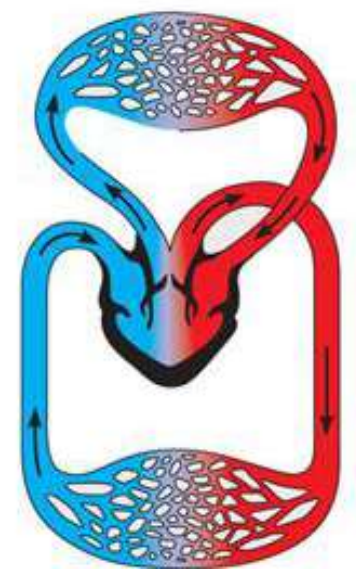
Vertebrates: Amphibians / Amphibia

Characteristics

- Body structure
 - Legs (walk on land)
 - Moist skin
- Body function
 - Breathe with lungs & through skin
 - Three-chambered heart
 - Cold-blooded
- Reproduction
 - External fertilization
 - External development in aquatic egg
 - Metamorphosis (tadpole to adult)



frogs
salamanders
toads

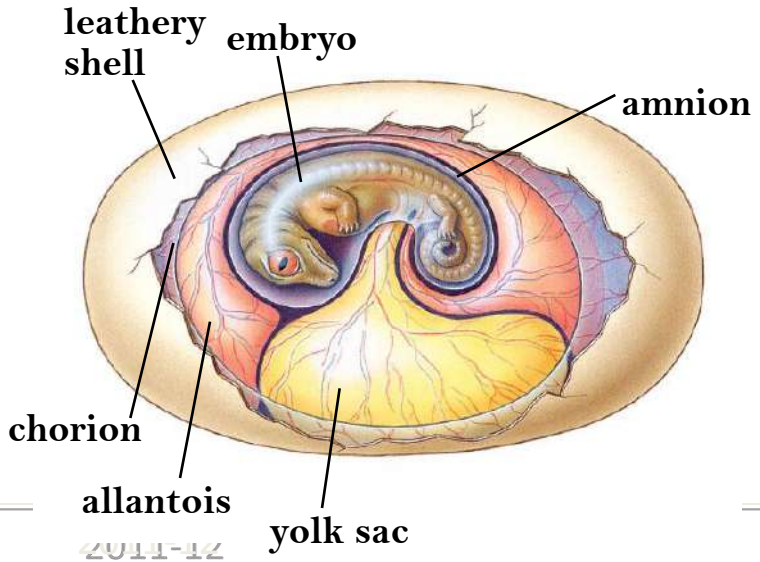
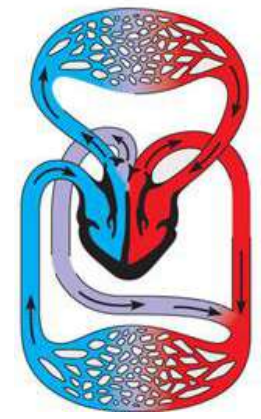


Vertebrates: Reptiles / Reptilia

Characteristics

- Body structure
 - Dry skin, scales, armor (shells)
- Body function
 - Breathe with lungs
 - Three-chambered heart
 - Cold-blooded
- Reproduction
 - Internal fertilization
 - External development in hard-shelled egg

dinosaurs, turtles
lizards, snakes
alligators, crocodile

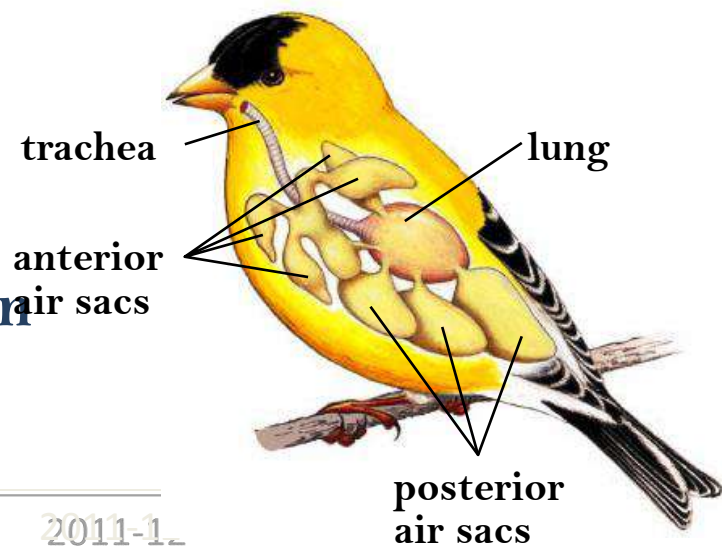
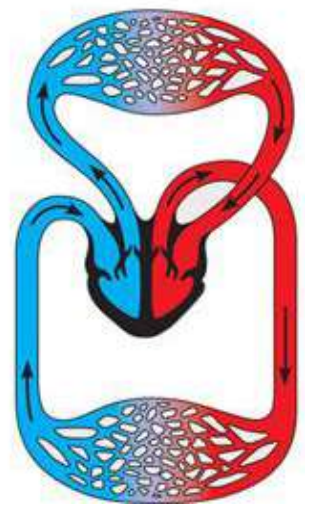
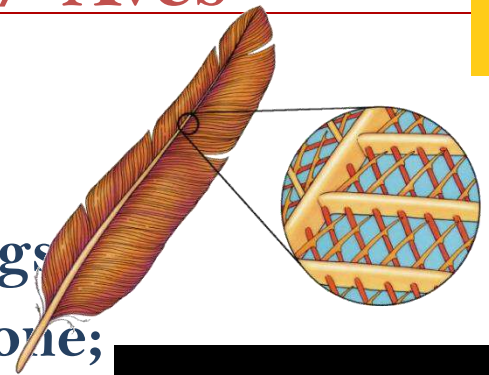


Vertebrates: Birds / Aves

finches, hawk
ostrich, turkey

Characteristics

- Body structure
 - Feathers & wings
 - Thin, hollow bone; flight skeleton
- Body function
 - Very efficient lungs & air sacs
 - Four-chambered heart
 - Warm-blooded
- Reproduction
 - Internal fertilization
 - External development in hard-shelled egg

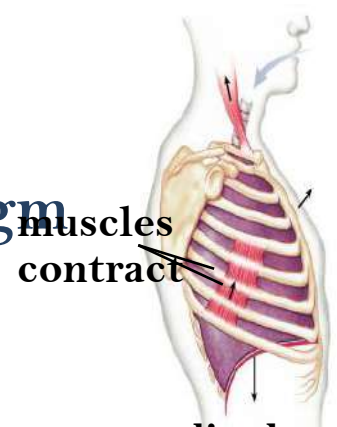
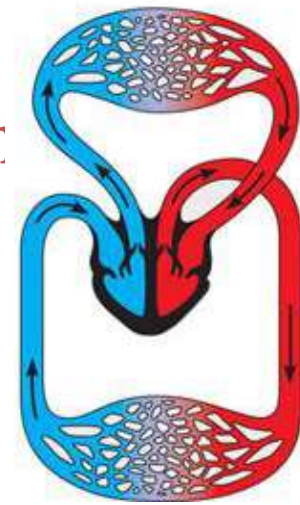


Vertebrates: Mammals / Mammalian

• Characteristics

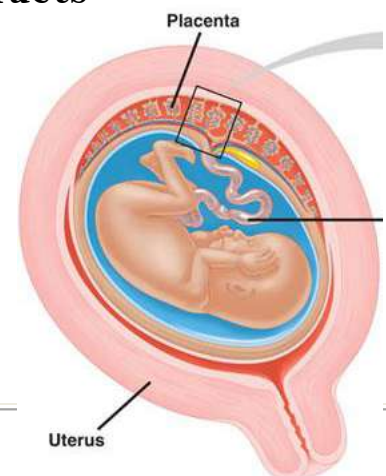
- Body structure
 - Hair
 - Specialized teeth
- Body function
 - Breathe with lungs, diaphragm
 - Four-chambered heart
 - Warm-blooded
- Reproduction
 - Internal fertilization
 - Internal development in uterus
+ nourishment through placenta
 - Birth live young
 - Mammary glands make milk

mice, ferret
elephants, bats
whales, humans



muscles contract

diaphragm contracts



Placenta

Uterus

Brain Busters

1. What are the characteristics of animals?
2. What is an invertebrate?
3. What are the characteristics of sponges?
4. What are the characteristics of jellyfish?
5. What are the characteristics of flatworms
6. What are the characteristics of roundworms?
7. What are the characteristics of segmented worms?
8. What are the characteristics of arthropods?
9. What are the characteristics of echinoderms?
10. What are the characteristics of vertebrates?
11. Identify the vertebrate
 - a. scales, 2-chambered heart, gills
 - b. hollow bones, 4-chambered heart, efficient lungs
 - c. moist skin, breathe with lungs and skin
 - d. internal fertilization, possess mammary glands
 - e. internal fertilization, scales, lay shelled eggs