The Six Kingdoms of Life

The Kingdoms

- Scientists look at the evolutionary history of organisms to divide them into kingdoms. For awhile, there has been 5 kingdoms, but many scientist are now using 6 kingdoms.
- Criteria/Questions:
  - What type of cell?
    - Prokaryote or Eukaryote
    - Unicellular or Multicellular
  - What type of organism? Producer, Consumer, or Decomposer
  - Reproduction? Asexually or Sexually
  - What is its genetic structure and function most like?

Let's Examine the 6 Kingdoms

Bacteria Kingdoms

Bacteria used to be in one kingdom!

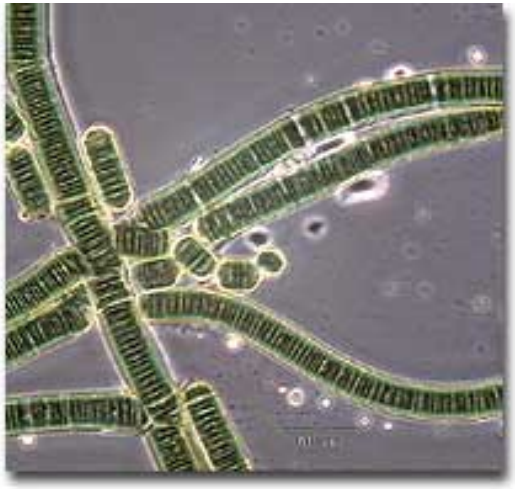
As scientist learned more about Bacteria, they have separated it into 2 separate kingdoms.

Eubacteria Kingdom

Archaebacteria Kingdom

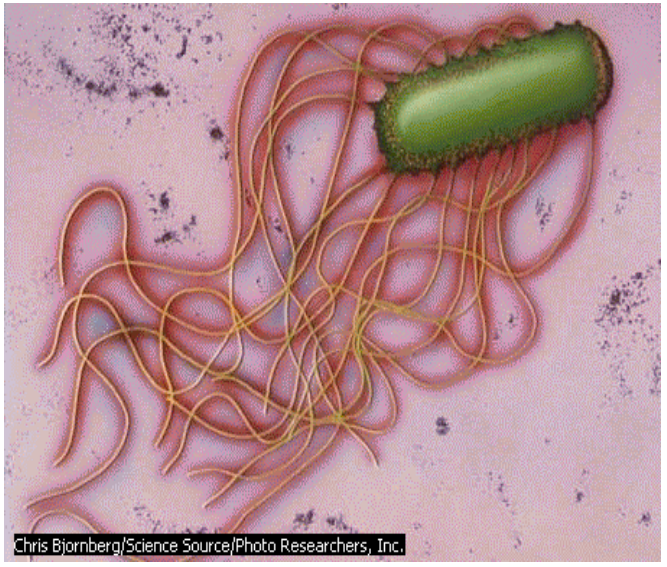
Bacteria Kingdoms
Archaebacteria

- Type of Cells:
  - Unicellular: made of one cell
  - Prokaryotes: very simple cells that do not have a nucleus and other organelles.
  - Some have a cell wall.
  - They are not seen because they are very small, and they can be identified only with the help of a microscope. In fact, bacteria are so tiny that 300 could fit end-to-end across the period at the end of a sentence.
- Type of Organism:
  - Decomposers: get energy from other organisms
  - Producers: make their own food from the chemicals in their surroundings.



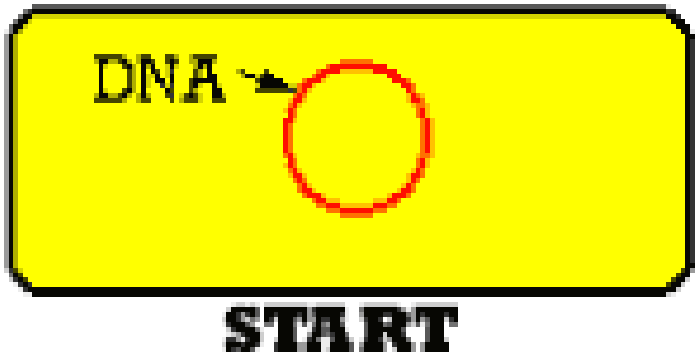
Bacteria Kingdoms
Archaebacteria and Eubacteria

- Some bacteria are helpful and some are harmful.
  - live in your stomach and help digest food.
  - make vitamins, yogurt, cheese, sauerkraut, and other products.
  - live in the soil and break down dead plants, animals, and wastes into simple substances that plants use.
  - decompose oil and are used to help clean up oil spills.
  - Cause infections in other organisms – like strep throat.



Bacteria Kingdoms
Archaebacteria and Eubacteria

- Type of Reproduction:
  - Asexually: Bacteria reproduce by splitting themselves in half in a process called BINARY FISSION.
  - During this process, one cell splits into two identical cells, which are sometimes called CLONES. Over time, these dividing bacterium cells often group together in colonies.
  - Bacteria multiply quickly. In fact, one cell can replicate into over a million cells in just 12 hours. In contrast, a human cell takes 24 hours to split.



ARCHAEBACTERIA KINGDOM

Archaebacteria Kingdom

- Archaebacteria live in extreme environments
- 3.5 billion years old
- Types:
  - Methanogens –
    - Live in Anaerobic
    - Make Methane
    - Found in – sewage treatment plants, digestive tract of ruminant, bogs
  - Halophiles –
    - Live in high salt concentration
  - Thermophiles –
    - Heat Loving
    - Chemosynthetic
    - Found in - hot springs, hydrothermal vents

What type of cell?

Prokaryote – simple

Unicellular – one celled

What type of organism?

Producer & Decomposer

Type of Reproduction?

Asexual – Binary Fission

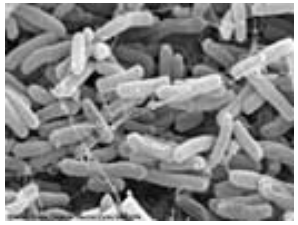
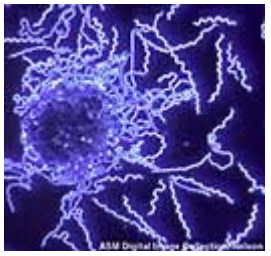
EUBACTERIA KINGDOM

Eubacteria Kingdom

- Eubacteria live everywhere
  - They live in air, water, and soil!
  - Each square centimeter of your skin averages about 100,000 bacteria.
  - One teaspoon of topsoil contains more than a billion bacteria.
- Some bacteria are photosynthetic (foe-toe-sin-theh-tick)—they can make their own food from sunlight, just like plants.
- Other bacteria absorb food from the material they live on or in.
- Some of these bacteria can live off unusual "foods" such as iron or sulfur.
- The microbes that live in your gut absorb nutrients from the digested food.

Eubacteria Kingdom

- Three major phylum (groups) based on shapes:

Shape	Characteristics	Examples
 Sphere-shaped bacteria	**Sphere-shaped bacteria (cocci)** sometimes grow in chains or in clumps like a bunch of grapes.	*Streptococcus* (strep throat) *Staphylococci* (responsible for "staph" infections and gangrene)
Rod-shaped bacteria 	**Rod-shaped bacteria (bacilli)** can also form in chains. Some types of these bacteria also have whip like structures called flagella to help them move around.	*Escherichia coli* or *E.coli* (found in the intestines of mammals) *Salmonella typhi* (causes typhoid fever and food poisoning)
Spiral-shaped bacteria 	**Spiral-shaped bacteria (spirilla)** can use their shape to propel themselves by twisting like a corkscrew.	*Treponema pallidumcholera* (syphilis) *Borrelia burgdorferi* (Lyme disease)

What type of cell?

Prokaryote – simple

Unicellular – one celled

What type of organism?

Producer & Decomposer

Type of Reproduction?

Asexual – Binary Fission

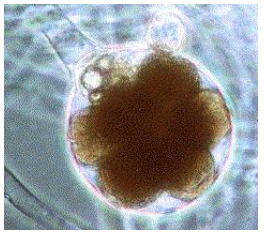
PROTIST KINGDOM

Protists Kingdom

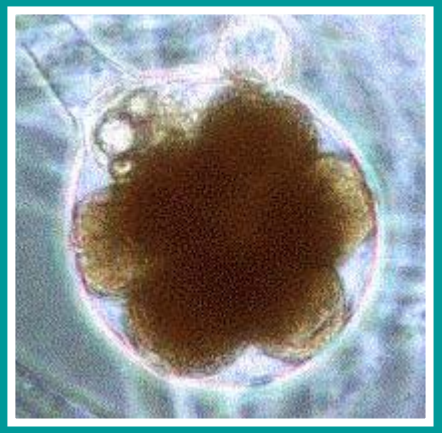
- Type of Cells:
  - Most protists are unicellular (only have one cell).
  - Some are multicellular (made of many cells).
  - Many unicellular protists live in colonies together.
  - All protists are eukaryotic (have cells with a nucleus and organelles).
  - Some are microscopic and others can be 100m in length.
  - All live in watery/moist environments.
- Type of Organism:
  - Decomposers: some break down other organisms or wastes (fungus-like)
  - Producers: some make their own food (plant-like)
  - Consumers: some obtain energy by eating (animals-like)
  - Some are parasitic and cause disease.

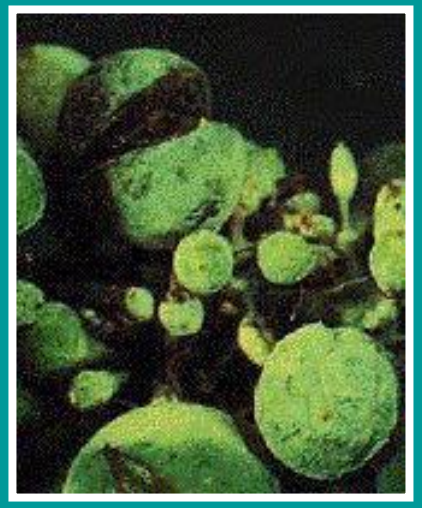
Protists Kingdom

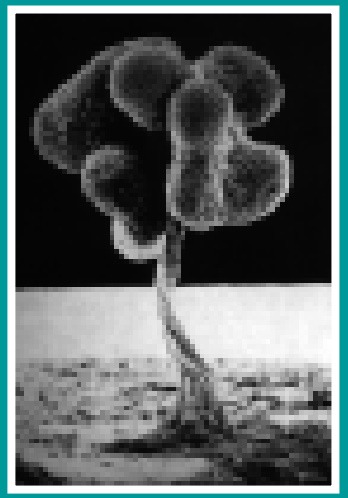
- Three major phylum (groups):

Type	Cell Type	Organism Type	Groups & Examples
Fungus-like	Unicellular	**Decomposers.** Fungus-like protists have cell walls and reproduce asexually by spores. All are able to move at some point in their lives.	**3 Basic Groups:** Water Molds, Downy Mildews, Slime Molds 
Plant-like	Unicellular, multicellular, and live in colonies	**Producers.** Live in soil, bark of trees, and fresh & salt water. Very important to the Earth because they produce a lot of oxygen and form the base of aquatic food chains.	**4 Basic Groups:** Euglenoids, Dinoflagellates, Diatoms, and Algae (Green, Red, and Brown)
Animal-like known as: Protozoan	Unicellular	**Consumers.** All animal-like protists are able to move in their environment in order to find their food.	**4 Basic Groups:** Pseudopods - ex: Amoebas, Cilia - ex: Paramecium, Flagella - ex: Giardia, Others - ex: Plasmodium (Disease Causing)

Protists Examples



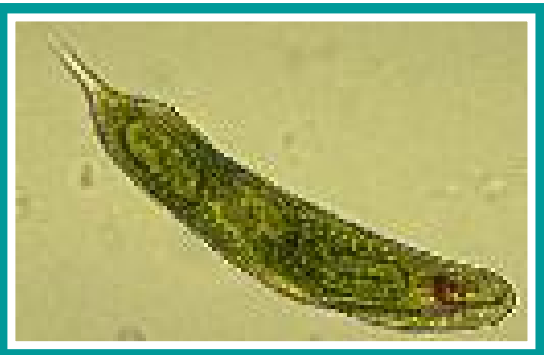


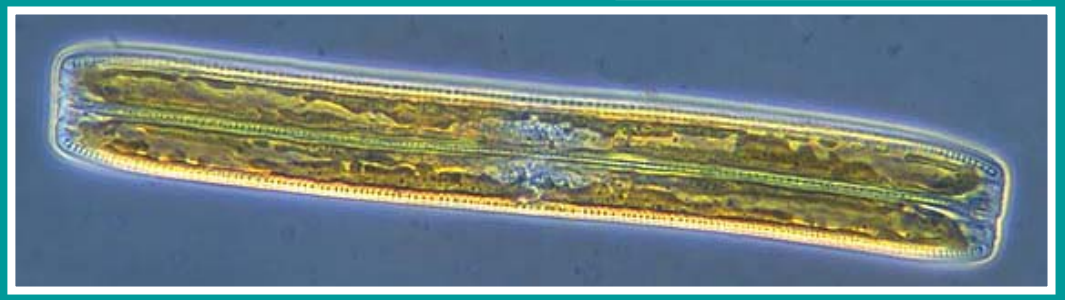


Fungus-like

Water Molds
Downy Mildews
Slime Molds

Protists Examples





Plant-like

Euglenoids
Dinoflagellates
Diatoms
Algae
(Green, Red, & Brown)

Protists Examples

Animal-like

Pseudopods – ex: Amoebas

Cilia - ex: Paramecium

Flagella - ex: Giardia

What type of cell?
Eukaryote - complex Unicellular, Multicellular, & Live in Colonies

What type of organism?
Producer, Consumer, Decomposer

Type of Reproduction?
Asexual or Sexual

FUNGUS KINGDOM

Fungi Kingdom

- **Types of Cells:**
  - Unicellular and Multicellular: some have one cell and others are made of many cells.
  - Fungus is eukaryotic and has cell walls.
- **Type of Organism:**
  - Decomposer: get energy by feeding on dead or decaying tissue
  - Fungi digest food outside their bodies: they release enzymes into the surrounding environment, breaking down organic matter into a form the fungus can absorb.
  - Mushrooms and other fungi grow almost everywhere, on every natural material imaginable. Where you look depends on the mushroom you are trying to find. Some fungi grow only in association with certain trees. Others grow on large logs. Mushrooms are also found in soil, on decomposing leaves, and in dung, mulch and compost.
- **Type of Reproduction:**
  - Asexually reproduces with SPORES.

Fungi Kingdom

- Five major phylums (groups):

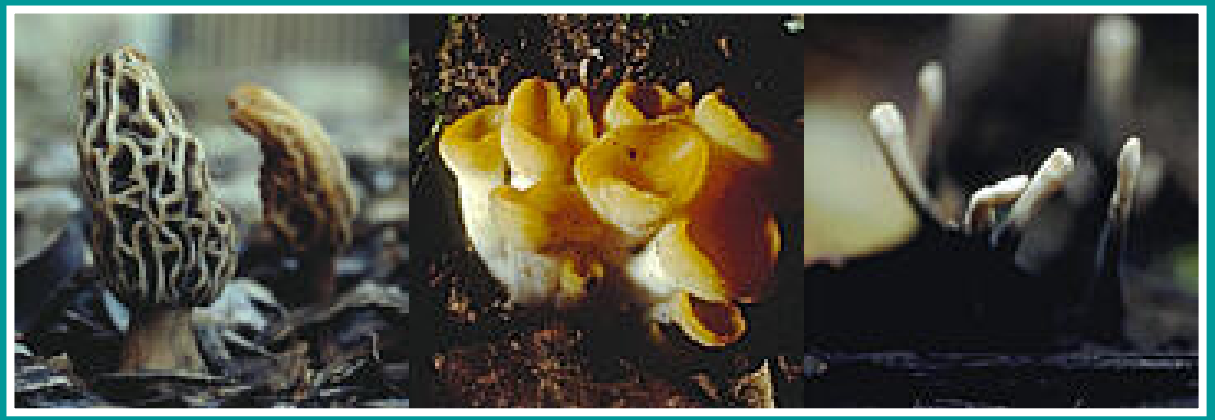
Club Fungi	Sac Fungi	Lichens	Conjugation Fungi	Imperfect Fungi
Basidiomycota	Ascomycota	Mycophycophyta	Zygomycota	Deuteromycota
				

Fungi Examples

- **Club Fungi** (Basidiomycota)
- Many mushrooms in this phylum, Basidiomycota, look like umbrellas growing from the ground or like shelves growing on wood, but some, such as the latticed stinkhorn, look quite different.
- Among the more famous families in this phylum are:
  - **Agaricus** -- including the supermarket variety of button mushrooms
  - **Amanita** -- including species that are deadly, delicious, or even hallucinogenic;
  - **Boletus** -- best known for the King Bolete (called *Porcini* in Italy and *Cepe* in France);
  - **Cantherellus** -- known for the delicious and beautiful Chanterelle.
  - These families include but a few of the mushrooms sought by collectors and gourmets from among the 25,000 species in this phylum.

Fungi Examples

- **Sac Fungi** Ascomycota
- Ascomycota produce their spores in special pods or sac-like structures called asci. Several species including the Helvella and Xylaria release a cloud of spore "smoke" when disturbed.
- Included among the 25,000 species of this phylum are the:
  - prized Morel and Truffle mushrooms
  - Another class of this phylum, Hemiascomycetae, is valued more for its activity than its beauty: *Sacharomyces cerevisiae* (Brewers, Bakers, and Nutritional Yeast) help us produce such popular staples as beer and bread.



Fungi Examples

- **Lichens** Mycophycophyta
- Lichens are a symbiotic union between fungus and algae (or sometimes cyanobacteria). The algae provide nutrients & the fungus protects them from the elements. The result is a new organism different from both original species.
- Scientists have identified 25,000 species of Lichens.

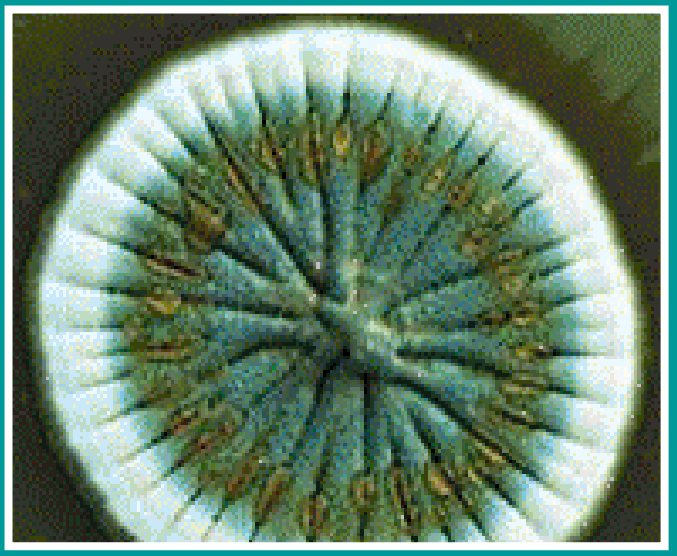
Fungi Examples

- **Conjugation Fungi**
  Zygomycota

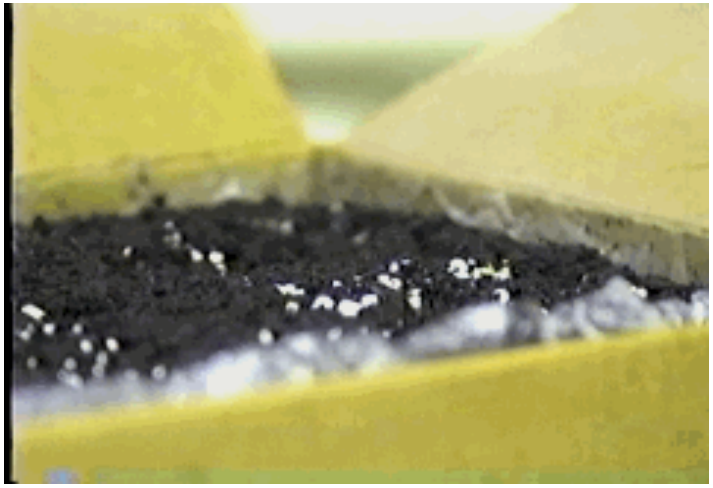
- The best known of this phylum of around 600 species is black bread mold.
- *Ex: Rhizopus stolonifer*.

Fungi Examples

- **Imperfect Fungi**
  Deuteromycota
- Around 25,000 additional fungus species are grouped in this phylum -- these species are the "left-overs" that don't fit well into any of the other groups.
- Members include *Trichophyton* (Athlete's foot), *Penicillium* (Penicillin), and *Candida albicans* ("Yeast" infections)



Fungi Kingdom



- Use:
  - People eat mushrooms of all shapes, sizes and colors.
  - Yeasts are used in making bread, wine, beer and solvents.
  - Drugs made from fungi cure diseases and stop the rejection of transplanted hearts and other organs.
  - Fungi are also grown in large vats to produce flavorings for cooking, vitamins and enzymes for removing stains.
  - Some fungi grows on food such as bread mold.
  - Penicillin is a type of fungus.
  - Fungus can cause athlete’s feet & ringworm.

What type of cell?
Eukaryote - complex
Unicellular & Multicellular

What type of organism?
Decomposer

Type of Reproduction?
Asexual (spores)

PLANT KINGDOM

Plant Kingdom

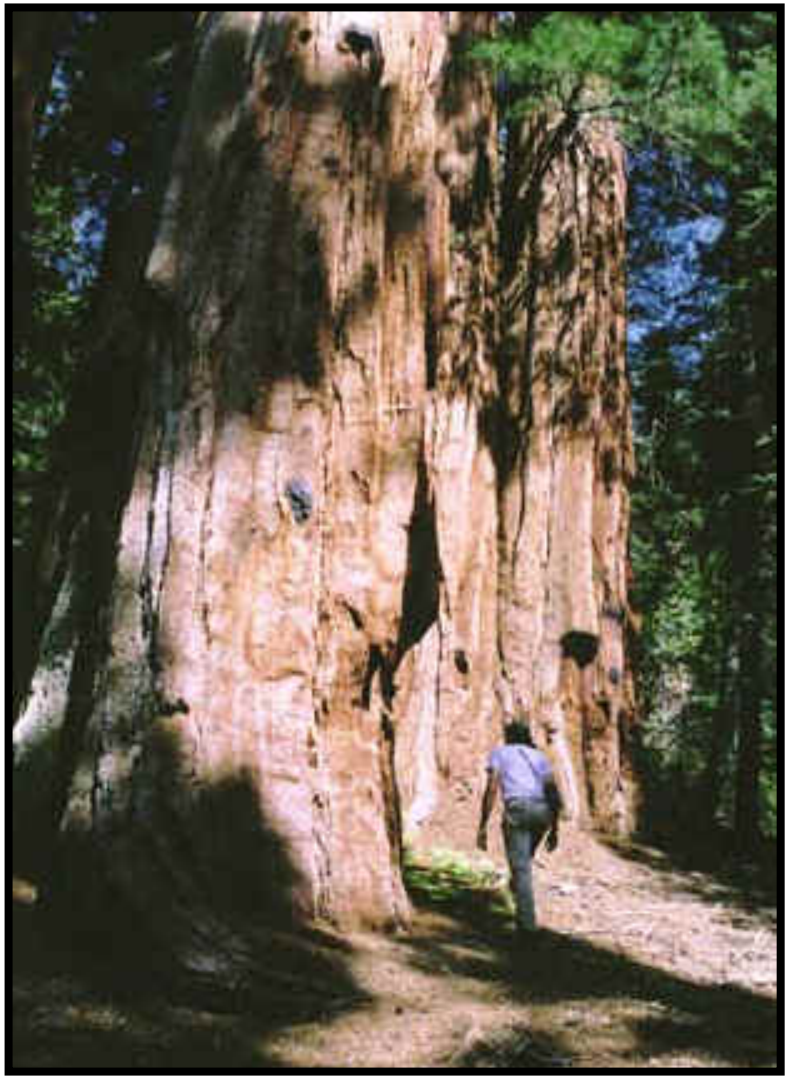
- Type of Cells:
  - Multicellular: made of many cells that all have different functions and work together.
  - Eukaryotes: very complex cells that have a nucleus and many other organelles.
  - All plant cells have a cell wall and many have chloroplasts.
  - All plants are adapted for living on land.

Plant Kingdom

- Type of Organism:
  - All plants are producers and make their own food. They do this through a process called photosynthesis.
  - In photosynthesis, plants use the energy in sunlight to change water and carbon dioxide into a sugar called glucose and oxygen.
  - Glucose is food for the plant and is also the base of most land food chains.
  - Plants take in carbon dioxide from the air and release oxygen into the air.

Plant Kingdom

- Type of Reproduction:
  - Most kinds of plants reproduce with seeds. The seeds develop in flowers or cones. Seeds are sexual reproduction.
  - Ferns and mosses reproduce asexually with spores.



Plant Kingdom

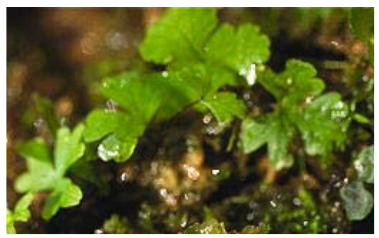
- 12 Major Groups of Plants (Divisions):
  - At least four classification systems are in common use for plants.
    - Plants are classified into 12 phyla or **divisions** based largely on reproductive characteristics.
    - Plants are classified by **tissue structure** into non-vascular (mosses) and vascular plants (all others)
    - Plants are classified by **"seed" structure** into those that reproduce through naked seeds, covered seeds, or spores;
    - Plants are classified by **stature** divided into mosses, ferns, shrubs and vines, trees, and herbs.

Plant Kingdom

Phylum	Tissue Structure	"Seed" Structure	Stature
Bryophyta - mosses	Non-vascular (*Bryophytes*)	Spore Producers	Moss-like
Psilophyta - whisk ferns	Vascular Plants (*Tracheophytes*)		Fern- and Tree-like
Lycopodophyta - club ferns			
Sphenophyta – horsetails			
Filicinophyta - ferns			
Cycadophyta – cycads		Naked seeds (*Gymnosperms*)	
Ginkophyta – Ginkoes			Tree-like
Coniferophyta – conifers			Tree- and shrub-like
Gnetophyta			
Angiospermophyta - flowering plants		Covered seeds (*Angiosperms*)	Tree-, shrub-, vine-, and herb-like
Dicotyledons - two seed-leaves			
Monocotyledons - single seed-leaf			

Plant Examples

- **Mosses:**
  - Mosses are the only non-vascular plants -- they cannot move fluids through their bodies. Instead, they rely on moisture in their surroundings.
  - Though small in stature (size), mosses are very important members of our ecosystem. They are the foundations for other plant growth, prevent erosion, and contribute to the green appearance of many forested areas.
  - The 24,000 bryophyte species are grouped in three phyla:
    - **Mosses** (*Bryophyta*),
    - **Liverworts** (*Hepatophyta*)
    - **Hornworts** (*Anthoceraphyta*).
  - They reproduce by spores, never have flowers, and can be found growing on the ground, on rocks, and on other plants.



Plant Examples

- **Ferns:**
  - Ferns have a vascular system to move fluids through their bodies.
  - Like the mosses, they reproduce from spores rather than seeds.
  - The main phylum, the **Ferns** (*Filicinophyta* = *Pteridophyta*) includes around 12,000 species
  - Three other phyla are included as fern allies:
    - **Horsetails** (*Sphenophyta* = *Equisetophyta*, 40 species)
    - **Club mosses** (*Lycopodophyta*, 1,000 species)
    - **Whisk ferns** (*Psilophyta*, 3 species)

Plant Examples

- **Conifers:**
  - Conifers (gymnosperms) reproduce from seeds instead of spores. The seeds, however, are "naked" (Greek: gummnos) which means they are not covered by an ovary.
  - Usually, the seed is produced inside a cone-like structure like a pine cone. Therefore, they are named "conifers." But, some conifers, such as the Yew and Ginko, produce their seeds inside a berry-like structure.
  - Conifers are easy to identify due to their cones and needle-like, scale-like, or awl-like leaves. And they never have flowers.
  - There are approximately 600 species of conifers: pines, firs, spruces, cedars, junipers, and yew.
  - Conifer allies include three small phyla containing fewer than 200 species all together:
    - **Ginko** (*Ginkophyta*) with a single species: the Maidenhair Tree (*Ginko biloba*);
    - palm-like **Cycads** (*Cycadophyta*)
    - herb-like cone-bearing plants (*Gnetophyta*) such as Ephedra.

Plant Examples

- **Angiosperms:**
  - Angiosperms which means they have the final improvement in plant reproduction:
    - they grow their seeds inside an ovary (Greek: *angeion* = vessel) which is inside a flower.
    - After it is fertilized, the flower falls away and the ovary swells to become a fruit.
  - Angiosperms have a vascular system to move fluids through their bodies.
  - Angiosperms are grouped into two categories based upon how many seed leaves they have:
    - Dicot - 2 seed leaves
    - Monocot - 1 seed leaf

Plant Examples

- **Dicots:**
  - Angiosperms in the class Dicots, *Dicotyledoneae,* grow two seed-leaves (*cotyledons*). In addition, foliage leaves typically have a single, branching, main vein originating at the base of the leaf blade, or three or more main veins that diverge from the base.
  - The vast majority of plants are Dicots. Most trees, shrubs, vines, and flowers belong to this group of around 200,000 species. Most fruits, vegetables and legumes come from this class.

Plant Examples

- **Monocots:**
  - Angiosperms in the class Monocots, *Monocotyledoneae,* start with one seed-leaf. The main veins of their foliage leaves are usually unbranched and nearly parallel to each other.
  - Around 30,000 plants are classified as monocots including many of the prettiest members of kingdom *Plantae*: orchids, lilies, irises, palms and even the Bird-of-Paradise plant.
  - The grasses which carpet our lawns and meadows are also monocots.
  - Monocots provide us with our primary sources of nutrition, supplying us and the animals we eat with grains such as wheat, oats, and corn, as well as fruits such as dates and bananas.

What type of cell?
Eukaryote – complex Multicellular – many specialized cells

What type of organism?
Producer

Type of Reproduction?
Asexual *spores* or Sexual *seeds*

ANIMAL KINGDOM

Animal Kingdom

- Type of Cells:
  - Multicellular: made of many cells that all have different functions and work together.
  - Eukaryotes: very complex cells that have a nucleus and many other organelles.
  - Animal cells do not have a cell wall, but they do have a cell membrane.
  - Some animals are adapted for living on land, in water, or a combination of both.

Animal Kingdom

- Type of Organism:
  - All animals are consumers and feed on other organisms. Some are carnivores, herbivores, omnivores, or scavengers.
- Type of Reproduction:
  - Many invertebrate animals are capable of reproducing asexually and sexually. All vertebrate animals reproduce sexually. Some animals reproduce by laying eggs. Other animals reproduce by giving birth to live young.

Animal Kingdom

- Types of Animals:
  - There are two major divisions in the animal kingdom:
    - Invertebrates- Animals without a backbone

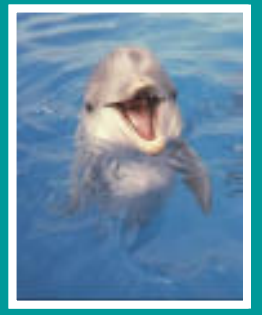
    - 32 phylum – 735,000 species
    - Vertebrates- Animals with a backbone

    - 1 phylum – 45,000 species

Animal Examples

- **Invertebrates:**
  - Sponges (soft body)
  - Cnidarians (soft body)
    - Examples: Jellyfish, Sea Anemones, and Corals
  - Worms (soft body)
    - Flatworms: Planarians and Tapeworms
    - Roundworms
    - Segmented Worms: Earthworms and Leeches
  - Mollusks (shelled)
    - Gastropods: Snails and Slugs
    - Bivalves: Clams, Oysters, Scallops, Mussels
    - Cephalopods: Octopi, Cuttlefish, Nautiluses, Squids
  - Arthropods (exoskeleton)
    - Crustaceans: Crabs, Crayfish, Shrimp, Lobster
    - Arachnids: Spiders, Mites, Ticks, Scorpions
    - Centipedes
    - Millipedes
    - Insects
  - Echinoderms (endoskeleton)
    - Examples: Sea Urchins, Sand Dollars, Sea Stars, and Brittle Fish

Animal Examples



- Vertebrates
  - Cold Blooded *(Ectothermic)*
    - Fish
      - *Osteichthyes* – bony fish: Trout, Cod, & Perch
      - *Chondrichthyes* – cartilage fish with jaws: Sharks & Rays
      - *Agnatha* – cartilage fish without jaws*:* Lamprey
    - Amphibians *Amphibia*
      - Amphibians with tails: Toads and Frogs
      - Amphibians without tails: Salamanders and Newts
    - Reptiles *Reptila*
      - Snakes and Lizards
      - Crocodiles and Alligators
      - Turtles and Tortoises
  - Warm Blooded *(Endothermic)*
    - Birds *Aves*
    - Mammals *Mammalia*
      - Placenta Mammals: Bats, Whales, Dolphins, Dogs, Humans
      - Marsupials: Opossum, Kangaroos, and Koalas
      - Egg Laying: Duck-billed Platypus & Spiny Anteater

What type of cell?
Eukaryote – complex
Multicellular – many specialized cells

What type of organism?
Consumer

Type of Reproduction?
Asexual and Sexual

Do Classifications Systems Really Exist?

- Not in nature, but in the minds of scientist...that is why it changes and there are more than one idea on classification!
- But this demonstrates how science is always working and adjusting!