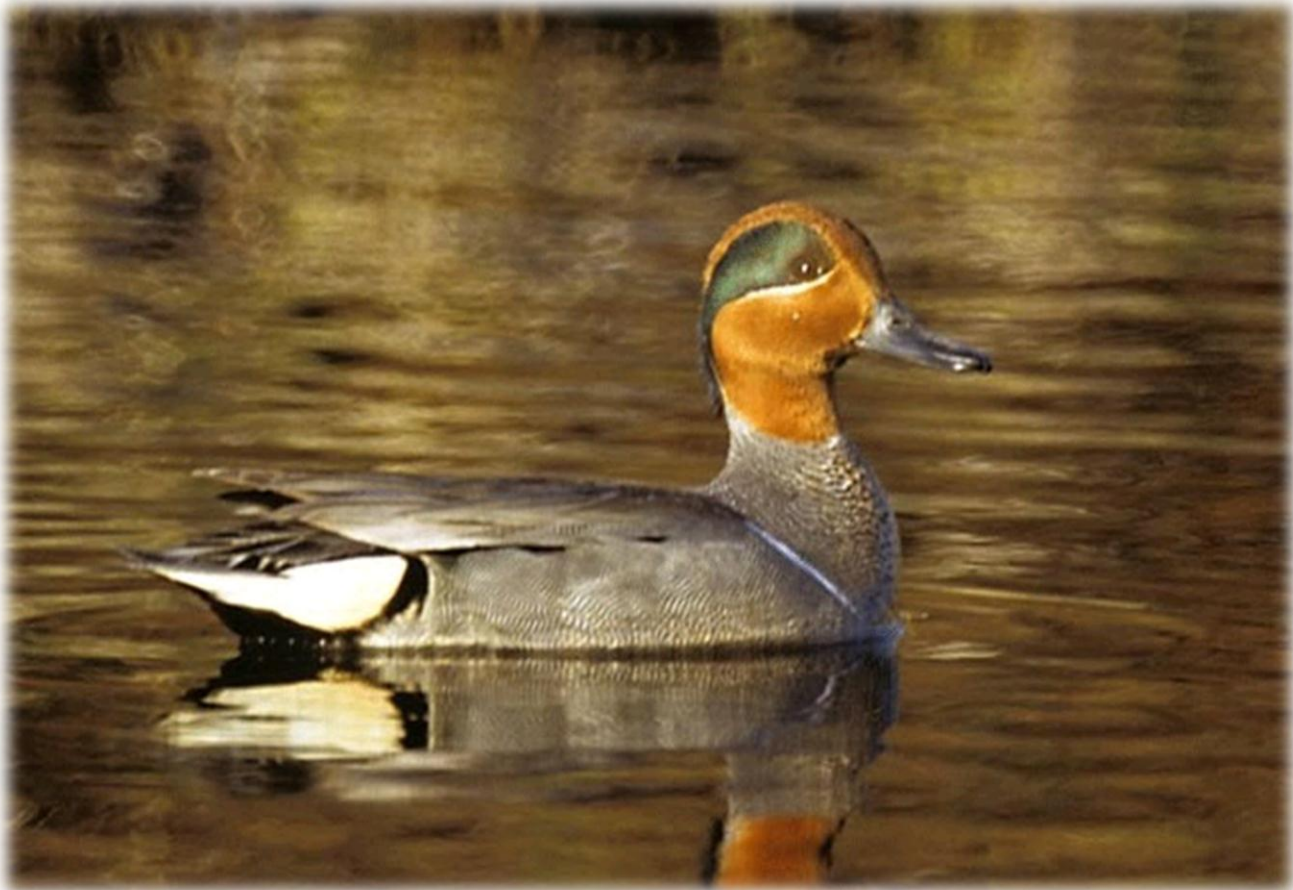


BIODIVERSITY

Miss Yorke

Which of the following three ducks belong to the same species?







American Wigeon Male (*Anas americana*)



Green-winged Teal Male (*Anas crecca*)



Green-winged Teal female (*Anas crecca*)



Classification

- Think about your home, school and neighbourhood. Can you think of any examples of classification systems in use?



□ Possible Answers:

Vegetable Activity Answers

- The varieties of *Brassica oleracea* are all artificially selected and derived from the wild-type that grows on the sea cliffs of Europe.
- Note that obvious traits are not always important in defining species. In this case, the detail of the flowers present is used to define the *Brassica* genus, and the arrangement of stalks defines the *Brassica* species.

Discuss the scientific names. These samples are good for reinforcing the idea that the scientific names do mean something (if you know Latin and Greek).

Latin Greek

- brassica = cabbage acephala = no head
- capitata = head botrytis = bunch of grapes
- oleracea = greens
- caulorapa = turnip
- rapa = stem
- gemmifera = bud-bearing
- chinensis = Chinese
- lactuca = lettuce

- The number of *Brassica oleracea* varieties is an excellent representation of the genetic variation in a species. Artificial selection can be demonstrated with broccoli, cauliflower, and broccoflower (*Brassica oleracea botrytis*), which have been bred for selected traits.
- Remind students of the role that artificially bred plants and animals played in the development of Darwin's ideas on natural selection.

Classification Tools

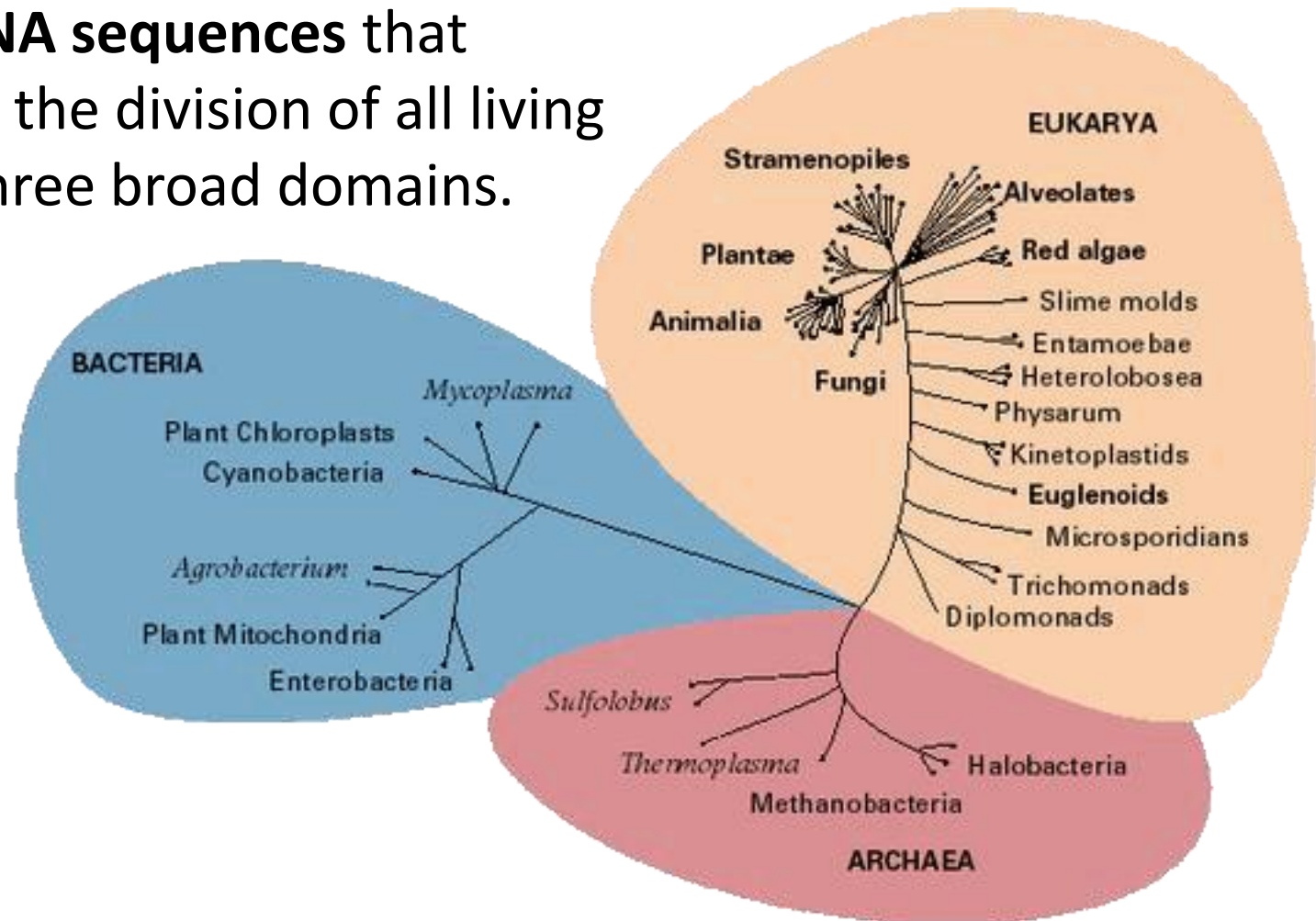
- Really great activity for using biotechnology to determine classification
- http://glencoe.mcgraw-hill.com/sites/0078695104/student_view0/unit4/chapter17/virtual_labs.html#

Kingdoms and Domains



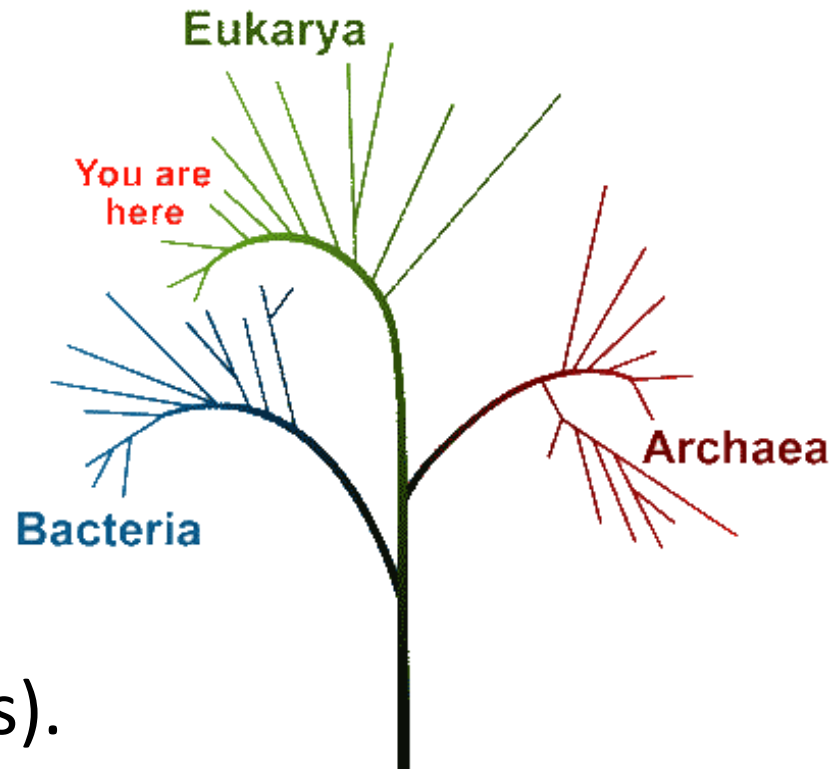
The 3 Domains of Life

This **phylogenetic tree** (a tree showing evolutionary relationships) is based on **rRNA sequences** that demonstrate the division of all living things into three broad domains.



The 3 Domains of Life

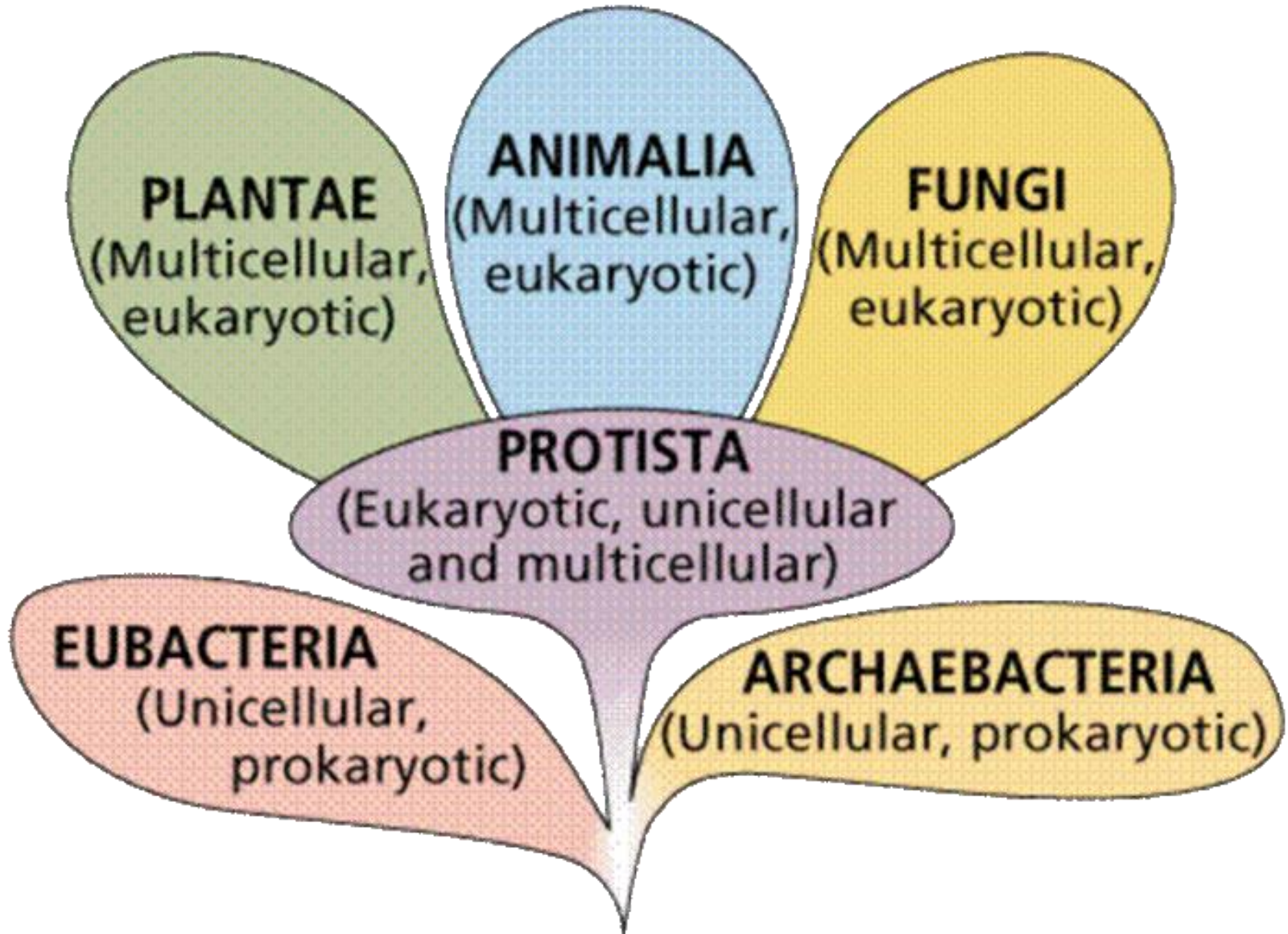
- The **Bacteria** domain is prokaryotic, is considered to be the oldest and is composed of the organisms in the **Kingdom Eubacteria** (the “true” bacteria).
- **Archaea** is the second prokaryotic domain and is also composed of single **kingdom Archaeobacteria**.
- The third domain, **Eukarya**, contains all four of the eukaryotic kingdoms: **Animalia** (animals), **Fungi** (fungi), **Plantae** (plants), and **Protista** (protists).



The Kingdoms of Life

- Biologists have further organized living things into large groups called **Kingdoms**.
- Biologists group organisms into six Kingdoms based on RNA and DNA sequencing and the following other similarities:
 - **Cell Type**
 - Organisms are either **prokaryotes** or **eukaryotes**.
 - **Cell Walls**
 - **Body Type**
 - Organisms are either **unicellular** or **multicellular**.
 - **Nutrition**
 - Organisms are either **autotrophs** or **heterotrophs**.

The 6 Kingdoms of Life



What happened to the 5 Kingdoms?

Just a few years ago, living things used to be classified into 5 Kingdoms:

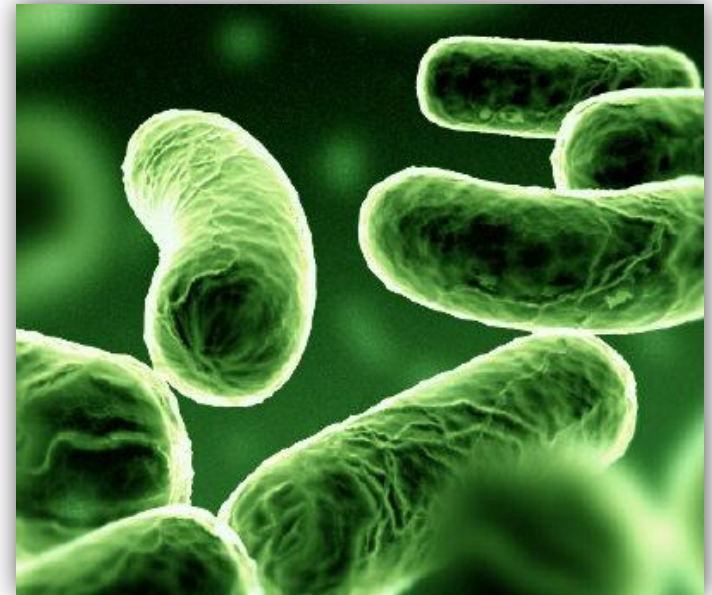
- i) Plantae
- ii) Animalia
- iii) Fungi
- iv) Protista
- v) Monera

* The difference is that Archaeobacteria **and Eubacteria were once in one category**. Recent RNA testing has shown that Archaeobacteria are not closely related to the “true” bacteria, Eubacteria.

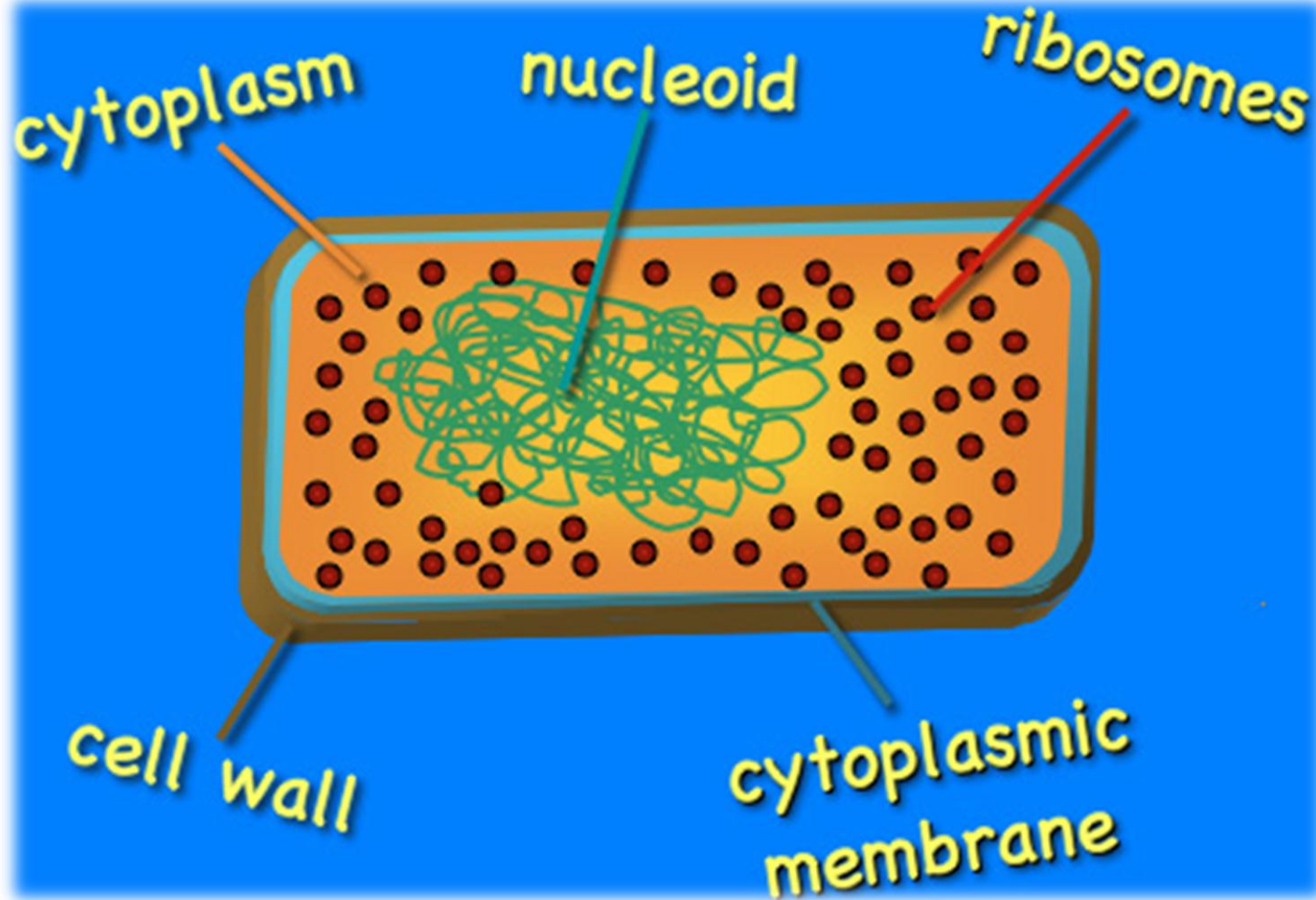
The Domain Bacteria

- Contains a single kingdom, **Eubacteria**.
 - Some scientists call this kingdom Bacteria.
- Bacteria are prokaryotes and **have no membrane bound structures** such as a nucleus or mitochondria
- Bacteria have a **nucleoid** instead of a nucleus.
- Like eukaryotic cells, bacteria have **ribosomes**
- Bacteria are found in practically every environment on Earth.

Bacilli bacteria under an electron microscope



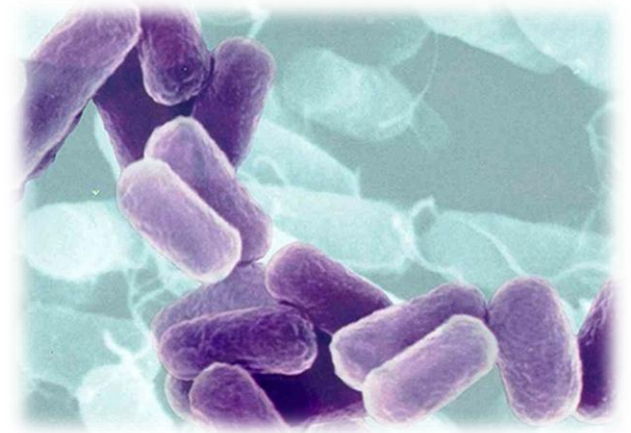
Characteristics of Bacteria



Bacteria have strong exterior **cell walls** made of **peptidoglycan**, a molecule complex consisting of sugars and amino acids that form a mesh-like layer outside the plasma membrane.

Kinds of Bacteria

- Bacteria can cause disease, while others are used by humans to **process food**.
- Bacteria are used to control agricultural pests, to produce various chemicals, and perform genetic engineering.
- Some Bacteria obtain energy from inorganic compounds such as hydrogen sulfide, ammonia, and methane.
- Some Bacteria are **photosynthetic** and are found in ocean and freshwater ecosystems.
- Some **heterotrophic** Bacteria are able to live in the absence of oxygen.
- Heterotrophic Bacteria are also important decomposers.



Uses of Bacteria - Cheese production

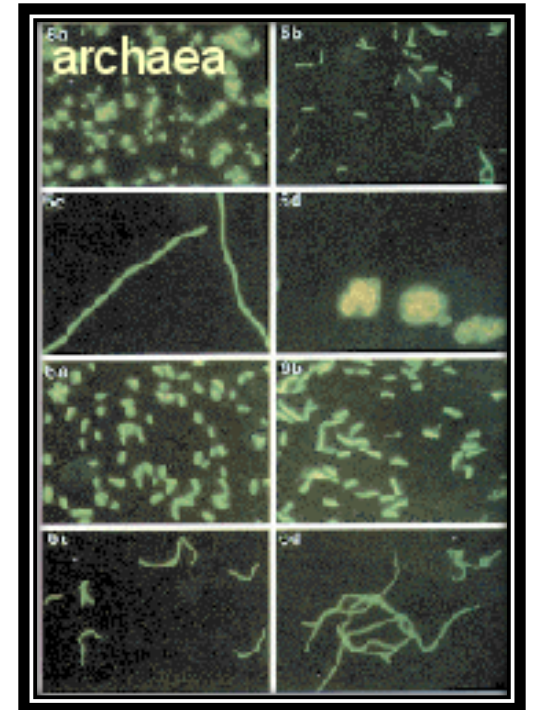
- Bacteria enables us to eat fermented dairy products such as **yogurt, buttermilk, and cheese**
- Example: *Lactococcus lactis* is used to ferment milk into Cheddar Cheese!
- We've all heard of probiotic yogurts – All yogurts are probiotic! This just means they have “good” bacteria.

Did you know?

- *Escherichia coli* (*E. coli*) exists in abundance in **everyone's intestine**. It is only dangerous when ingested.

The Domain Archaea

- Contains a single kingdom **Archaeobacteria**.
- Archaeobacteria are **prokaryotes** that have diverged very early from bacteria.
- They are **more closely related to eukaryotes** than to bacteria.



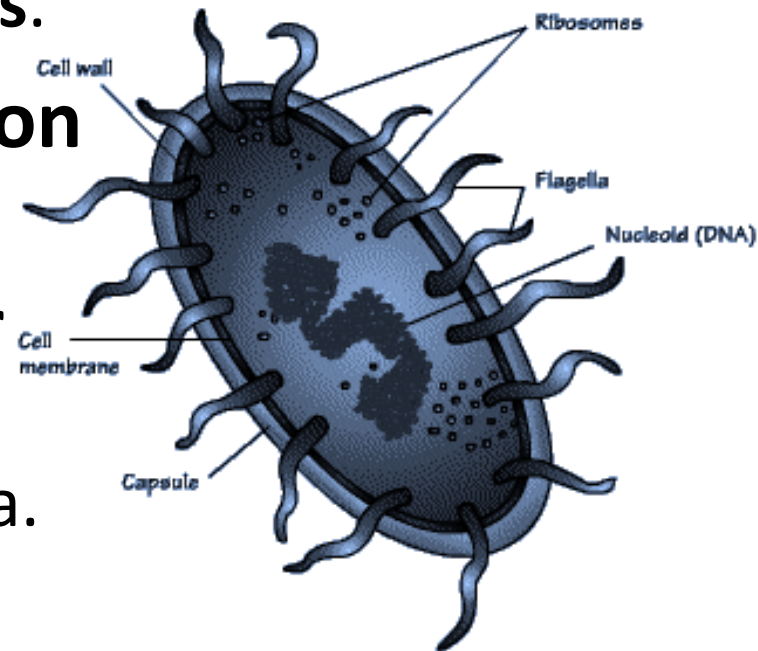
Characteristics of Archaeobacteria

- **Cell Wall and Membrane**

- The cell walls of archaeobacteria **do not contain peptidoglycan**, as the cell walls of bacteria do.
- Archaeobacteria contain **lipids** very different from those of **bacteria** or **eukaryotes**.

- **Gene Structure and Translation**

- The **ribosomal proteins** of archaeobacteria are very **similar** to those of **eukaryotes** and different from those of bacteria.



Kinds of Archaeobacteria

1) Methanogens

- These archaeobacteria obtain energy by combining hydrogen gas and carbon dioxide to form methane gas.
- Methanogens live deep in the mud of swamps and are poisoned by even traces of oxygen.
- They are common in **wetlands**, where they are responsible for **marsh gas**, and in the guts of animals such as **ruminants** (cud-chewing animals) and **humans**, where they are responsible for the **methane** content of **flatulence**.



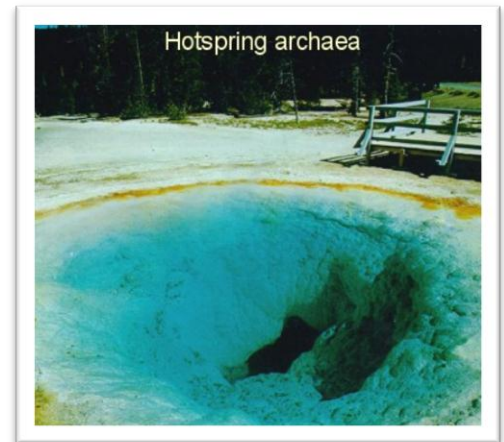
Kinds of Archaeobacteria cont'd

2) Extremophiles

- A group of extremophiles called **Thermophiles** lives in very hot places.
- **Halophiles** inhabit very **salty lakes** that can be three times as salty as seawater.
- Other extremophiles live in very **acidic places** or under enormous pressure.

3) Nonextreme Archaeobacteria

- These grow in all the same environments that bacteria do.



The Domain Eukarya

- Eukarya is made up of four kingdoms:
 - Protista
 - Fungi
 - Plantae
 - Animalia
- Members of this domain are **Eukaryotes**.



Characteristics of Eukarya

- **Highly Organized Cell Interior**

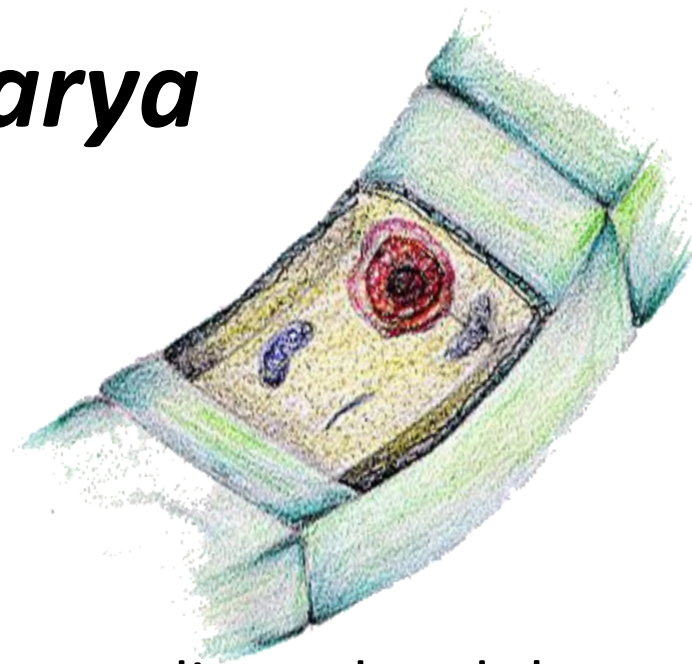
- All eukaryotes have cells with a nucleus and other internal compartments.

- **Multicellularity**

- The activities of individual cells are coordinated and the cells themselves are in contact, occurs only in eukaryotes.

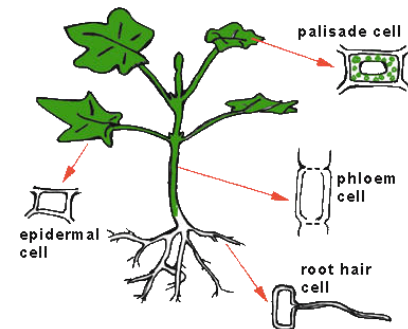
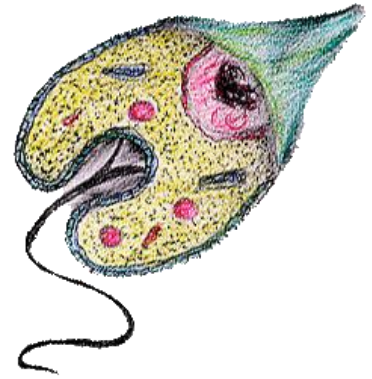
- **Sexual Reproduction**

- Meiotic cell division forms haploid gametes and two gametes unite to form a diploid cell in fertilization.
- Genetic recombination during meiosis and fertilization causes the offspring of eukaryotes to vary widely, providing for evolution.



Kinds of Eukarya

- A wide variety of Eukaryotes are unicellular.
 - Most unicellular Eukaryotes are in the kingdom **Protista**.
- **Protists** contain both unicellular and multicellular organisms, many are aquatic.
- **Fungi** are heterotrophs that are mostly multicellular.
 - Many fungi live on and decompose dead organisms, many others are parasitic.
- **Plants and Animals** are all **multicellular**.
 - Almost all plants are autotrophs and have cells with cell walls composed of cellulose.
 - All animals are heterotrophs composed of cells that do not have cell walls.
 - Most plants and animals have tissues and organs.

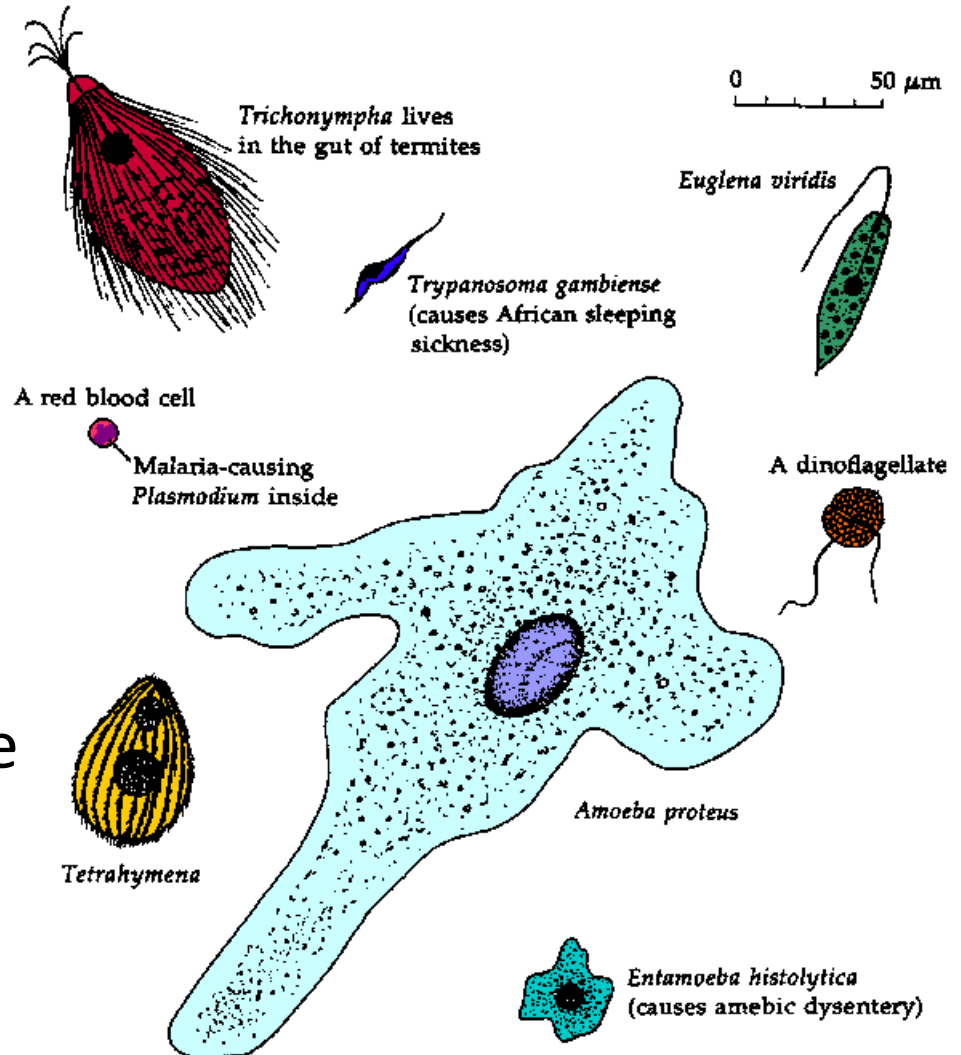


Kingdom and Domain Characteristics

Domain	Kingdom	Characteristics				
		Cell type	Cell Structure	Body Type	Nutrition	Example
Bacteria	Eubacteria	Prokaryotic	Cell Wall, Peptidoglycan	Unicellular	Autotrophic and Heterotrophic	Enterobacteria Spirochetes
Archaea	Archaeobacteria	Prokaryotic	Cell Wall, No Peptidoglycan	Unicellular	Autotrophic and Heterotrophic	Methanogens
Eukarya	Protista	Eukaryotic	Mixed	Unicellular and Multicellular	Autotrophic and Heterotrophic	Amoebas Euglenas Kelps
Eukarya	Fungi	Eukaryotic	Cell Wall, Chitin	Unicellular and Multicellular	Heterotrophic	Yeasts Mushrooms
Eukarya	Plantae	Eukaryotic	Cell Wall, Cellulose	Multicellular	Autotrophic	Ferns Pine trees
Eukarya	Animalia	Eukaryotic	No Cell Wall	Multicellular	Heterotrophic	Birds Earthworms

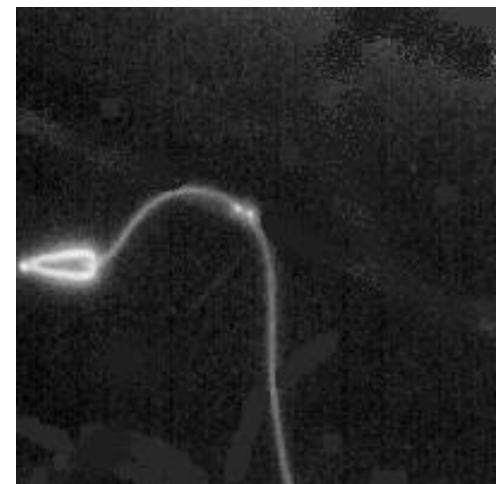
Kingdom Protista

- Of the six kingdoms of organisms, **Protista** is the most diverse.
- They are **eukaryotes** that are not fungi, plants, or animals.
- Many are **unicellular**.
- All single celled eukaryotes (except yeasts) are protists.
- Some protists, such as some kinds of algae, have cell specialization.
- Most are microscopic, but some are as large as trees.



Kinds of Protists

- Protists that use **Pseudopodia**
 - Amoebas are protists that have flexible surfaces with no cell walls or flagella.
 - They move by using extensions of cytoplasm called pseudopodia.
 - Forams have porous shells through which long, thin projections of cytoplasm can be extended.
- Protists that use **Flagella**
 - Many protists move by using flagella.



Kinds of Protists

1) Animal-like Protists - also called protozoa (means "first animal") – heterotrophs

2) Plant-like Protists

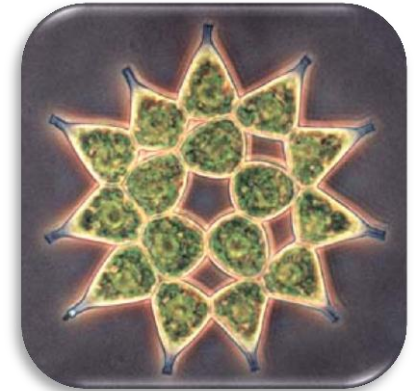
- also called algae - autotrophs Distinguished by the type of chlorophyll they contain.

– Many algae are multicellular and reproduce sexually.

3) Fungus-like Protists

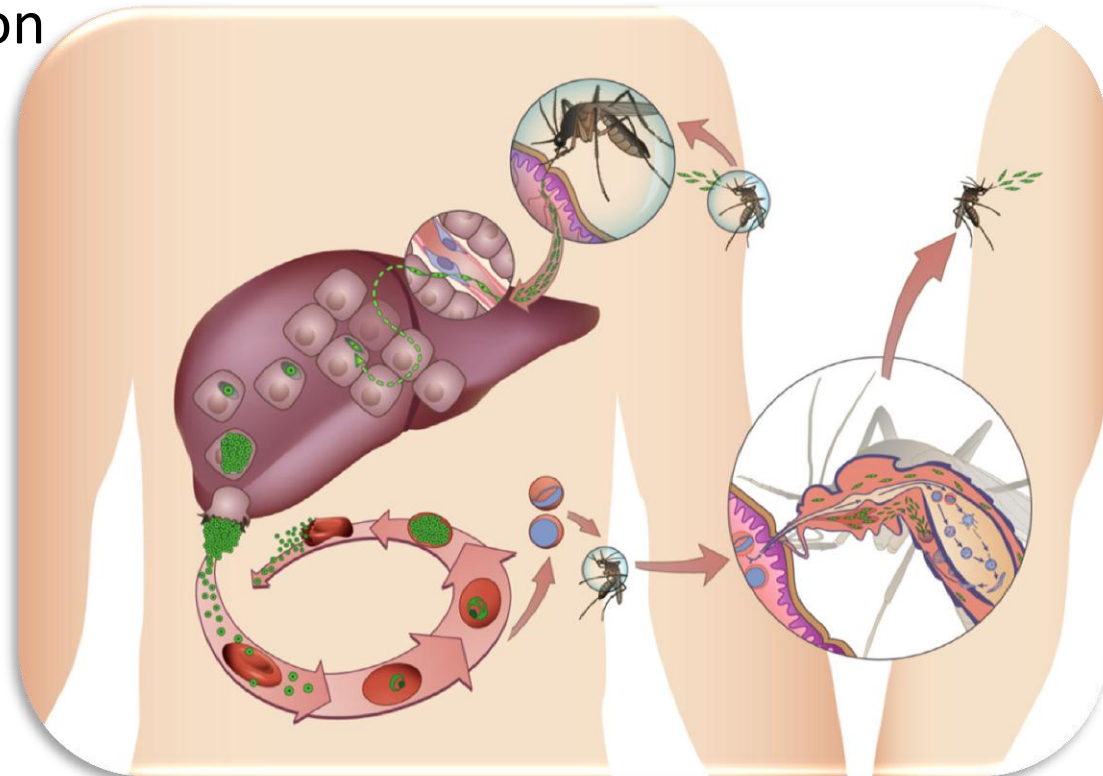
– Slime molds and water molds are often confused with fungi because they aggregate in times of stress to form spore-producing bodies.

– heterotrophs, decomposers, external digestion



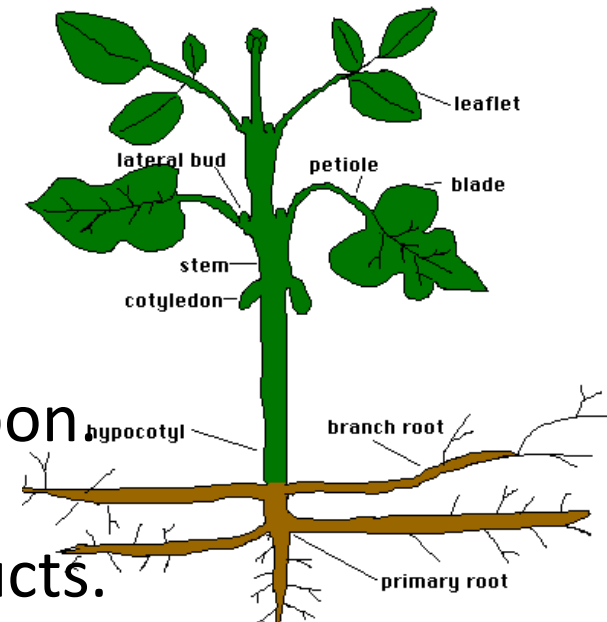
Malaria

- Malaria is caused by the protozoa *Plasmodium falciparum* and is spread by the mosquito
- Each year, malaria kills between **1 and 3 million people!**
- Economists suggest that malaria can be controlled for \$3 billion US per year through drugs, mosquito eradication, and bite prevention



Kingdom Plantae

- Plants are complex multicellular **autotrophs**.
- Plants have specialized cells and tissues.
- Most plants have several different types of cells that are organized into many specialized tissues.
- Plants cannot move from one place to another.
- Portable reproductive structures, such as **spores** and **seeds**, enable the dispersal of plants.
- As autotrophs, plants are the primary producers in most terrestrial food webs.
- Plants also release **oxygen** gas to the atmosphere.
- Plants are very important in the cycling of phosphorus, water, nitrogen, and carbon.
- Plants are a source of food, medicines, dyes, cloth, paper and many other products.



Example of Plant

Western prairie fringed orchid

Platanthera praeclara Scheviak and Bowles (Orchidaceae)

Endangered in Manitoba



Western Fringed Prairie Orchid

- The largest population in the world exists by Tolstoi, MB.
- Pollinated by a specific moth (hawk moth). This moth lives in trees and the flower lives in grassland, so they can only coexist along the borders of these regions.
- These orchid seeds may take up to 12 years to germinate because they have to form a relationship with the fungi in the soil.

Kinds of Plants

- **Nonvascular Plants**

- Plants without a well-developed system of vascular tissue.
- These plants are relatively small.
- They lack tissue to transport water and dissolved nutrients.
- They also lack true roots, stems, and leaves.
- Mosses are the most familiar example.



- **Seedless Vascular Plants**

- They have roots, stems, and leaves and their surfaces are coated with a waxy covering that reduces water loss.
- They reproduce with spores that are resistant to drying.
- Both haploid and diploid phases occupy significant parts of the life cycle.
- Ferns are the most common and familiar example.



Kinds of Plants

- **Nonflowering Seed Plants**

- **Gymnosperms** are vascular plants that reproduce using seeds but do not produce flowers.
- Gymnosperms include plants that produce seeds in cones, such as pines and spruces.

- **Flowering Seed Plants**

- Most plants that produce seeds also produce flowers.
- Flowering plants are called **angiosperms**.
- Angiosperms, such as roses, grasses, and oaks, produce seeds in **fruits**.
 - Fruits are structures that enable the dispersal of seeds.
 - Seeds enable plants to scatter offspring and to survive long periods of harsh environmental conditions, such as drought and extreme temperatures.



Kingdom Animalia

- Animals are complex multicellular heterotrophs.
- Their cells are mostly diploid, lack a cell wall, and are organized as tissues.
- Animals are able to move rapidly in complex ways.
 - Movement enables animals to avoid predators and to look for food and mates.



Kingdom Animalia

- Most animals reproduce sexually.
- Almost all animals (99%) are **invertebrates**; they lack a backbone.
- Of more than 1 million living species, only about 42,500 have a backbone; they are referred to as **vertebrates**.



Damselfly

The animal kingdom includes about 35 phyla, most of which live in the sea.

Nine Animal Phyla

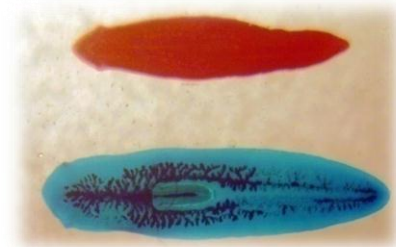
Phylum Porifera → *Sponges*



Phylum Cnidaria → *Hydra, jellyfishes, corals, sea anemones*



Phylum Platyhelminthes → *Marine / freshwater flatworms*



Phylum Nematoda → *Roundworms*



Phylum Annelida → *leeches and segmented worms*



Phylum Mollusca → *snails*
(gastropods), octopus, squid,
nautilus, “bivalves”



Phylum Arthropoda → *Crustaceans*
(e.g. Lobsters, crabs), insects



Phylum Echinodermata → *Star fish, sea urchins, sea cucumbers*



Phylum Chordata → *invertebrate chordates, fish, amphibians, reptiles, birds, mammals*



Fish



Birds



Mammals



Reptile



Amphibians