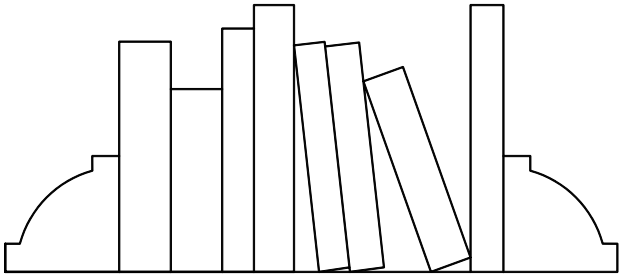
Environmental Science 101 *Fall 2012*

Water

Lecture Outline:

16. SURFACE WATER POLLUTION
    - A. Two Kinds of Aquatic Plants
    - B. Upsetting the Balance by Nutrient Enrichment
    - C. Idaho Examples
    - D. Sources of Nutrients
    - E. Controlling Nutrients and Sediments
    - F. Fresh Water Pollution
    - G. Salt Water Pollution
    - H. Water Quality Measurements



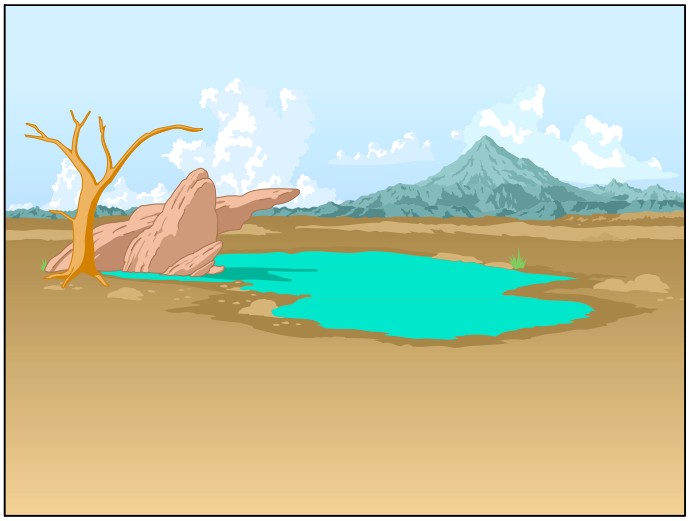
Learning Objectives:

When you are finished with this unit you should be able to:

1. Describe two categories of aquatic plants and contrast how the balance between them is altered by the nutrient content of the water.
2. Describe the process of eutrophication.
3. Describe the Chesapeake Bay story.
4. Contrast methods of eutrophication control.
5. Identify the major sources of sediment and discuss control strategies for each source.
6. Identify the major sources of nutrients leading to eutrophication and discuss control strategies for each source.

Terms You Should Know:

- Pollution, Pollutants
- BMPs
- Eutrophication
- Chesapeake Bay
- Turbid
- Benthic plants
- Phytoplankton
- Submerged aquatic vegetation (SAV)
- Emergent vegetation
- Oligotrophic
- Eutrophic
- Biochemical Oxygen Demand (BOD)
- Cultural eutrophication
- Aeration
- Sediments
- Euphotic zone
- Advanced sewage treatment
- Sediment trap



Reading Assignment:

Brennan and Withgott:
Chapter 15; pages 420-430.

16. SURFACE WATER POLLUTION

THE PROCESS OF EUTROPHICATION

EUTROPHICATION—process whereby a body of water becomes nutrient rich, supporting abundant growth of algae and/or other aquatic plants at the surface. Deep water becomes oxygen depleted.

- Natural process that takes place over thousands of years
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A. Two Kinds of Aquatic Plants

Two distinct life forms of aquatic plants:

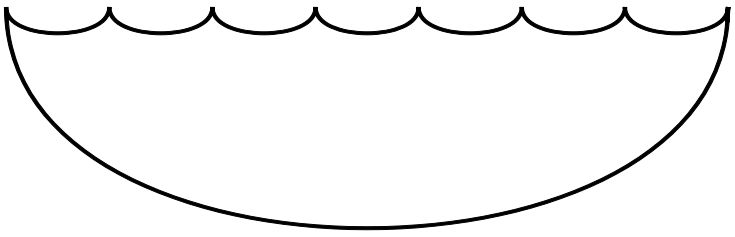
1.

2.

1. BENTHIC PLANTS:

-

- Can be submerged (SAV) or emerged vegetation:



- These plants thrive in nutrient poor water
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- SAVs need clear water for enough light for photosynthesis
- The depth to which adequate light can penetrate is called the ***EUPHOTIC ZONE***
  - in clear water:
  - in murky water:

2. PHYTOPLANKTON:

- Numerous species of algae; microscopic cells or threads
-
- Tolerate turbid water; actually cause turbidity
-

- Pea green water; scum
- Reach high densities in nutrient-rich waters
-

B. Upsetting the Balance by Nutrient Enrichment

a. Oligotrophic Conditions

-
- Most ecosystems untouched by man
  -
  - benthic plants thrive to great depth (30 to 60 feet)
  - benthic plants aid in maintaining dissolved O_2 in deep water
- Nutrient poor but O_2 rich from top to bottom

-

b. Eutrophic Conditions

-
- Nutrient enrichment:
  - rapid growth and multiplication of phytoplankton
  -
- Turbidity shades out benthic plants
  -
  -
- Sediments also create turbidity
-
-

The cycle:

  - phytoplankton rapidly multiply
  -
  -
  - decomposers consume O_2 to break down dead materials
  -
  -

- Organic matter additions to water will deplete O_2
  -
  -
  -

- Measure health of system:

  BOD — biological oxygen demand

  BOD to measure what O_2 is demanded to break substances down

  if BOD > dissolved O_2 in water

c. Natural vs Cultural Eutrophication

- Oligotrophic lakes get occasional bursts of phytoplankton growth — algal blooms
  - happens over 1,000s of years
  -
- If humans speed up the process, called ***CULTURAL EUTROPHICATION***

EXAMPLE: Lake Erie

d. Combatting Eutrophication

2 approaches:

1.

2.

1. Attacking the symptoms:

- Chemical treatments:
  - herbicides to suppress the growth of unwanted plants
- Aeration:
  - mechanical aeration to add O_2 and reduce fishkills
  -

- Harvesting algae:
  –
  – feasible only in small water bodies

Controlling inputs:

- Decrease the inputs of nutrients
-

e. Chesapeake Bay

- North America's largest estuary
- Prior to 1970 it was North America's most productive estuary
  – 1970s seagrasses in the major rivers began to die; dramatic by 1975
  –
- Populations of organisms which depended on seagrasses declined
  –
  –
  –
- Bottom waters in deep areas of the bay became depleted of O_2
  –

Why did this happen?

TURBIDITY (murky or cloudy water)

  – cut off light required for photosynthesis → seagrass died
  –

- Bay fell victim to EUTROPHICATION

C. Idaho Examples

- Middle Snake

Problems: algal blooms

–

–

- Lake Coeur d'Alene

Problems starting to occur

Enrichment from:

– sediments from cropland

–

– sediments from forest land

– sediments from construction sites along shore

–

–

– lawns along the shore — nutrients

–

CONTROLLING EUTROPHICATION

- First:

- Second, develop a control strategy for each source

D. Sources of Nutrients

Agriculture:

-

- Leaching of fertilizers applied to crops
-

Urban:

-

- Leaching of fertilizers applied to lawns and gardens (compost)
-

Sewage Effluents:

- Discharge from centralized sewage treatment plants
-

-

E. Controlling Nutrients and Sediments

What to do is obvious!!!

a. BMPs on farms, lawns, and gardens
   - keep ground covered
   - prevent erosion

b. Sediment Control on Construction and Mining Sites
   -
   -

c. Preservation of Wetlands

d. Banning Phosphate Detergents
   - Idaho — ban in northern Idaho

e. Advanced Sewage Treatment
   -

F. Fresh Water Pollution

Types of pollutants

1. Nutrients —
   - ✓
   - ✓
2. Pathogens / Diseases
   - ✓ makes water unsafe for swimming
   - ✓
3. Toxic Chemicals
   - ✓
   - ✓
   - ✓
4. Sediments
   - ✓
   - ✓ mining, forestry, agriculture
5. Thermal Pollution
   - ✓
   - ✓

G. Salt Water Pollution

Nutrient Pollution = HYPOXIA

-

- Caused by nutrient pollution (eutrophication)
-

-

- Nutrients exit farmland and flow down Mississippi River
-

H. Water Quality Measurements

1. Biological Measurements
   - ✓ presence of fecal coliforms
   - ✓
   - ✓
   - ✓

2. Chemical Measurements
   - ✓
   - ✓
   - ✓ dissolved oxygen content
3. Physical Measurements
   - ✓
   - ✓
   - ✓