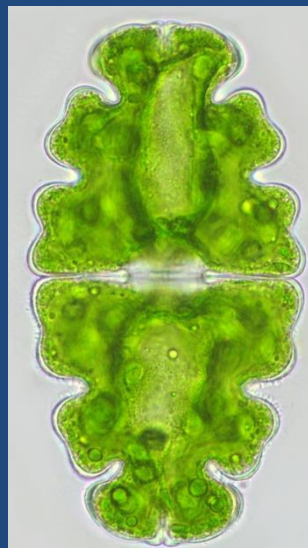


Algae 101

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Presented by: Greg Barren

The Academy of Natural Sciences of Drexel University



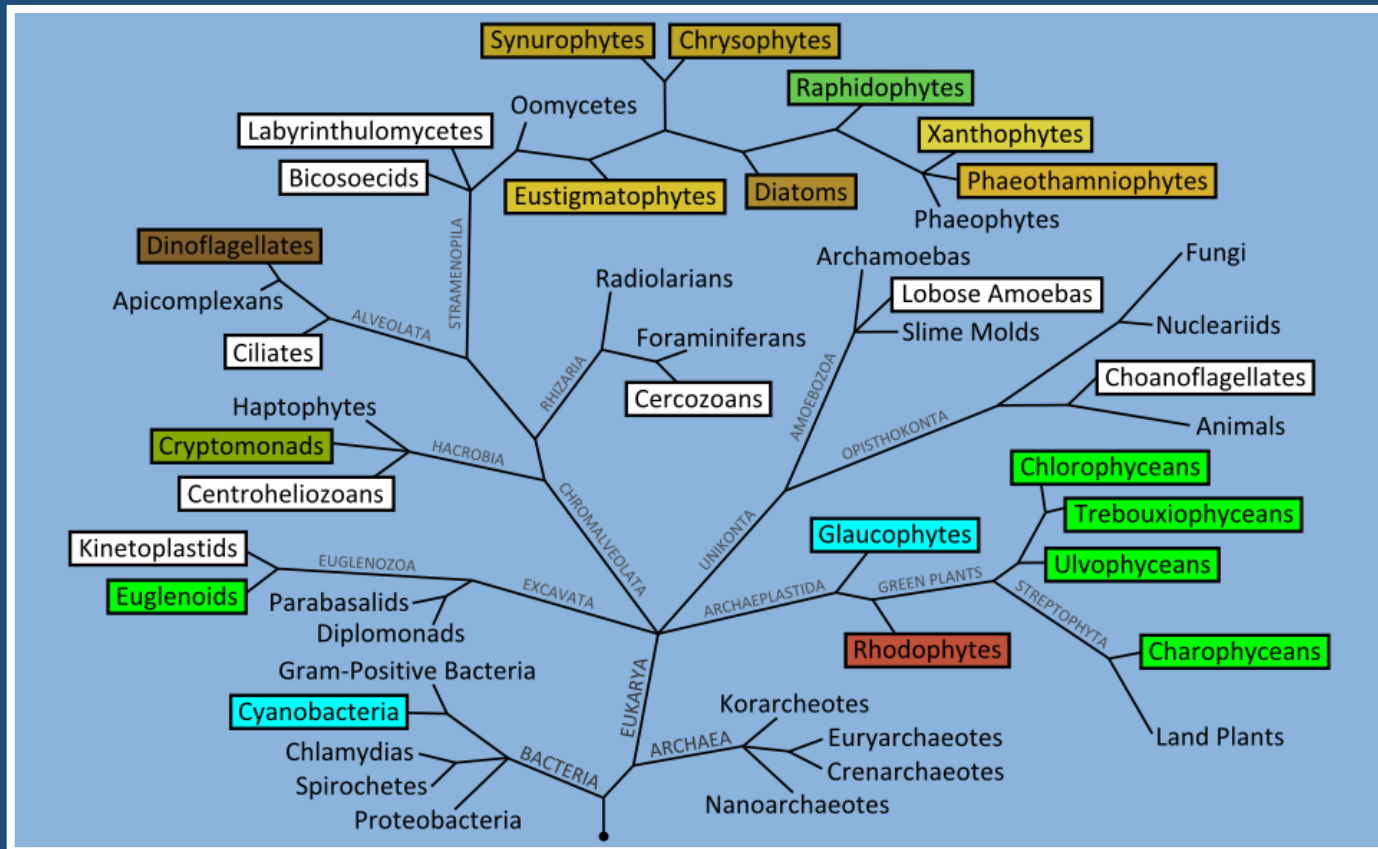


Summary

- What are they
- Habitat
- Ecology
- Why monitor
- Ways to monitor

Algae

- Algae: photosynthetic organism that lacks tissue differentiation
- Classified by physical characteristics not evolutionary relationships

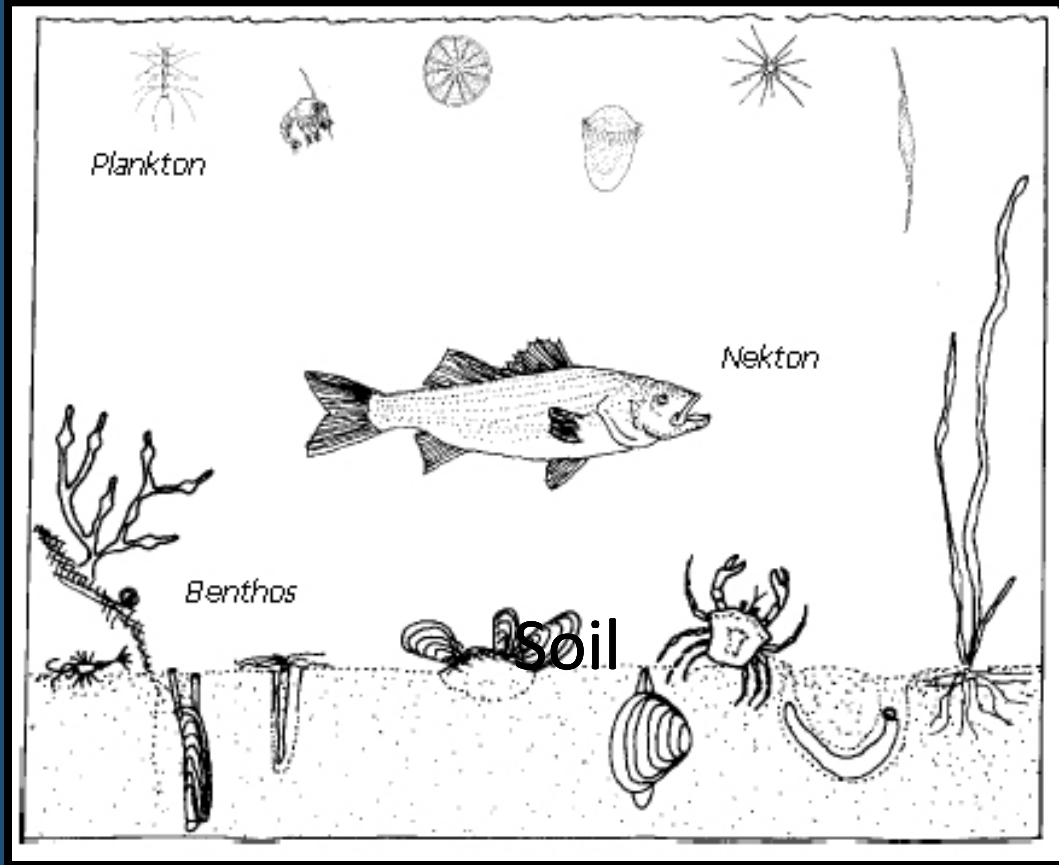


Algae Habitats

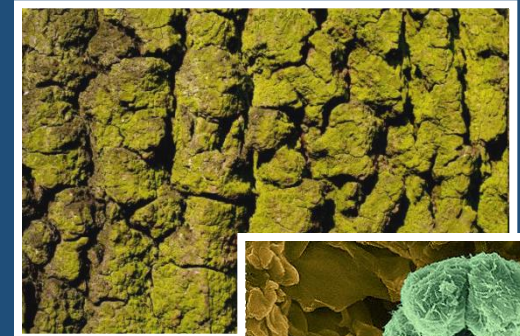
Mostly in water bodies: oceans, lakes, rivers

Algae suspended in water column = phytoplankton

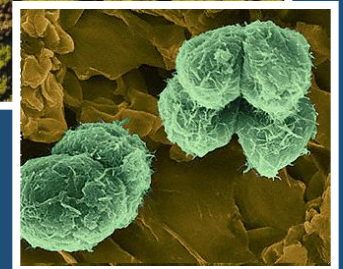
Algae attached to bottom or submerged objects =
phytobenthos



Soil

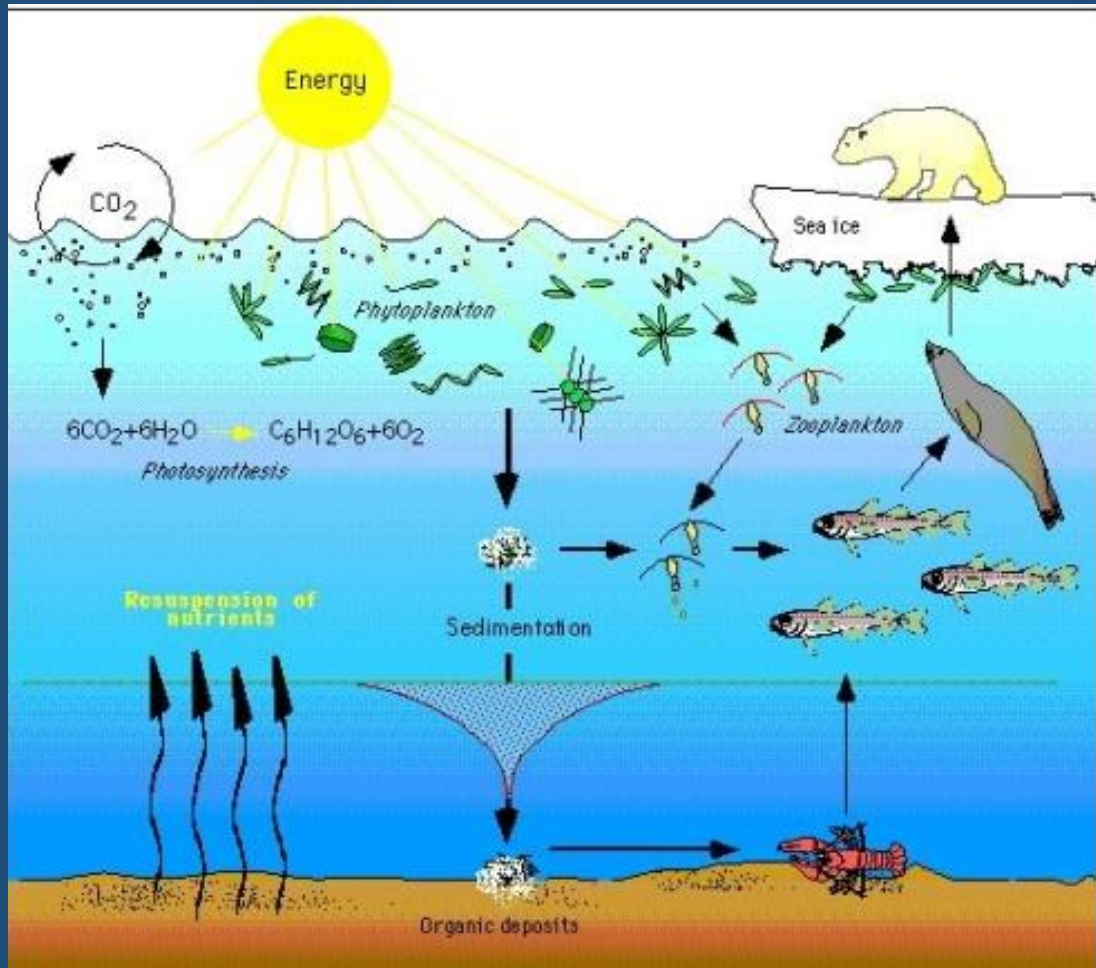


Tree
bark



Algae Habitats

Phytoplankton: 0.2% of the total biomass of autotrophs, but produce 47% of organic matter on Earth



Algae Habitats

Phytobenthos



Kelp - huge algal underwater "forests"



tiny attached
diatoms
(magnified x1000)

Algae Habitats

- Freshwater Habitats
 - Mostly attached to substrate in smaller streams (biofilms)
 - Sediment
 - Rocks
 - Plants
 - Mostly suspended in larger streams
 - Light limitations

Epiphytic Diatoms



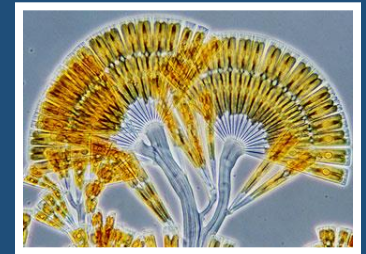
Rock Biofilm



Types of algae

Classification of algae: divisions correspond to major groups

- Cyanophyta = blue-green
- Rhodophyta = red
- Chlorophyta = green
- Bacillariophyta = diatoms
- Phaeophyta = brown
- Chrysophyta = golden
- Xanthophyta = yellow-green
- etc.

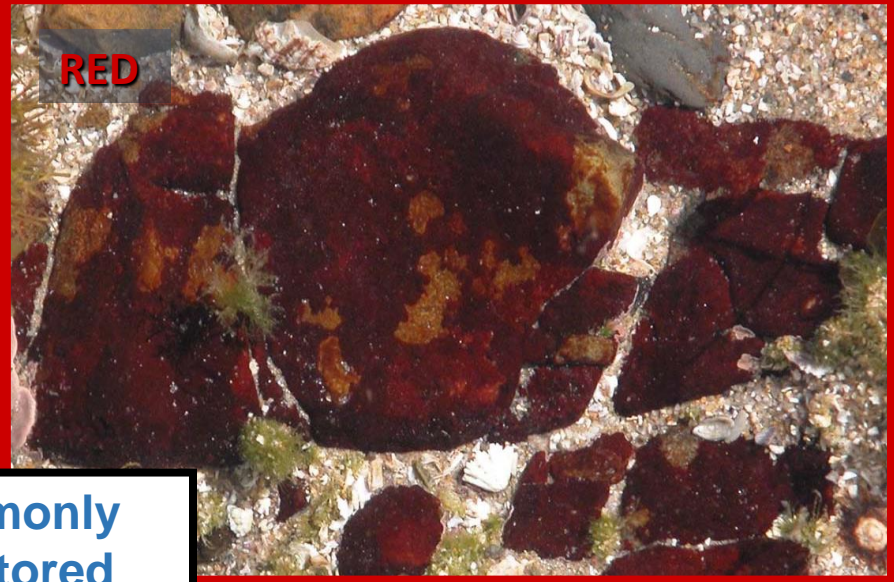


Color reflects fundamental differences in cell chemistry (pigments)

Types of algae

| Pigment/ Storage product | Cyanophyta | Rhodophyta | Chrysophyta | Xanthophyta | Bacillariophyta | Phaeophyta | Haptophyta | Cryptophyta | Dinophyta | Euglenophyta | Chlorophyta |
|-----------------------------|------------|------------|-------------|-------------|-----------------|------------|------------|-------------|-----------|--------------|-------------|
| Chl A | + | + | + | + | + | + | + | + | + | + | + |
| Chl B | | | | | | | | | | + | + |
| Chl C | | | + | + | + | + | + | + | + | | |
| Phycocyanin | + | + | | | | | | + | | | |
| Allophycocyanin | + | + | | | | | | | | | |
| Phycoerythrin | + | + | | | | | | + | | | |
| A-carotene | | + | + | | | | + | + | + | | + |
| B-carotene | + | + | + | + | + | + | + | + | + | + | + |
| G-carotene | | | | | | | | | | + | + |
| Zeaxanthin | + | + | + | | | + | | + | | + | + |
| Fucoxanthin | | | + | | + | + | + | | + | | |
| Cyanophycin | + | | | | | | | | | | |
| Starch-like | + | + | | | | | | + | + | | + |
| Chrysolaminaran | | | + | + | + | + | + | | | | |

Types of algae



Commonly
monitored
groups of
algae in rivers



Types of algae

Freshwater algae

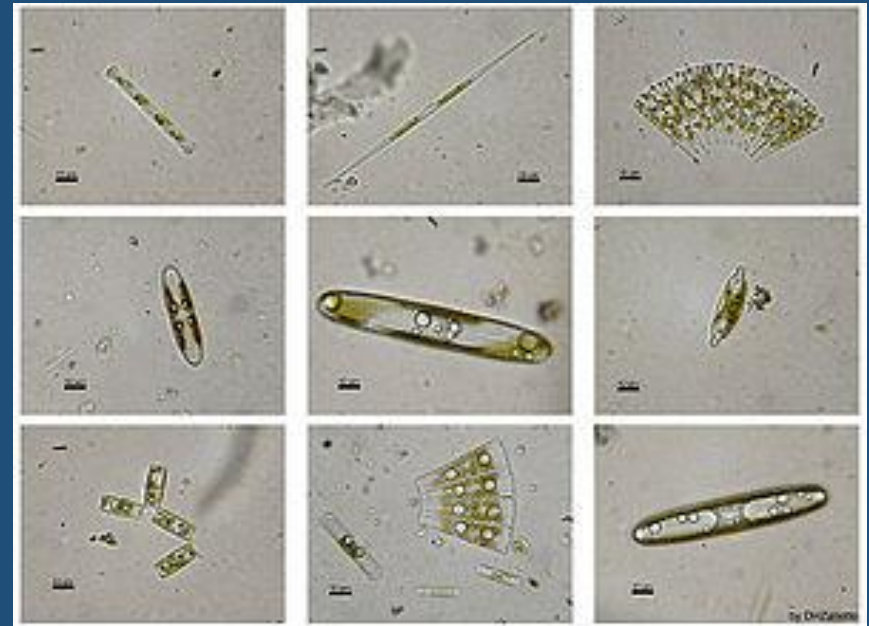


Cladophora aegagrophila in a lake (aquarium)



"pond scum" = filamentous algae

Freshwater algae form macroscopic colonies that can be seen with the naked eye, but are mostly microscopic, living either as solitary cells or colonies.



Microscopic diatoms
(<https://en.wikipedia.org/wiki/Diatom>)

Algae Ecology

Biomass Gains

Biomass Loss

Resources

Nutrients

Light

Temperature

High Biomass

Disturbance

Scouring/sloughing

Substrate movement

Grazing

Invertebrates

fish

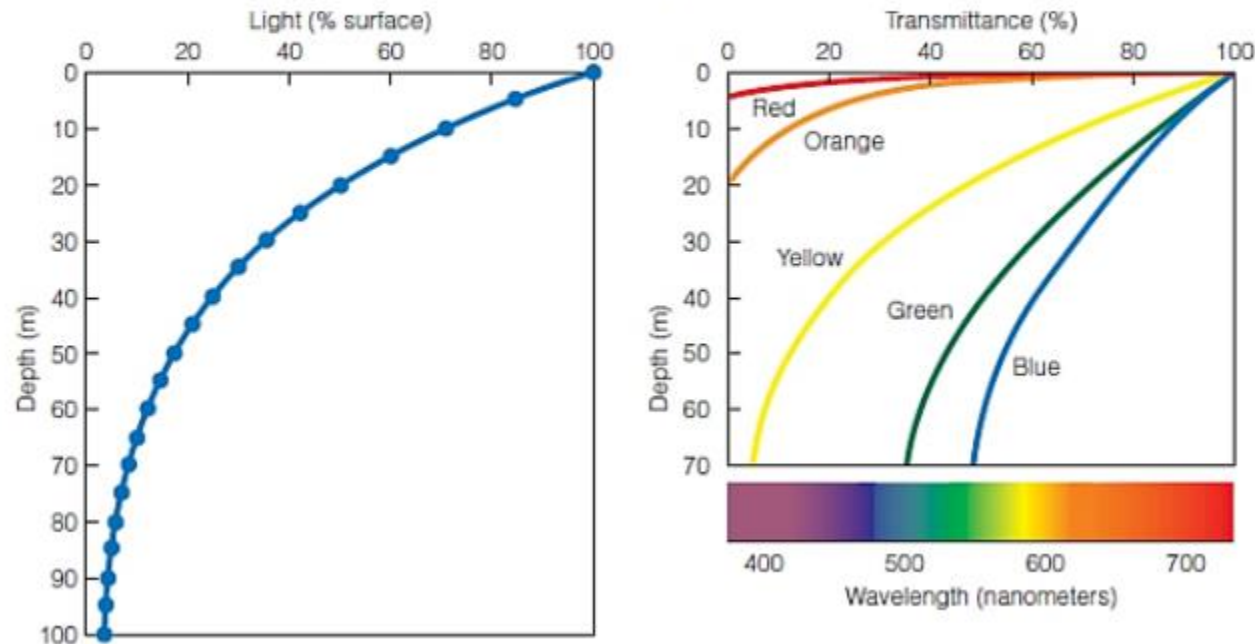
Low Biomass

Algae Ecology

Resources: Light

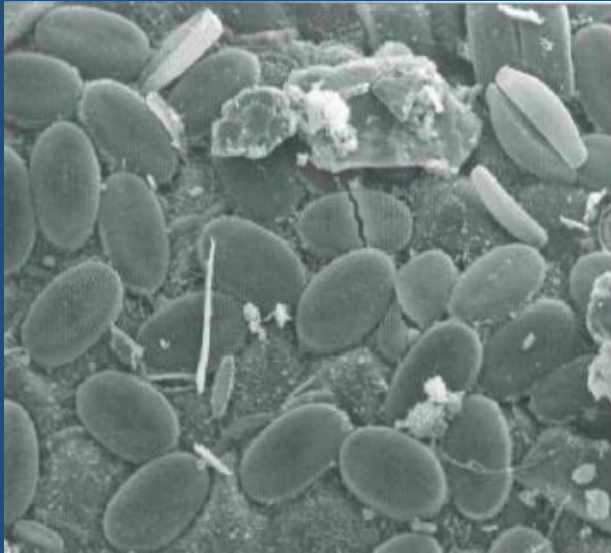
- Light varies with latitude, canopy cover, season (sun position/snow), depth, habitat

Figure 6 (a) Attenuation of incident light with water depth (pure water), expressed as a percentage of light at the water surface. Estimates assume a light extinction coefficient of $k_w \equiv 0.035$ (see Quantifying Ecology, pp. 56–57). **(b)** The passage of light through water (transmittance) reduces the quantity of light and modifies its spectral distribution (see Figure 7). Red wavelengths are attenuated more rapidly than green and blue wavelengths.



Algae Ecology

Resources: Light



Top of moss leaf (high light) (Knapp and Lowe, 2009)

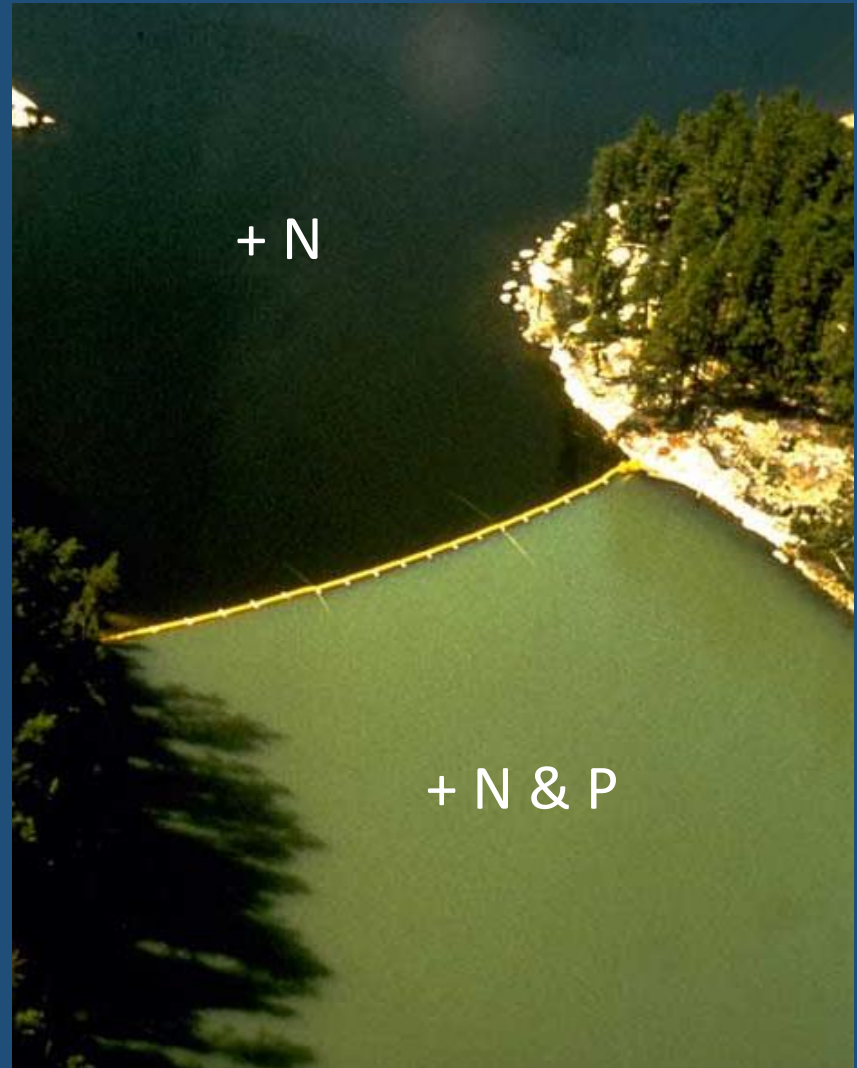


Bottom of moss leaf (low light) (Knapp and Lowe, 2009)

Algae Ecology

Resources: Temperature

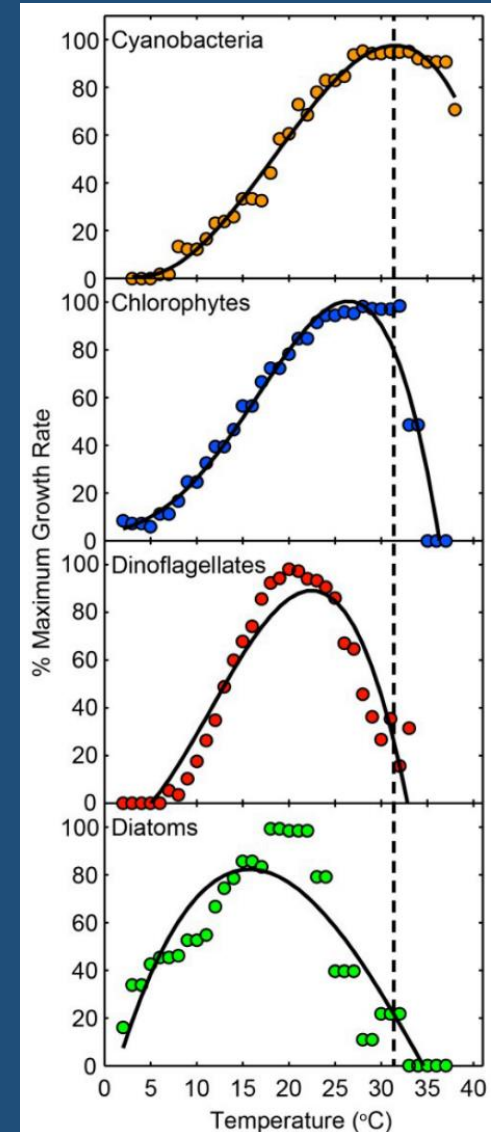
- Limiting nutrients:
 - Phosphorus
(Commonly in freshwater)
 - Nitrogen
 - Silica (diatoms)



Algae Ecology

Resources: Temperature

- Increased temperature means greater enzyme activity (greater reproductive rates)
- Above certain temperature enzymes denatured and productivity drops off



Algae Ecology

Disturbance



Algae Ecology

Grazing

Invertebrate Grazers

**GATHERING, SHREDDING,
& PIERCING**

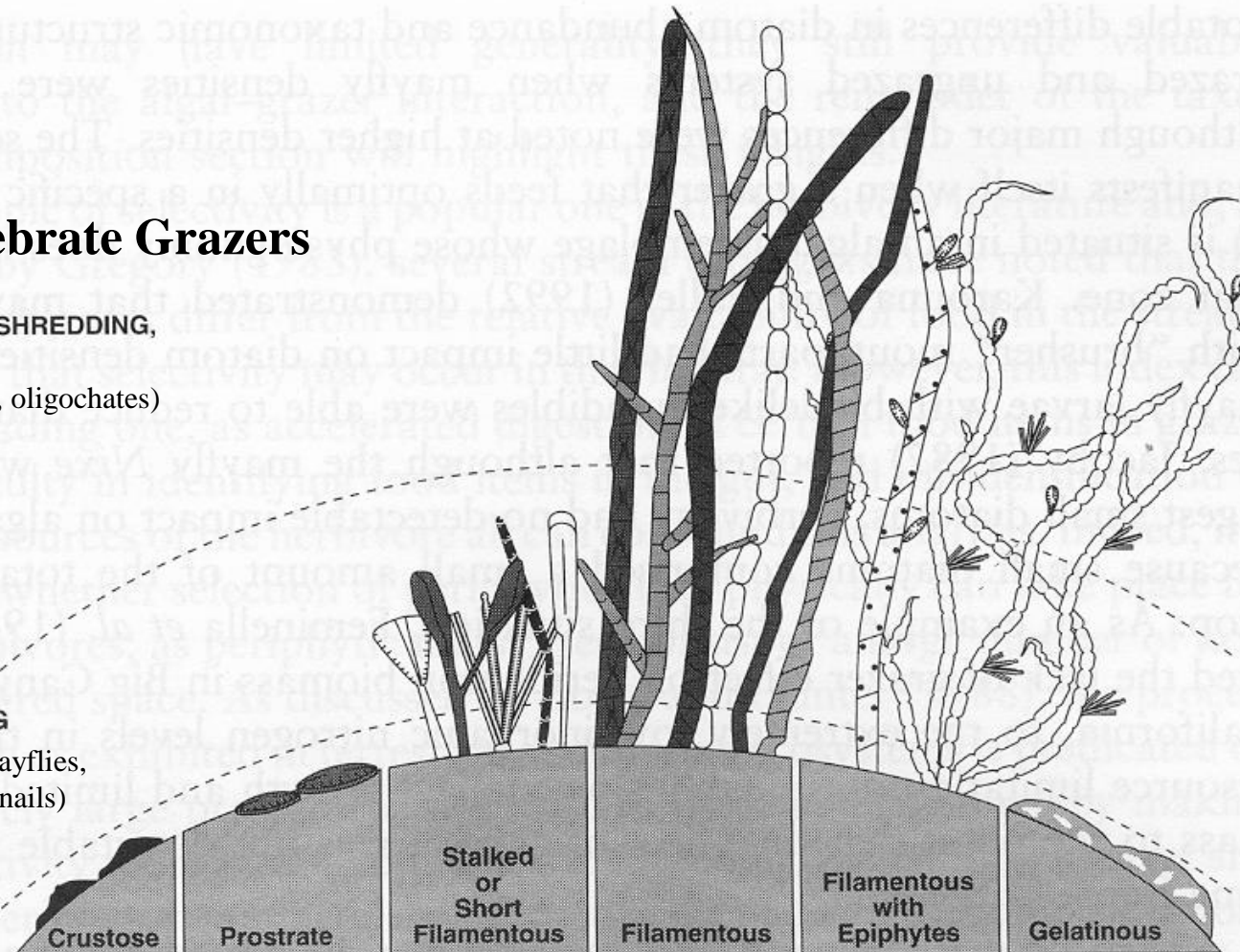
(chironomids, oligochaetes)

**SCRAPING
& GATHERING**

(caddisflies, mayflies,
chironomids, snails)

**RASPING
& SCRAPING**

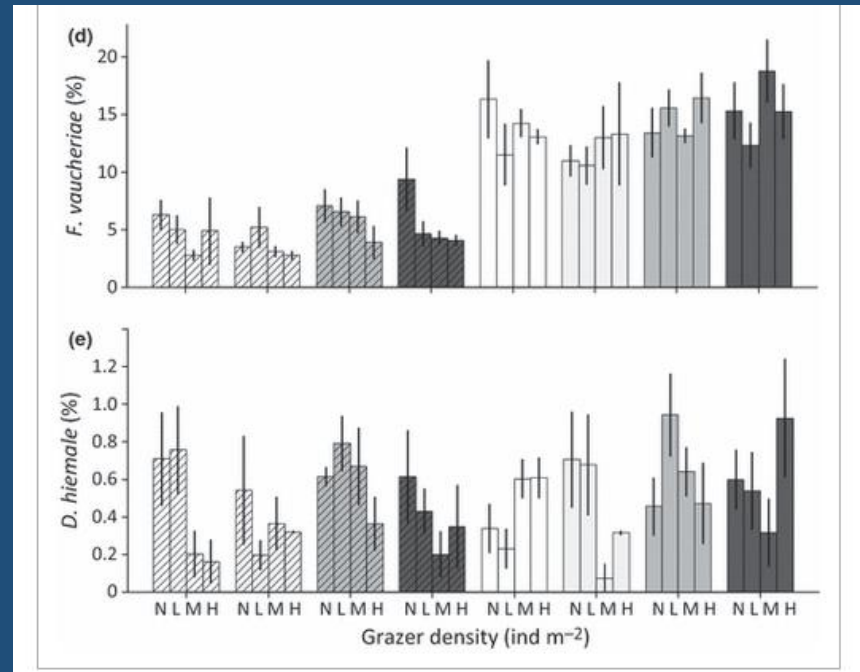
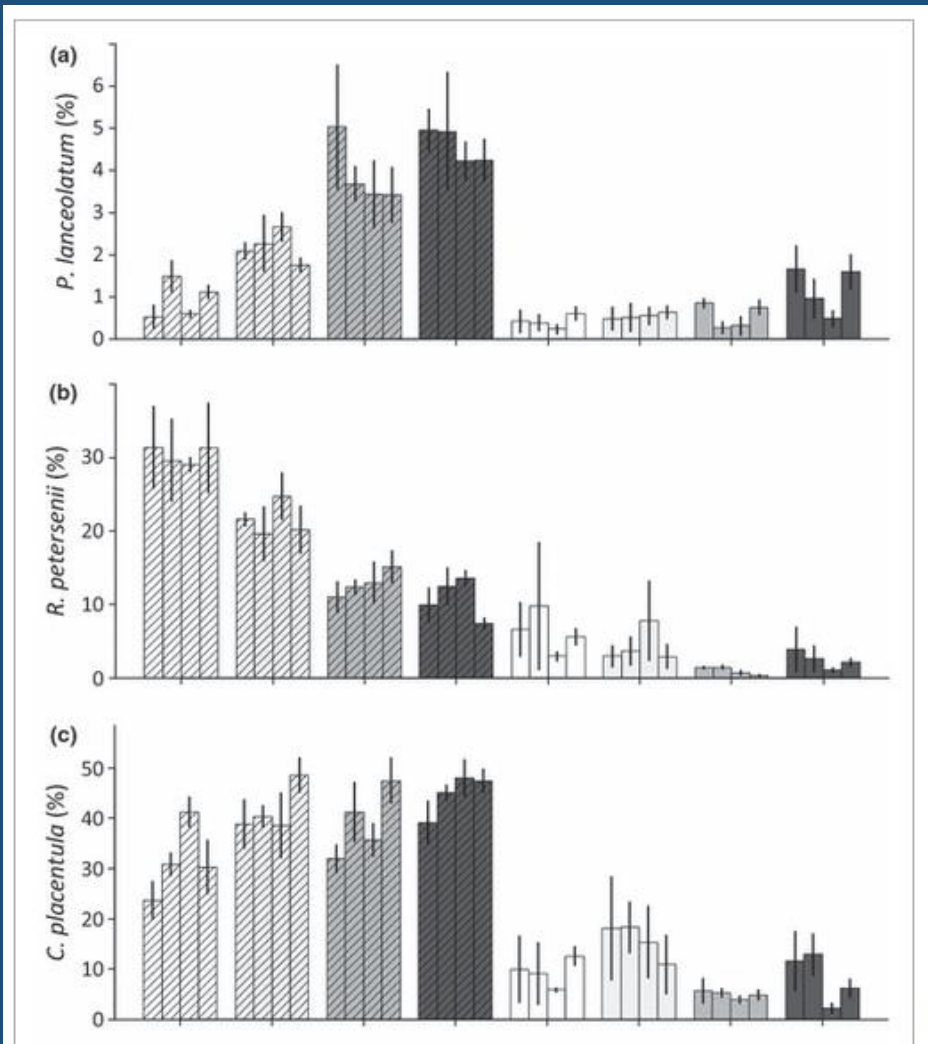
(mayflies, stoneflies,
Caddisflies, snails)



Modified from Steinman (1996)

Algae Ecology

Interactions: Grazing, light, and nutrients

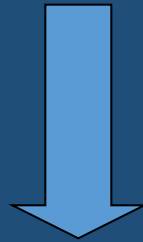


Relative abundances of (a) *P. lanceolatum*, (b) *R. petersenii*, (c) *C. placentula*, (d) *F. vaucheriae* and (e) *D. hiemale* var. *mesodon* (means ± 1 SE) at different grazer densities (N = no snails, L = low, M = medium, H = high), in reduced light (hatched bars) and ambient light (non-hatched bars) conditions, and in ambient (white), medium (light grey), high (medium grey) and very high (dark grey) nutrient treatments.

Monitoring

Algae in rivers and streams:
why monitor them?

- Algae are good indicators of water quality
- Presence or excessive growth of some algae can cause problems

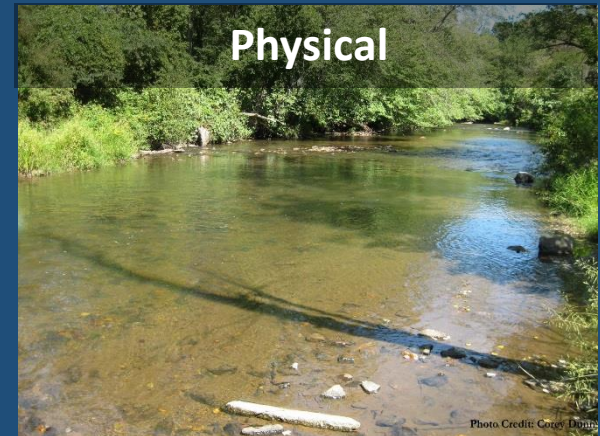


Algal assemblages in rivers
are increasingly being used in
biomonitoring programs



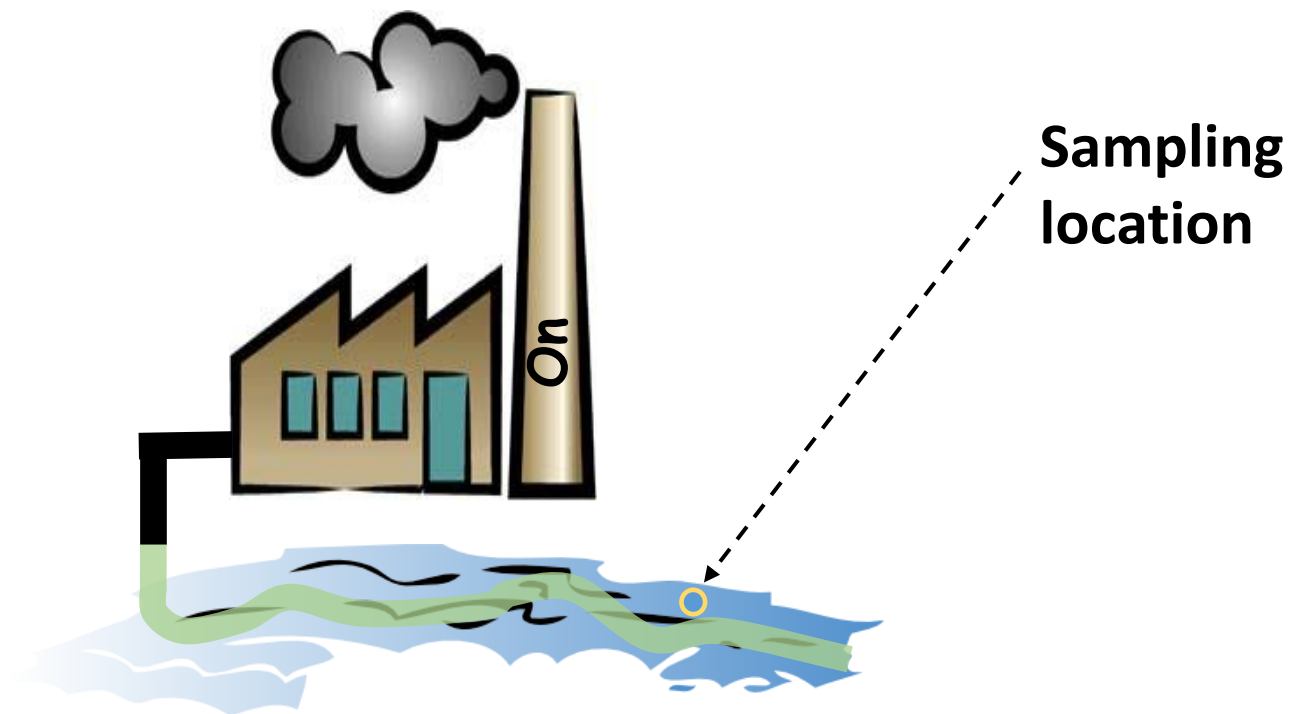
Bioindicators

- Organisms that show changes in response to natural and manmade disturbances
 - Physical or Chemical
- Useful bioindicators: presence of organism tells us something about the environment
 - Nutrient tolerant vs. nutrient intolerant taxa
 - Indices of Biological Integrity (IBIs)
- Algae respond quickly relative to fish and macroinvertebrates
 - Reproduce quickly



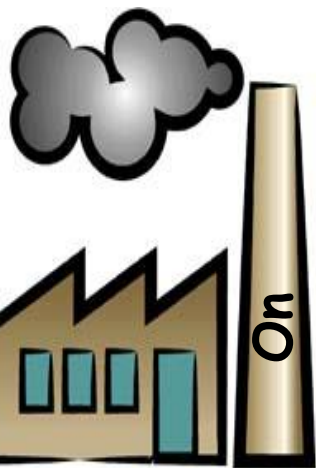
Chemistry vs Bioindicators

EXAMPLE



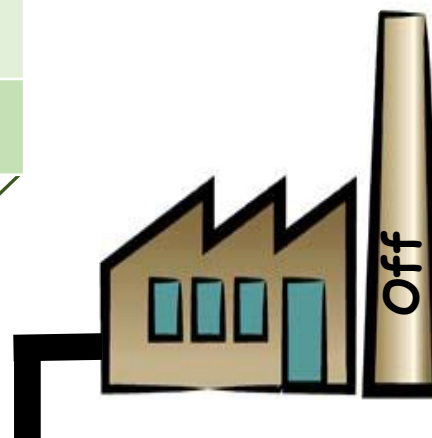
Chemistry vs Bioindicators

Sampling event #1



| Parameter | Value (mg/L) |
|-----------|--------------|
| TN ↑ | 9.2 |
| TP ↑ | 4.9 |
| TSS ↑ | 78.0 |

Sampling event #2



| Parameter | Value (mg/L) |
|-----------|--------------|
| TN ↓ | 2.5 |
| TP ↓ | 0.51 |
| TSS ↓ | 21.8 |

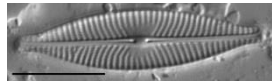
Chemistry vs Bioindicators

Sampling event #1

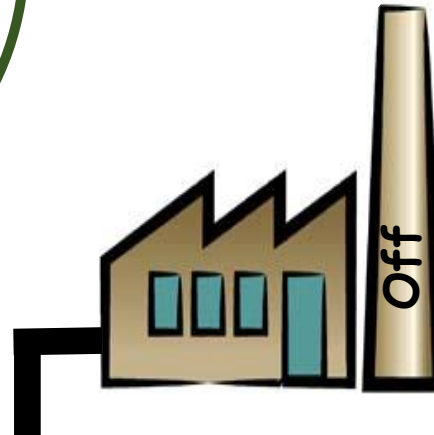


On

Low-quality diatom indicators

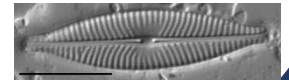
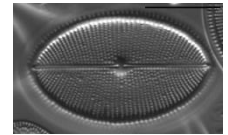


Sampling event #2



Off

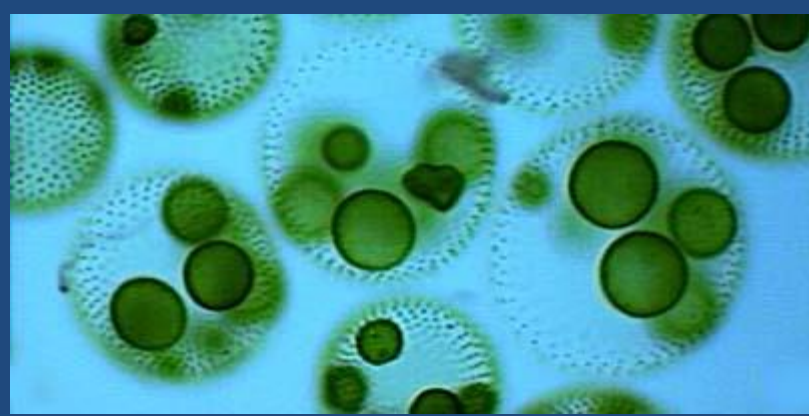
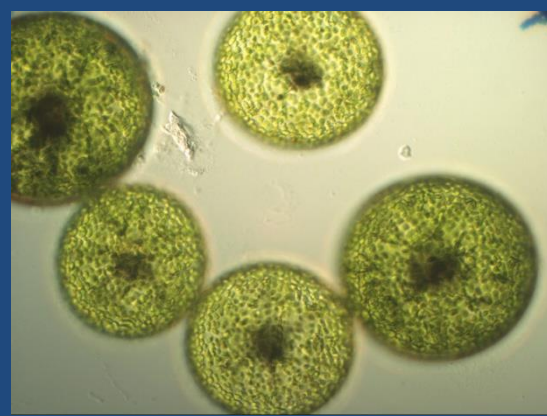
Low-quality diatom indicators



Types of Monitoring

- Visual Assessment
- Biomass
 - Chlorophyll-a analysis
- Stream bed Metabolism
- Community analysis





Questions?

