Eutrophication

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Eutrophication

- **Definition**
  - The increase in organic matter leading to the overenrichment of a system

- **Organic Matter created by primary producers**
  - Phytoplankton or Algae
  - Feed on CO$_2$, Sunlight, and
  - **Nutrients**, the limiting factor
Major Eutrophication Locations

- **Gulf of Mexico**
  - Second Largest Hypoxic Zone (no Oxygen) in the World
  - Low Oxygen Concentrations extend over 7,000 square miles
  - 25% of the US Commercial Fishing Industry

- **65% of United States Estuaries**
Other Major Locations

- Black Sea
- Baltic Sea
- Chesapeake Bay
- Long Island Sound
Primary Nutrients

- **Nitrogen and Phosphorus**
  - **Major Sources vary by Location**
    - **Long Island Sound**
      - 60% of nitrogen load from wastewater of NYC
    - **Chesapeake Bay**
      - 25% of N and P loads from point sources
    - **Mississippi River**
      - 10% of N and 40% P form point sources
Non Point Sources

- Erosion of soil
  - Major phosphorus additions

- Agricultural Runoff
  - Manures and fertilizers

- Atmospheric Deposition
  - Fossil Fuel Combustion
Aquatic Interaction

- Phytoplankton Nutrient Consumption

- Phytoplankton Community Change
  - Dinofagellate
  - Cyanobacteria

- Unconsumed Phytoplankton
  - Fall to Bottom Waters
Aquatic Interactions

- Microbes Breakdown
  Phytoplankton
  - Use Oxygen during Process
Aquatic Interactions

- Massive Algae Blooms
  - Block Light to Plants Below
    - Habitat for Smaller Species is Destroyed
Aquatic Interactions
Major Physical Parameter

- Discharge Rate
  - Residence Time
    - Oxygen Replenishment
    - Break Stratification
Interactions Result

- Oxygen Depletion by Microbes
- Blooms Blocking Light

- No Food or Oxygen
  - Mobile Organisms Move
  - Stationary Organisms Die
HAB

- **Harmful Algae Blooms**
  - Unconsumed Blooms
  - Toxic Blooms

  - Can Cause Death to
    - Fish
    - Sea Birds
    - Aquatic Mammals

  Also Death or Illness to Humans
Effects of Eutrophication

External Nutrient Inputs and Susceptibility

Nitrogen and Phosphorus

Influence of Physical and Biological Processes (i.e. freshwater inflow, flushing, wetlands uptake, filter feeders)

Primary Symptoms

Decreased Light Availability

Algal Dominance Changes

Secondary Symptoms

Loss of Submerged Aquatic Vegetation

Nuisance/Toxic Algal Blooms

Potential Effects and Use Impairments

Loss of Habitat

Commercial Fishing
Recreational Fishing
Tourism

Increase of Algal Toxins

Commercial Fishing
Recreational Fishing
Human Health Problems
Swimming
Tourism

Fish Kills

Commercial Fishing
Recreational Fishing
Aesthetic Values
Tourism

Loss of Habitat

Commercial Fishing
Recreational Fishing
Tourism

Offensive Odors

Aesthetic Values
Tourism
References

Questions?