

Viruses

- All organisms have viruses
- Viruses are not really organisms because they cannot survive without a host and are not capable of basic metabolic function.
- RNA or DNA, capsid (covering) also important
- Prions little understood
- Virus-like particles are very common in lakes

Archaea

- As different from bacteria as eukarya
- Morphologically similar to bacteria
- often overlooked component of ecosystems because they are extremely small (few micrometers).....
- Originally thought to be mainly extremophiles (hyperthermic, halophilic, anaerobic)
- Now known to occur in all habitats
- Essential in nutrient cycling

Bacteria

- Most important organisms in nutrient cycling on earth
- Also overlooked component of ecosystems because they are extremely small (few micrometers).....
- Can only culture < 1% of all species
- Most species only have few morphologies
- Most identification based on metabolic or chemical characteristics
- Can be mutualistic, commensal, or parasitic
- Cyanobacteria are included in this group

Cyanobacteria

- Produce O₂, photosynthetic
- Fix nitrogen with heterocysts
- Others fix nitrogen w/o heterocysts
- Float by gas vesicles
- Produce objectionable odors, tastes, and toxins
- Unique light-harvesting pigments

Cyanobacterial Toxins

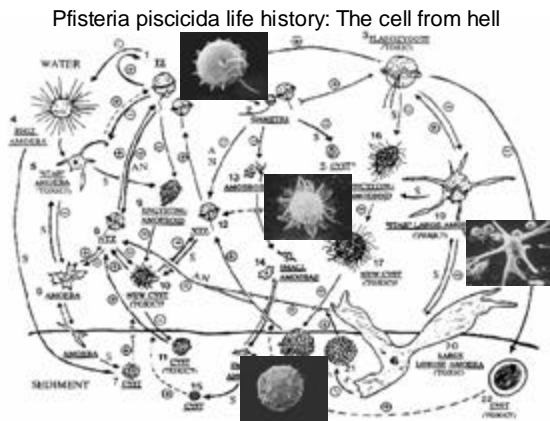
- Produce hepatotoxins and neurotoxins
- Neurotoxins are highly toxic
- Hepatotoxins damage liver. Low, chronic exposures may cause liver cancer
- Toxins can be bioconcentrated by some organisms, and influence many different types of animals
- Toxins evolved as protection against zooplankton grazing
- Other algae make toxins, red-tide, *Pyrnnesium parvum* responsible for a massive fish kill in summer 2002 in NE Colorado. Coming to a reservoir near you soon!

Protista (Protoctista)

Protista are all eukaryotes that are not plants, animals, or fungi, ranging from a single cell amoeba to a 100-ft long kelp
 Photosynthetic (autotrophic) protists are plant-like
 Heterotrophic protists are more animal-like

Protists are important because:

1. Photosynthetic protists form the base of open water food webs
2. Some photosynthetic protists form symbiotic relationship with animals
3. Toxic forms produce red-tides that can kill millions of fish and make people ill
4. Make up much of the plankton



Protoctista: Eukaryotic Algae

- Chrysophyceae- Golden algae, flagellated, and ingest particles
- Bacillariophyceae- diatoms, have silicon frustule that is useful in paleolimnology, abundant in many types of freshwaters
- Dinophyceae- dinoflagellates, flagellates, some toxic and cause fish kills
- Euglenophyceae- *Euglena*
- Chlorophyceae and Charophyceae- green algae

Pfiesteria piscicida Human Health Impacts

Thirteen researchers who worked with dilute toxic cultures of *Pfiesteria* sustained mild to severe adverse health impacts through water contact or by inhaling toxic aerosols from laboratory cultures. These people generally worked with the toxic cultures for 1-2 hours per day over a 5-6 week period. The effects included a suite of symptoms such as narcosis (a "drugged" or lethargic effect), development of sores (in areas that had directly contacted water containing toxic cultures of *P. piscicida*, as well as on the chest and face, suggestive of a systemic response), uniform reddening of the eyes, severe headaches, blurred vision, nausea/vomiting, sustained difficulty breathing (asthma-like effects), kidney and liver dysfunction, acute short-term memory loss, and severe cognitive impairment (= serious difficulty in being able to read, remember one's name, dial a telephone number, or do simple arithmetic beyond $1 + 2 = 3$).

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Protoctista: Protozoa

- Important consumers of bacteria
- Mastigophora- flagellates
 - Phytomastigophora- green
 - Zomastigophora- colorless
- Sarcodina- amoeboid protozoa
- Ciliophora- ciliates

Sediment tells about the Past

Covered by a steady rain of sediment caused by settling dust, terrestrial erosion, and the skeletons of dead plankton

Diatoms (microscopic algae) and Radiolarians (protozoan): organisms with siliceous skeletons, although some Radiolarians have radioactive skeletons made of strontium sulfate.

Coccolithophores (algae), Foraminiferans (protozoa): organisms with calcium carbonate skeletons.

Fungi - decomposers of the ecosystem

Eukaryotes: have nucleus and mitochondria

They are heterotrophic, meaning they get their nutrition from other organic sources, usually dead biomass, but occasionally living material.

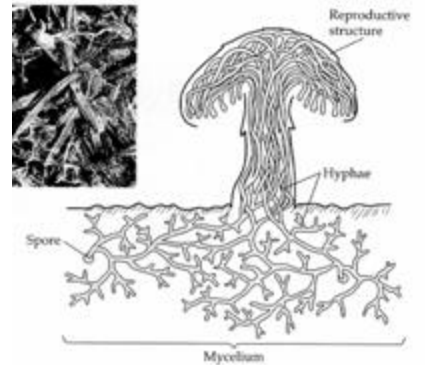
They obtain nutrients by absorbing it through their cell surfaces. Common examples: yeast, mushrooms, athlete's foot fungus

While most are terrestrial, they do prefer moist environments, and there are freshwater and aquatic forms.

They are important because:

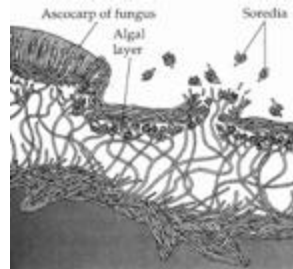
1. they decompose dead biomass into usable nutrients
2. through symbiotic relationships with algae, they prepare bare rocks for colonization by plants (they initiate soil formation)
3. some are pathogens
4. produce antibiotics (Penicillium)

Fungal Sex



Lichens - a symbiotic relationship between fungus and algae

the algae provide photosynthate and the fungus provides nutrients - can even dissolve minerals from rocks. Very important in primary succession of islands.



Plantae

- Nonvascular plants
- Vascular plants
- Large algae and plants called macrophytes, often classified by growth habit

Non-Vascular Plants

- Bryophytes- mosses and liverworts
- *Sphagnum* globally important in carbon deposition in peat bogs
- Some aquatic mosses can be found very deep in oligotrophic lakes
- Some streams can be dominated by bryophytes

Vascular Plants

- Dominant producers in many wetlands, shallow lakes and ponds
- Many wetlands classified based on the vegetation that they contain
- A wide variety of forms