Muck

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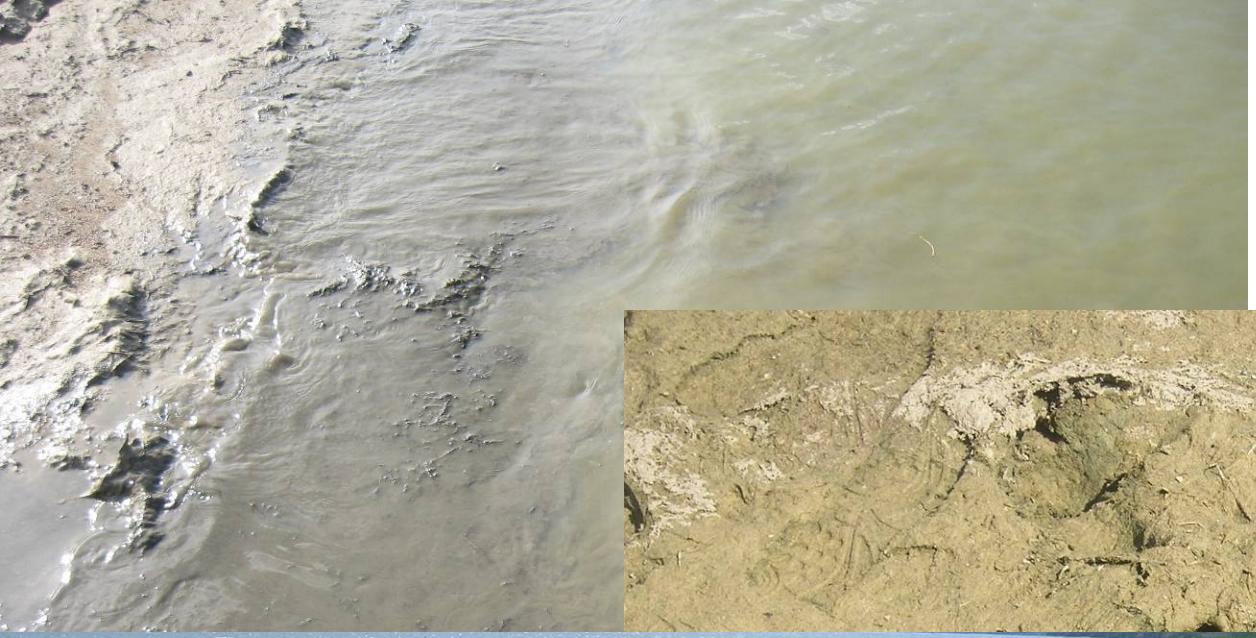
Muck: why are we studying it?

Muck was identified, by far, as the number one area of concern at first stakeholders meeting. This priority was confirmed by DEQ managers associated with our project.

Why is muck a problem?

- As the name implies: It is stinky, gross squishy stuff.
- Ruins beaches for:
  - Recreational use
  - Homeowners
- Decreased property value
- Public health concern
  - May harbor increased levels of pathogens

Saginaw Bay
Bay City
Aug. 4, 2008



What is muck?

- Decaying, benthic, filamentous algae that has washed on shore.

Muck project component goals

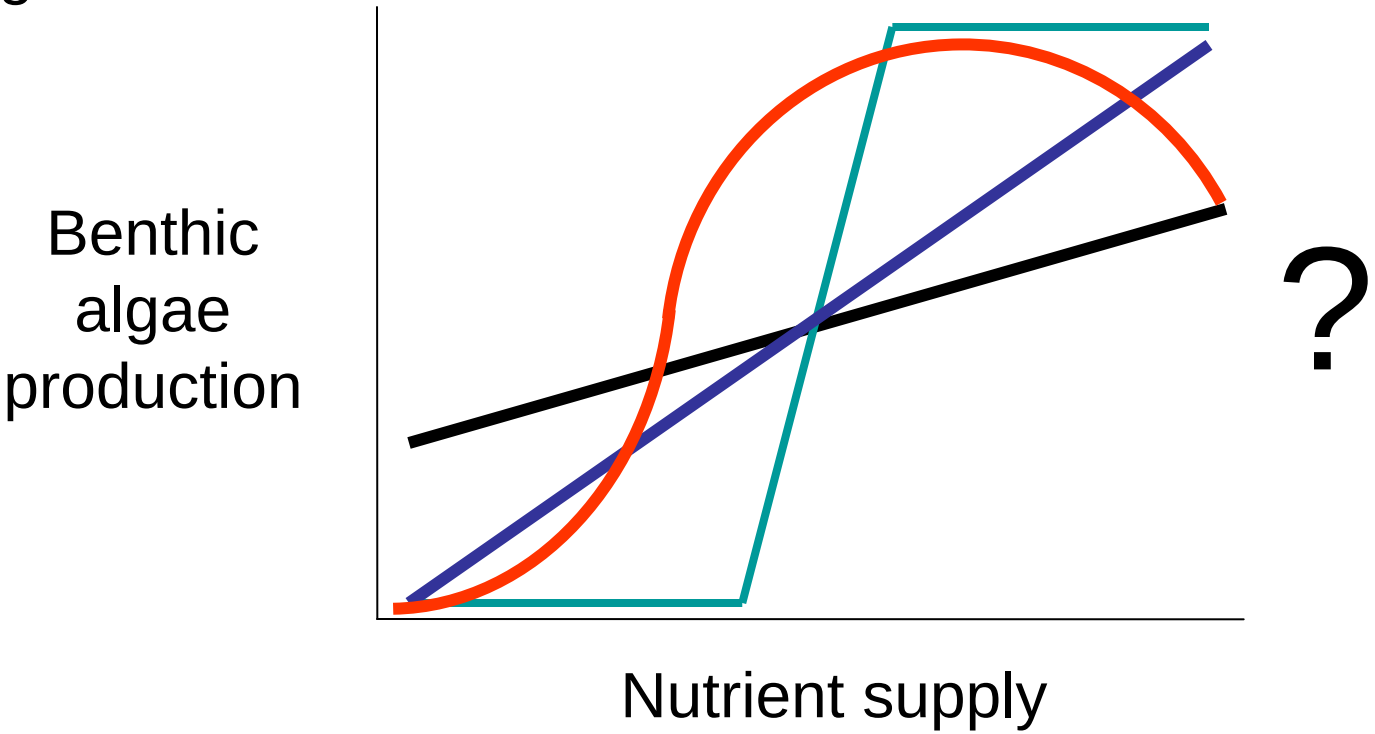
- Construct models that predict how changes in stressors will affect benthic algae that forms muck:
  - Nutrient input from watershed
  - Invasive species (mussels)
  - Global Climate Change
    - Water levels
    - Storm frequency
    - Temperature
- Construct models that inform management on benthic algae (muck) reduction
  - Nutrient levels: Possible to manage.
  - Water level: Model predictions could influence water level considerations.
  - Invasive species: Likely impossible to manage.

What affects benthic algae growth?

1) Nutrient levels
    - Phosphorous is likely most important
    - Direct effects:
        - more nutrients → more growth
    - Indirect effects:
        - more nutrients → more shading → less growth
2) Water levels
    - Sloughing during storms
    - Affect light level
3) Invasive mussels
    - Light level
    - “Benthification” Transfer of nutrients from water column to benthos
    - Recycling of nutrients

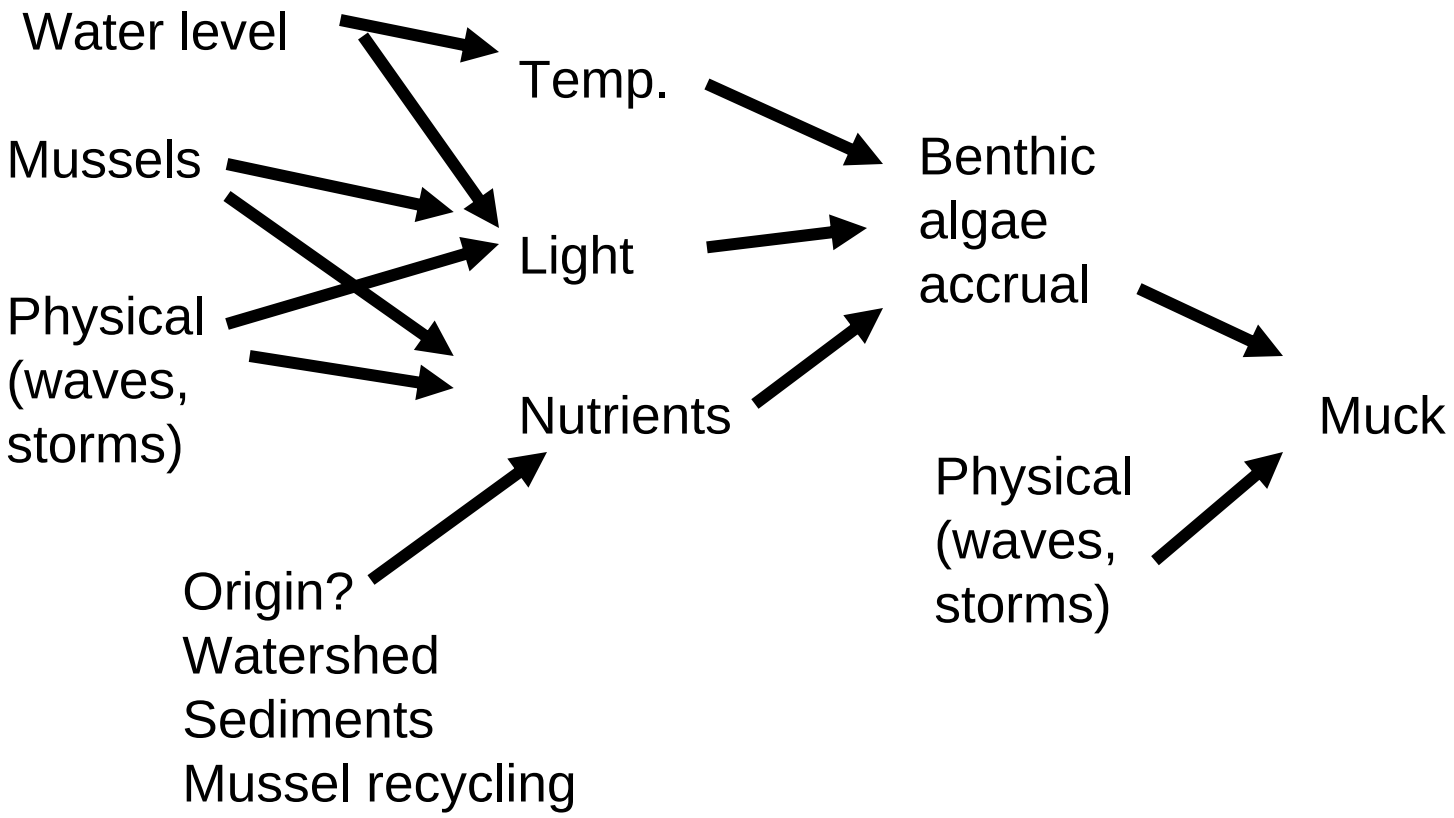
What affects muck levels?

We have little quantitative understanding of relationship between different factors and benthic algae that causes muck.



Yet understanding such relationship is key to addressing the relationship between e.g. nutrient levels and muck levels.

What affects muck levels?



Muck models

This summer's goals:

Collect parameters and data needed for models that describe and predict muck levels

Two types of models:

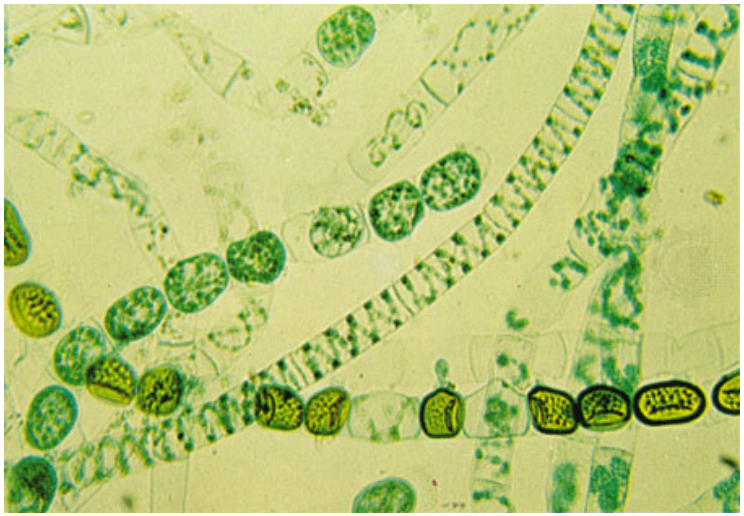
Process based.

Explicitly model how benthic algae grows, and sloughs.

Phenomenological:

Correlative models between muck and environmental variables.

Model Description



Algae growth
and sloughing

Muck models

Challenge:

Models of Benthic filamentous algae rare.
Because it's hard!

Advantage:

Muck is a problem throughout Great Lakes
One of best filamentous algae models is in the Great Lakes.

Challenge:

Filamentous algae in Saginaw Bay likely a different species.
Spirogyra rather than *Cladophora*
Therefore previous work less appliable

Muck models

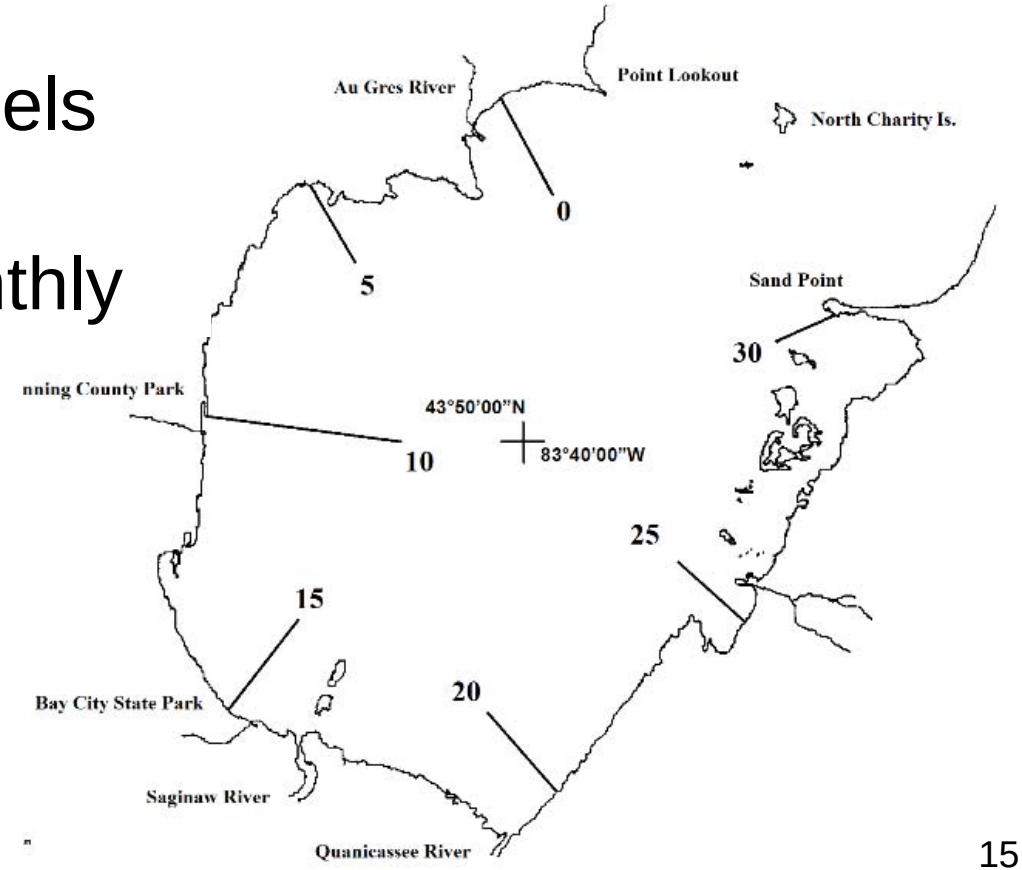
- Information we need:
  - Benthic algae and muck composition
  - Spatial and temporal distribution of benthic algae and muck
  - Factors affecting benthic algae and subsequent muck production
    - Benthic algae growth rates
    - Sloughing
    - Transport
    - Deposition

Field Measurements of Benthic Algae

Where:

- ~7 Bay Transects
- Areas with key environmental factors
    - W/ and w/out mussels
    - Different sediment

Frequency: Weekly – Monthly



Field Measurements of Benthic Algae

Will Measure:

Relationship between benthic algae and environmental variables

Algal charecterization:

– algal biomass, algal composition

– algal growth parameters: internal phosphorous, PAM flourometry to measure light and nutrient limitation.

Water charecterization:

– Depth, nutrients, temperature, light level, pH, O_2,

Substate charecterization:

– Sediment type

– mussel abbundance

Field Measurements of Benthic Algae

Muck quantification near and on beaches

Survey beaches around bay

- Weekly basis
- Before and after storms

Citizen surveys

Flyovers

- Arial photos

Field Measurements of Muck

- Natural stable & radioactive isotope tracers
- Identify the sources of nutrients in the muck:
  - Mussel recycling
  - Sediment
  - Watershed
    - Manure
    - Fertilizers
    - Groundwater
- Measure stable and radioactive isotopes in samples of muck and benthic algae
- Stable & radioactive isotopes used:
  - Oxygen ($\delta^{18}O$), Nitrogen ($\delta^{15}N_{org}$, $\delta^{15}N_{NO3}$) & Carbon ($\delta^{13}C_{org}$)
  - ^{238}U, ^{234}U, ^{137}Cs, ^{7}Be, ^{210}Pb, ^{226}Ra and ^{228}Ra

Laboratory Experiments

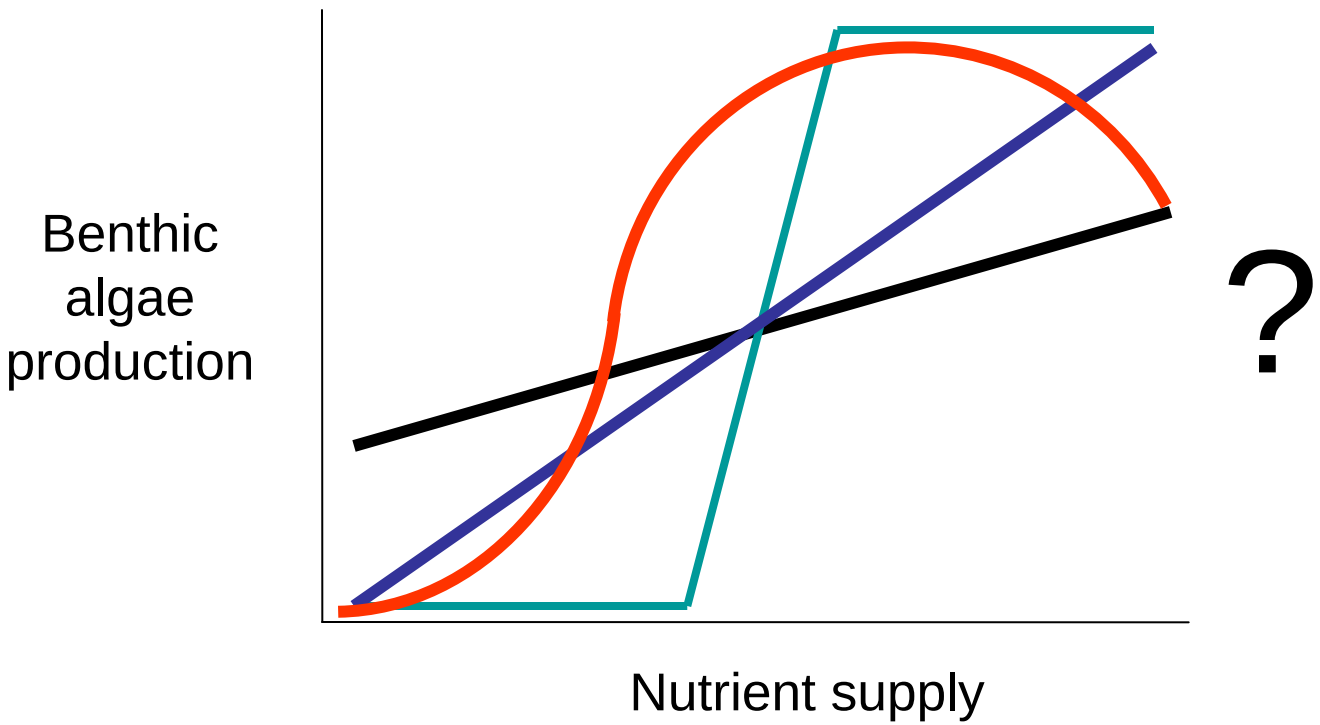
<u>Laboratory Experiments</u>

Growth rate experiments: small vials in incubators.

Parameterize algal growth as a function of

- Light
- Temperature
- Phosphorus

Models



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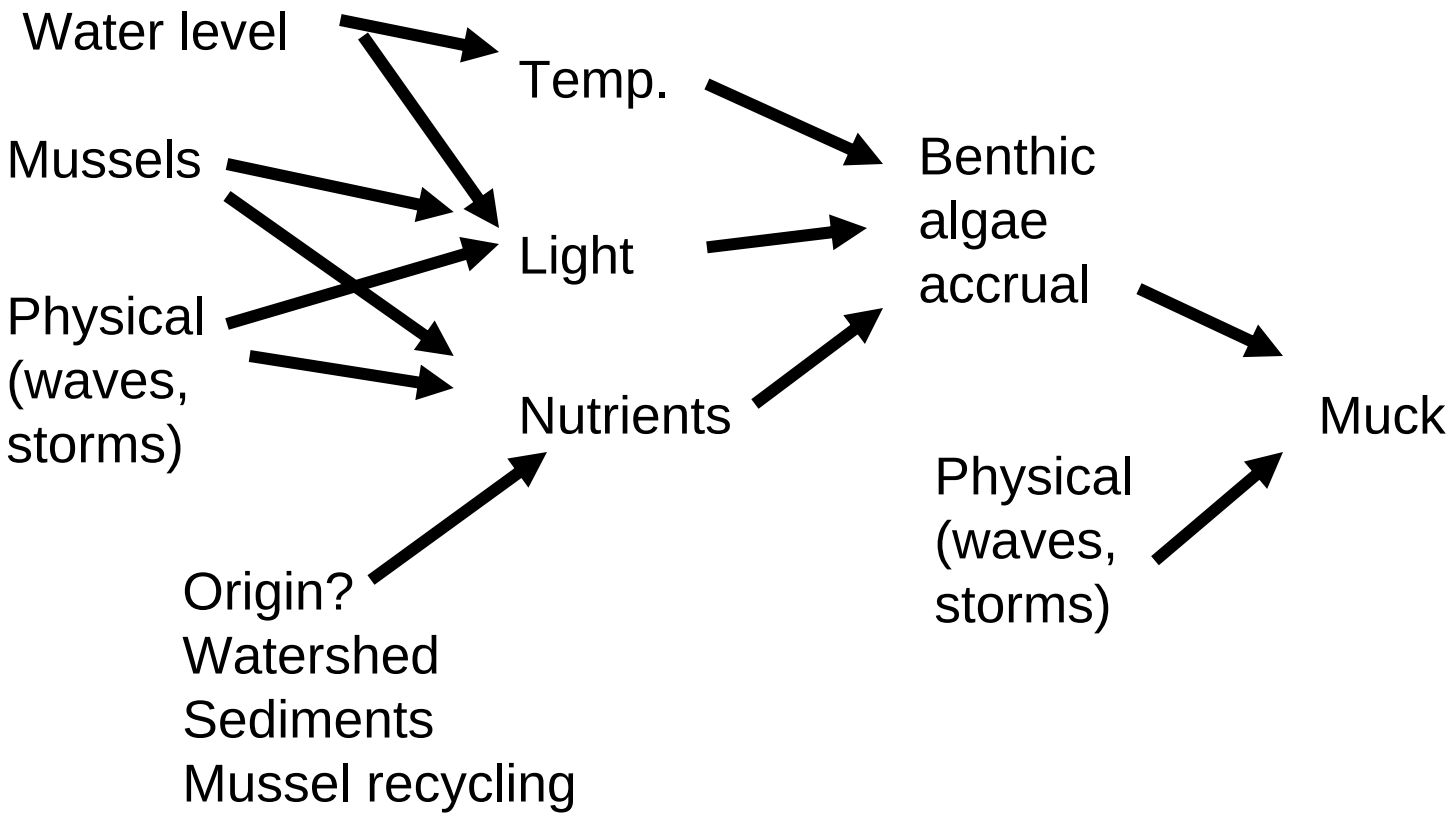

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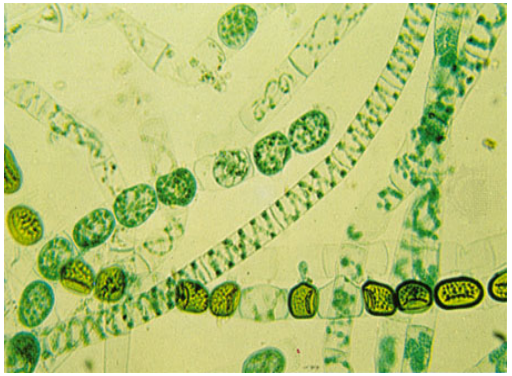

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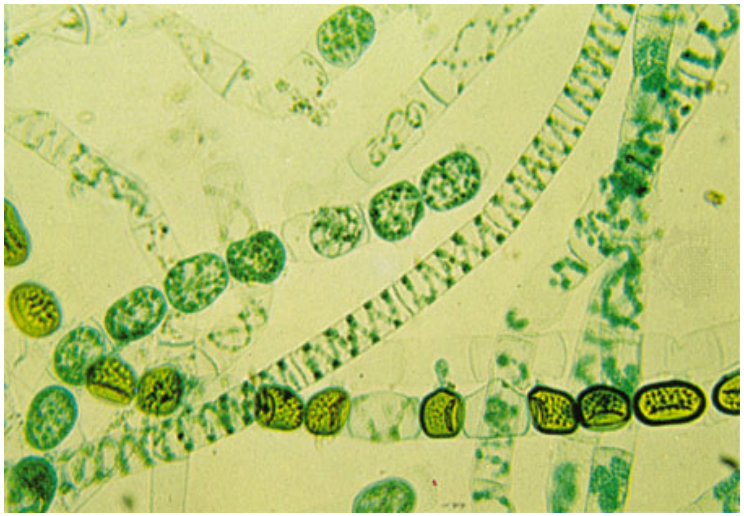

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