Water Quality: Measurement and Interpretation

Session II – Nitrogen

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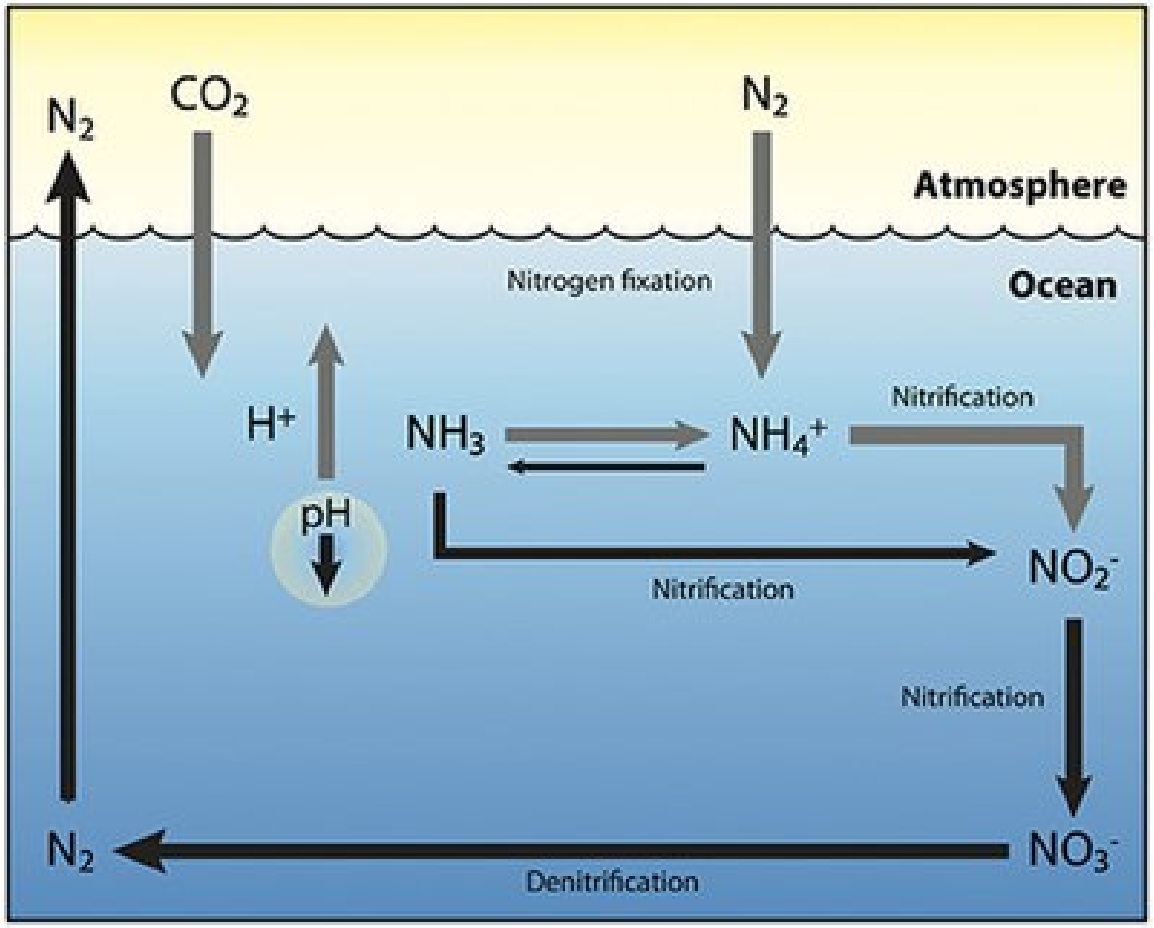
BOP Workshop, November 16, 2021


CT 7973
MARINE SCIENCES
UCONN
Johnson


STARCRAFT

Learning Objectives

1. Explain the importance and impact of nitrogen and know the NY State standards
2. Describe some basic methods for measuring nitrogen (ammonia and nitrate) and the strengths and weaknesses of each
3. Explain the factors that control dissolved oxygen concentration
4. Interpret spatial and temporal patterns of nitrogen concentrations in water around New York City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Ocean
Nitrogen fixation
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NH_3
NH_4^+
Nitrification
NO_2^-
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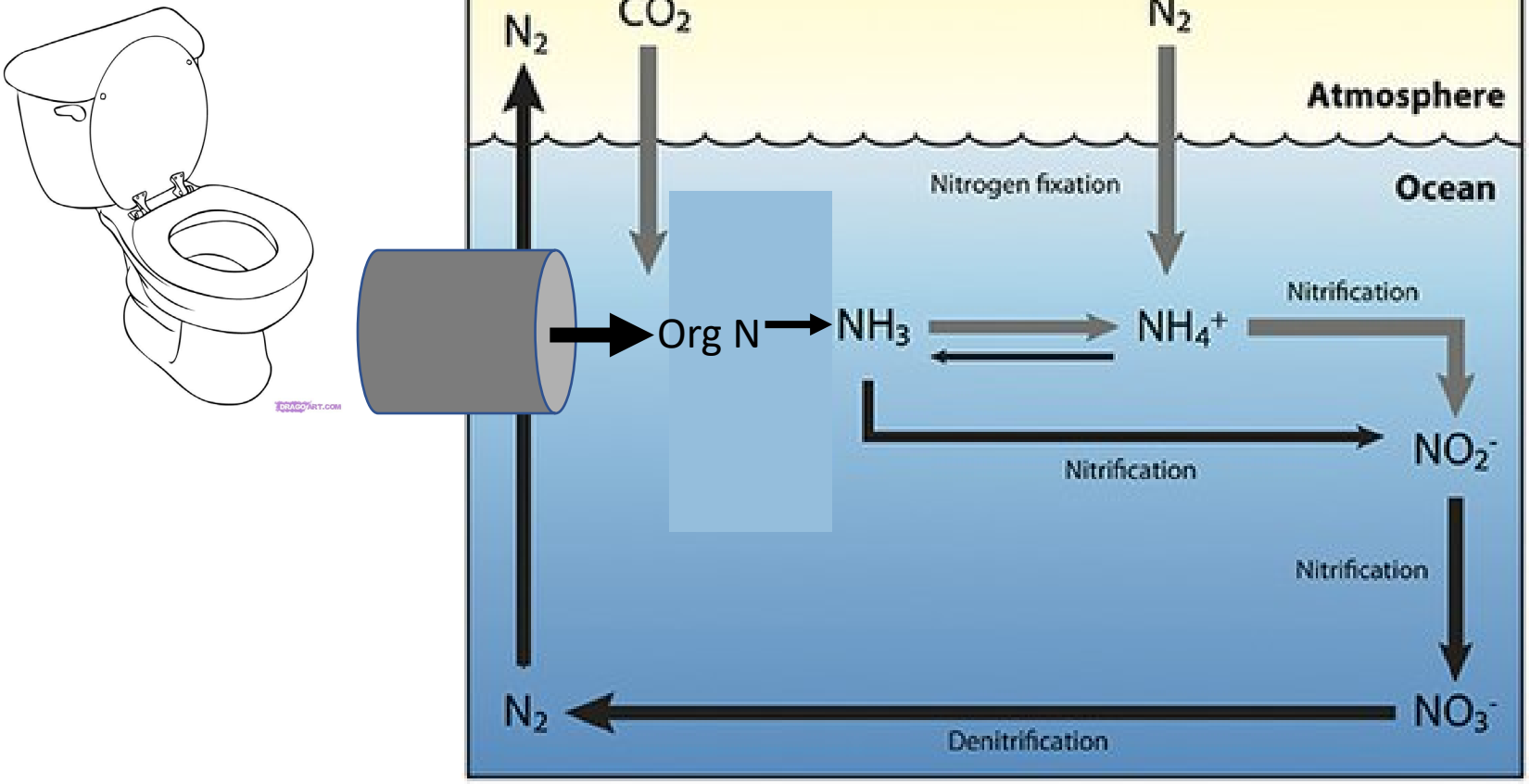
N_2
NO_3^-
Denitrification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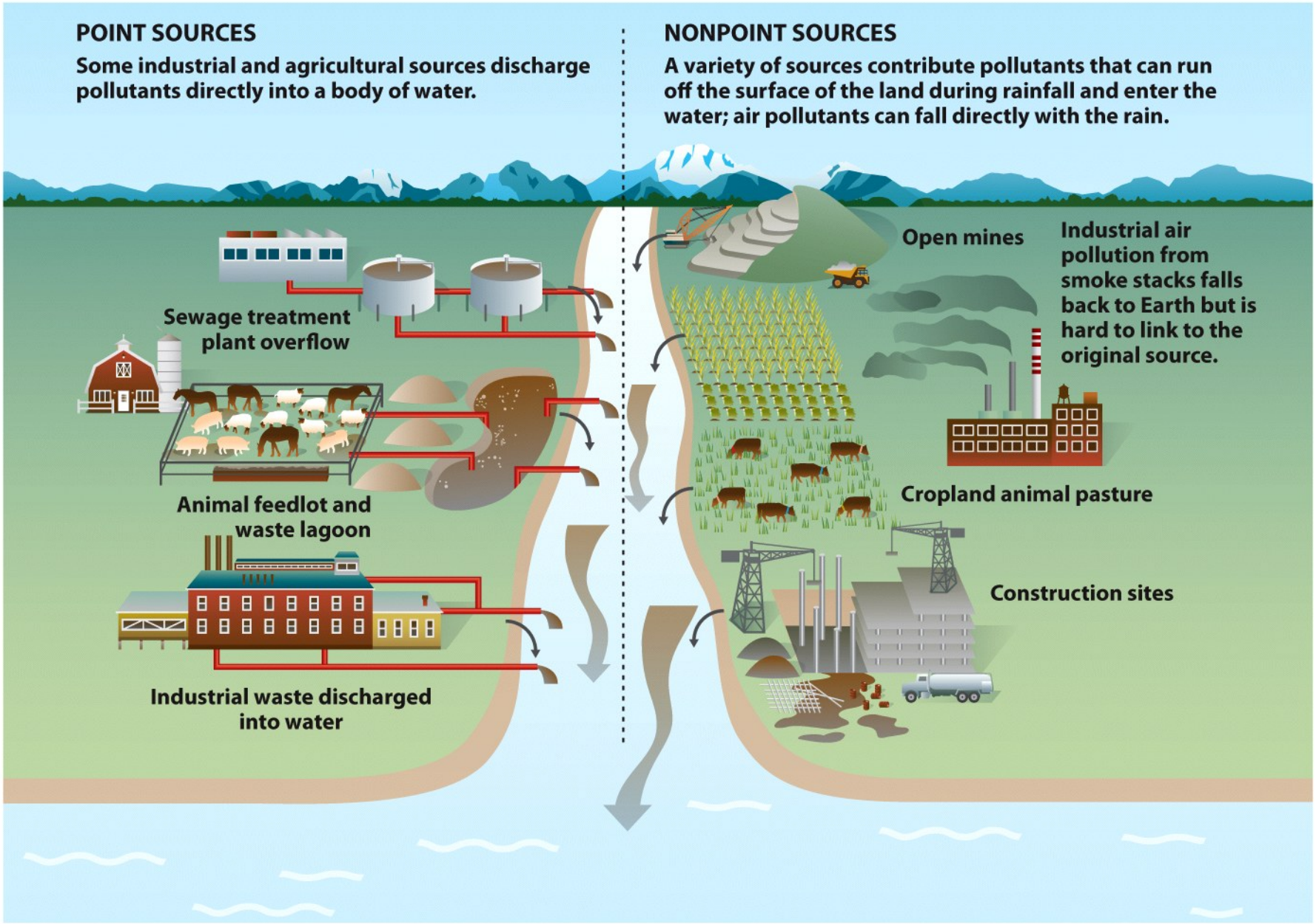
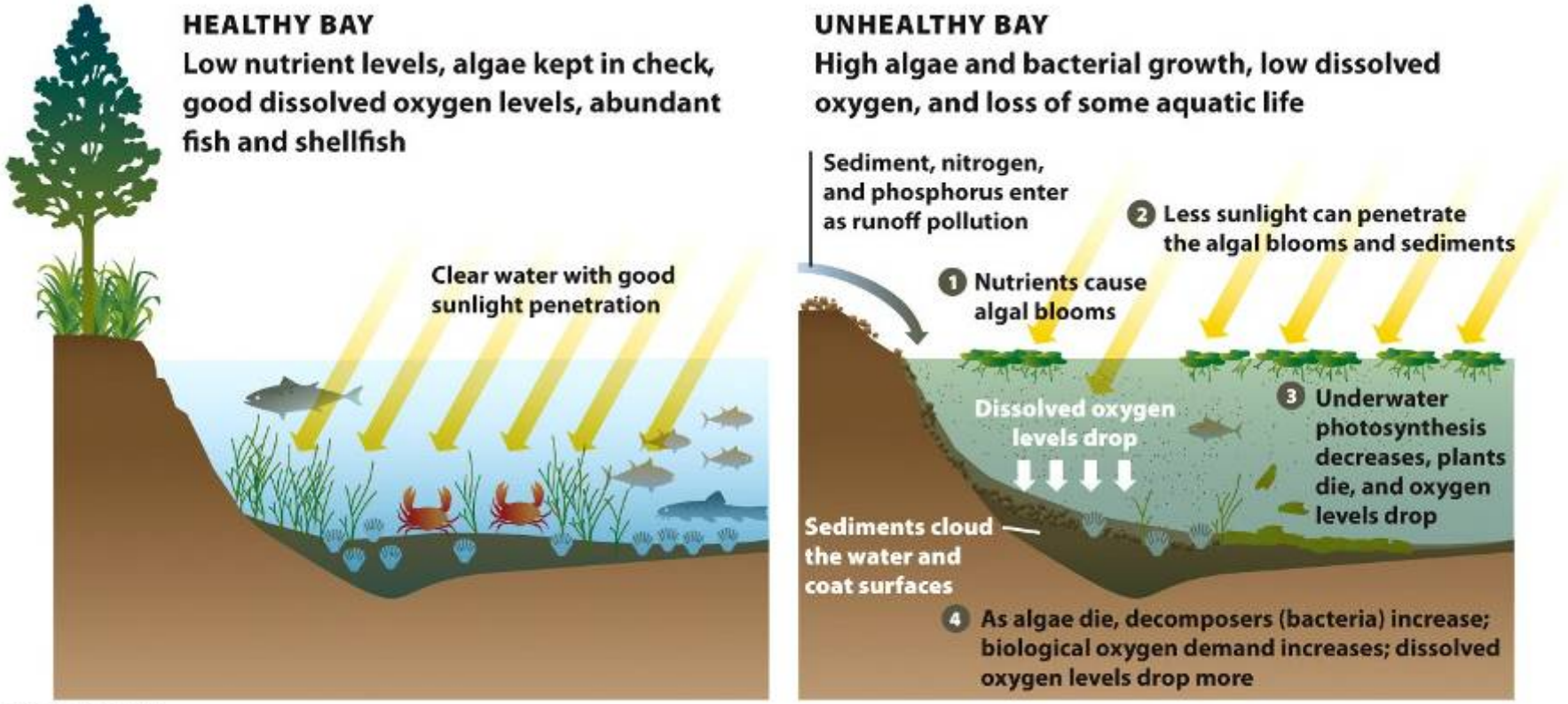
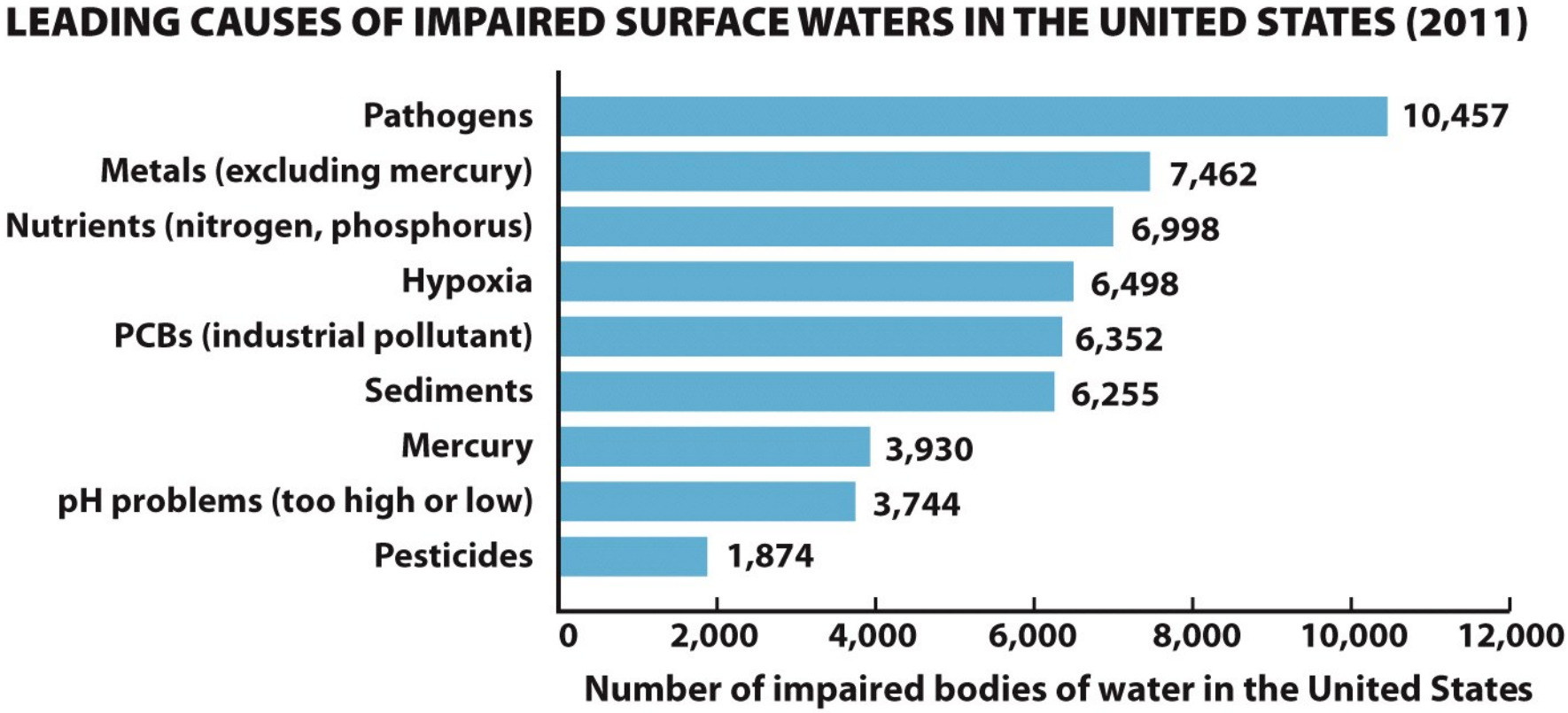


Infographic 16.2 part 1

Environmental Science for a Changing World



Infographic 16.1
Environmental Science for a Changing World



Infographic 16.2 part 2

Environmental Science for a Changing World

Definitions

NY State Standards

Nutrients are regulated in New York State Waters by a **narrative** water quality standard rather than a numeric standard. A numeric standard provides a specific numeric threshold (e.g., mercury not more than 0.0007 ug/L), and a narrative standard lays out a descriptive condition that needs to be met. The narrative standard for nitrogen is: *None in amounts that result in the growths of algae, weeds and slimes that will impair the waters for their best usages*.

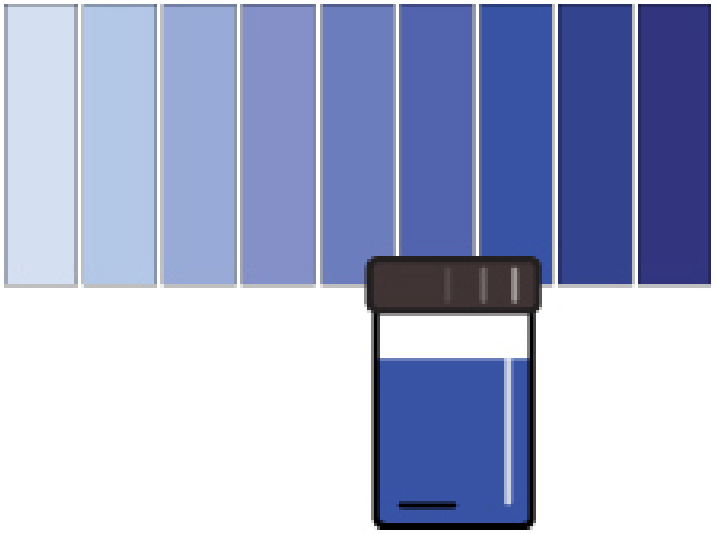
How do we measure nitrogen?

Ion Selective Electrodes

Absorbance of UV radiation

Colorimetric Method (Visual readings using a comparator)

Sample comparison against a comparator such as a color wheel or color block is quick and inexpensive. However, as the human eye is not objective, this can result in some inaccuracy.



Comparator

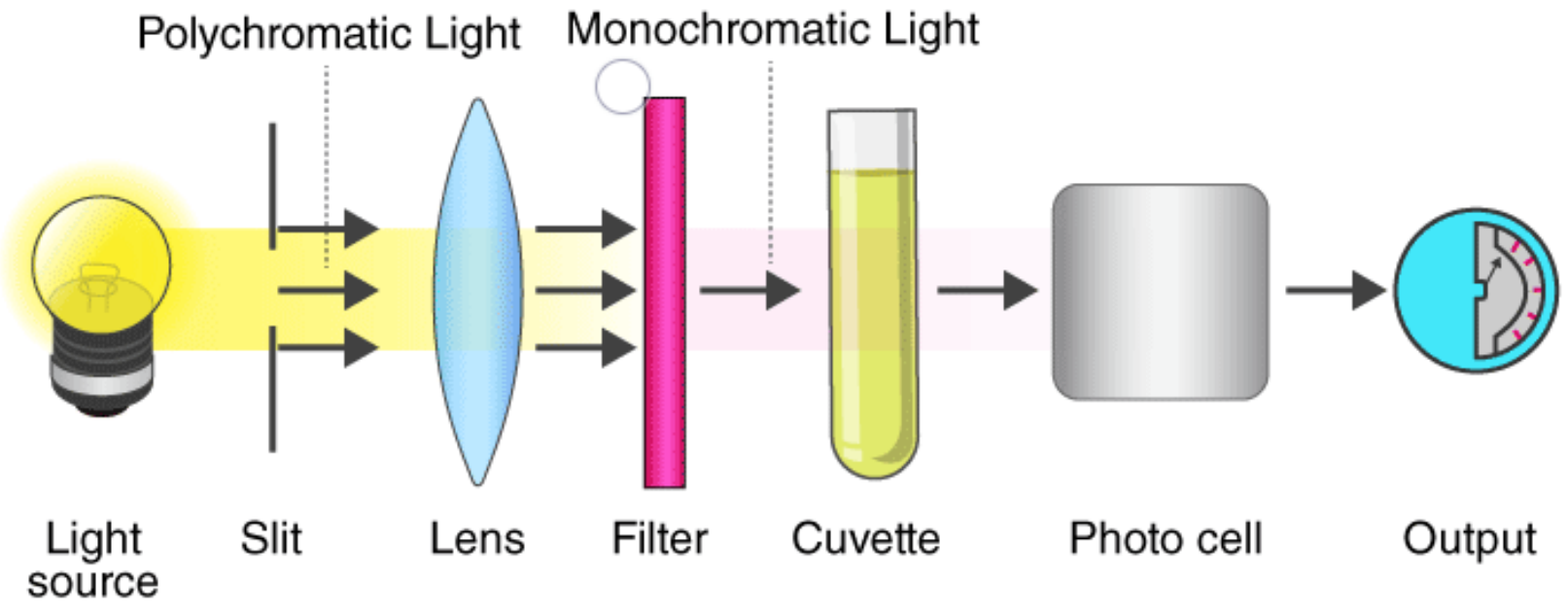
Strengths

Easy and quick to perform and economical.

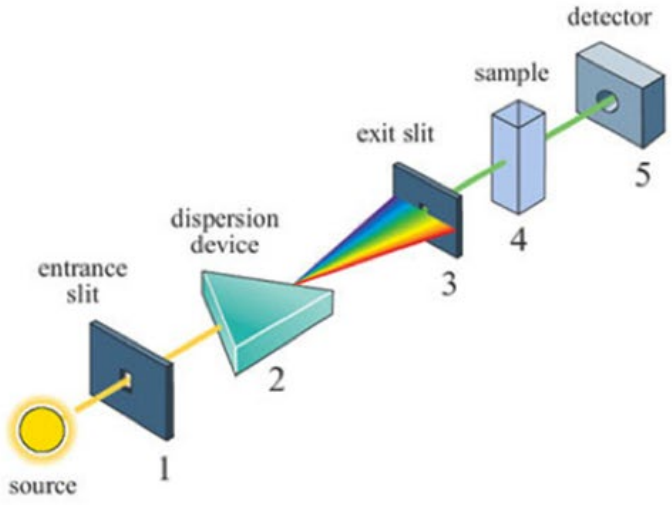
Weaknesses

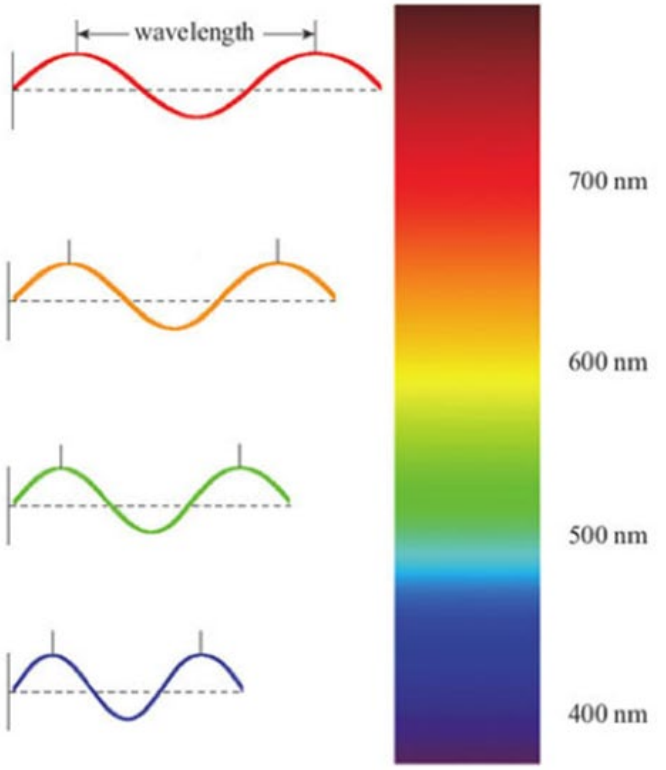
However, visual measurements of color are subjective. Everyone's eyes are different. Colors might look different when there is different lighting.

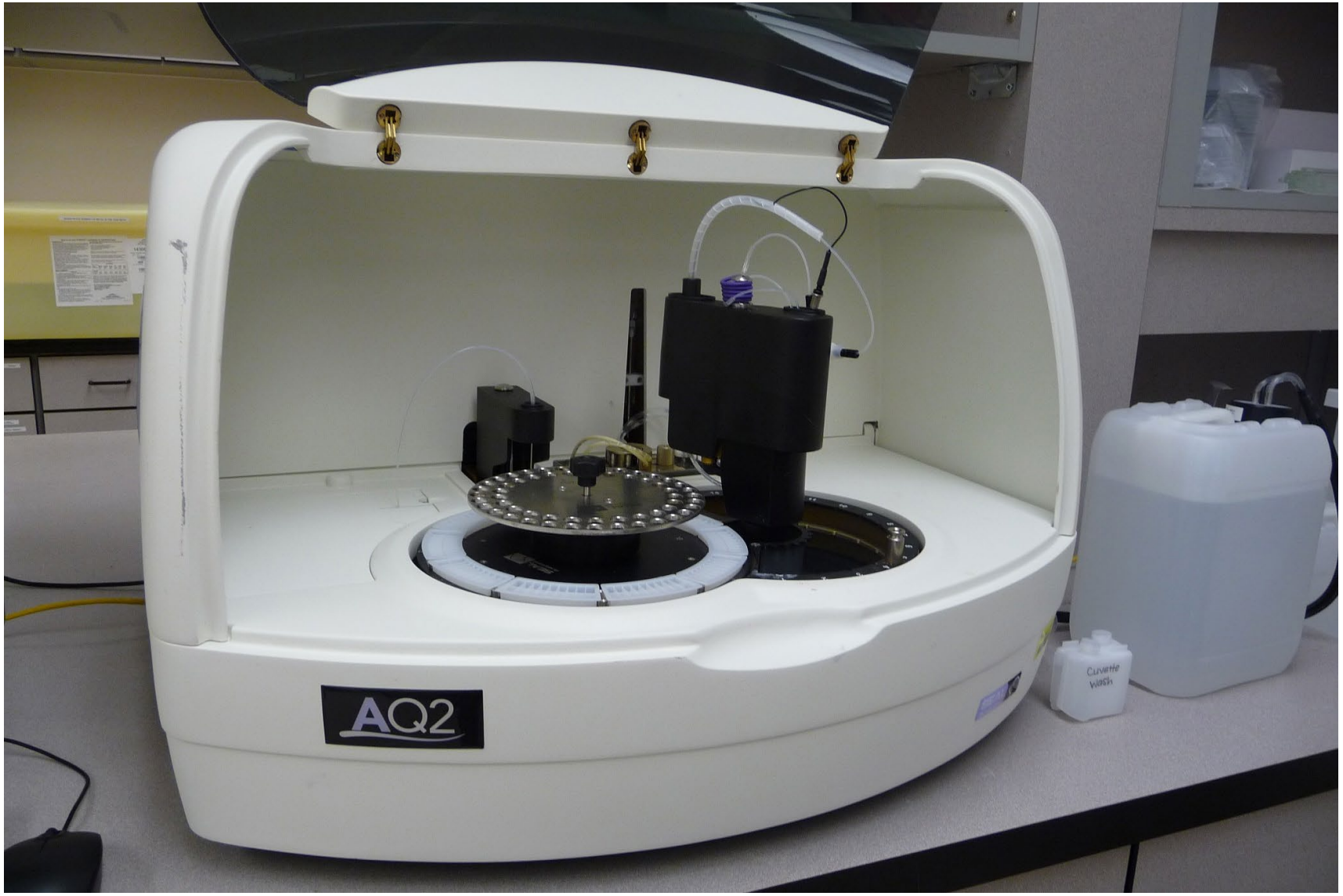
Filter Photometer



Filter Photometer






AQ2
Cuvette
Wash


AutoAnalyzer 3
High Resolution Digital Colorimeter
SEAL
BRAN+LUEBBE
AutoAnalyzer 3
SEAL
BRAN+LUEBBE

Colorimeter

Strengths

The detectors in colorimeters are very sensitive and can detect very small differences in color. These measurements do not depend on the eyes of the person making the measurement.

Weaknesses

More expensive equipment

- Specific test methods for Ammonia and Nitrate.

Ammonia/Ammonium-Salicylate Method

Ammonia reacts with salicylate and hypochlorite ions in the presence of ferricyanide ions to form the salicylic acid analog of indophenol blue. The resulting color is directly proportional to the concentration of ammonia present. Ammonia levels are then determined using a color comparator or colorimeter.

Nitrate- Cadmium Reduction Method

- The cadmium reduction method is a colorimetric method that involves contact of the nitrate in the sample with cadmium particles, which cause nitrates to be converted to nitrites. The nitrites then react with another reagent to form a red color whose intensity is proportional to the original amount of nitrate.

Testing Water for Nitrate - YouTube

Not Used in Training Session

Resources

- https://lamotte.com/smart-3-colorimeter-1910
- https://us.vwr.com/store/product/25649937/dr300-pocket-colorimeters-hach

- **WHAT ARE NUTRIENTS?**
- elements found in the food that plants and animals need to grow and survive. Although there are many kinds of nutrients, one of the most important and abundant is Nitrogen. Nitrogen occurs in a variety of forms (ammonia/ammonium, nitrite, nitrate), and these forms can change as they move between the air, water, and soil.
- **AMMONIA (NH_3) and AMMONIUM (NH_4^+)** are among the primary forms of nitrogen in natural waters. Ammonia can be toxic to fish. It is also soluble in water and relatively unstable in most environments. Ammonia is easily transformed into nitrate (NO_3^-) in waters that contain sufficient dissolved oxygen or into nitrogen gas in waters that have no dissolved oxygen.
- **NITRATE (NO_3^-)** is another primary form of nitrogen in lakes and streams. Nitrate is very soluble in water and is stable over a wide range of environmental conditions. It is readily transported in groundwater and streams. An excessive amount of nitrate in drinking water can cause health problems.

Where does the Nitrogen come from?

Point and nonpoint sources of nutrient enrichment and eutrophication to streams, lakes, and estuaries include:

- Agricultural activities that result in animal waste and sediments washing into waterbodies
- Urban runoff from impervious surfaces (parking lots, lawns, rooftops, roads)
- Inadequate onsite septic system
- Municipal wastewater treatment plant discharges
- Atmospheric deposition

Impact of excess Nitrogen

- High levels of nitrogen in waters can produce nuisance algal blooms and increase aquatic weed growth.

Excessive algal and weed growth reduces:

- water clarity
- oxygen in the water and can produce "dead zones" where dissolved oxygen levels drop so low that aquatic life cannot survive (fish kills)

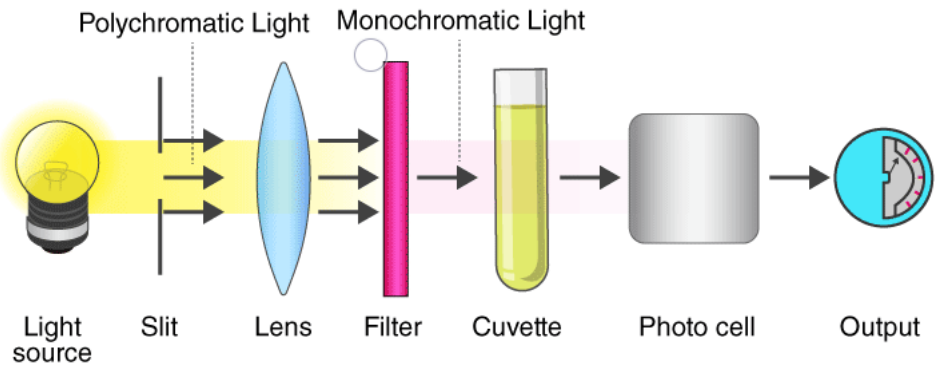
How do we measure nitrogen?

We most often use a method called colorimetry

Colorimetry is the use of colored compounds to determine the concentration of a target chemical compound. It is one of the earliest and most reliable forms of water analysis and is used to test for a wide array of analytes. The target analyte causes the sample solution to change color proportionally to its concentration in the solution, and that change in color can be measured visually or instrumentally.

Colorimetric Method (Using a colorimeter)

Colorimeters, also known as filter photometers, are instruments that measure color intensity. When using these instruments, chemical reagents are mixed with the sample. If the target parameter is present, the solution will have a color, and its intensity will be proportional to the concentration of the parameter being tested.



Colorimetric Method (continued)

Light is passed through a colored filter then through a cuvette (test tube) containing the sample solution and then onto a photodetector. Filters are chosen so that light of a specific wavelength is selected. When the solution is colorless, all of the light passes through. With colored samples, light is absorbed, and that which passes through the sample is proportionately reduced.