Nitrogen

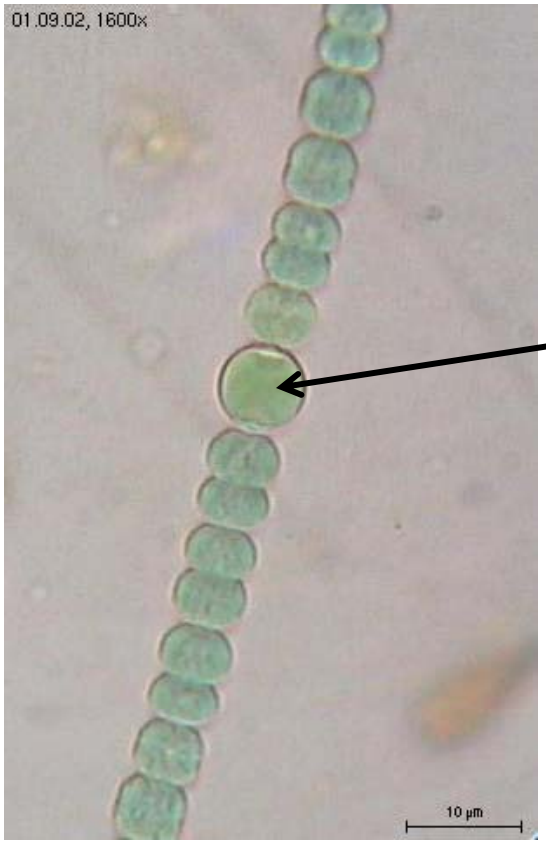
- Cultural eutrophication
  - Increase in P until P is no longer limiting nutrient
  - N then typically becomes limiting (macronutrient)
- N has complex chemical behavior
  - Depends on temperature and pH
  - Oxygen availability

Nitrogen

- Comes from many sources
  - Atmospheric gas (diffusion) … not very soluble
  - Inflows/sediment
  - Precipitation (industry, lightning)
  - Excretion by organisms
  - Fixation by blue-green algae

Key Forms

- Fixation by blue-green algae (cyanobacteria)



Heterocyst

- enzymes fix atmospheric N gas into organic N used by the algae
- oxygen damages enzymes


MERCURY

Key Forms

- Ammonia - excretion product…can be toxic under certain conditions to many organisms
  - Ionized form (ammonium) is preferred nutrient for plants and algae

Ammonia & Ammonium

toxic

nontoxic

Depends on temperature and pH

Percent ammonia as NH_3

	Temperature			
pH	0	10	20	30
6	.0008	.02	.04	.08
7	.08	.19	.4	.8
8	.82	1.83	3.82	7.56
9	7.64	15.7	28.4	44.6

Key Forms

- Nitrification
  - ammonia NH_3 can be oxidized to less toxic forms

Ammonia NH_3 *< 1 PPM toxic*

↓ *Nitrosomonas*

Nitrite NO_2 *15 PPM toxic*

↓ *Nitrobacter*

Nitrate NO_3 *1500 PPM toxic*

Nitrification

- Consumes oxygen…can reduce concentrations in water
- Occurs in oxidized sediments & hypolimnion
- Nitrate will accumulate & then used by plants/algae

Key forms

- Denitrification
  - Bacterial reduction of NO_3 to N_2 gas
  - Must be anoxic (sediments in hypolimnion, hydric soil in wetlands)

Limiting nutrient

- Redfield Ratio
  - TN:TP
  - 7:1 is typical for “balanced” phytoplankton
  - TN:TP > 10 (P limited)
  - TN:TP < 10 (N limited…eutrophic)

Nitrogen “crisis”

- Humans altering nitrogen cycling
  - Fertilizer application
  - Industry
  - Nitrogen fixation has doubled