

Water Quality Indicators



Units for Measuring Water Quality



PARTS PER MILLION


Most dissolved substances found in water are measured in parts per million (ppm) or even smaller amounts. This means that for every one million parts (units) of water there is a certain number of parts of the substance.

It is also expressed as milligrams per liter. There are 1000 milliliters in a liter and 1000 milligrams in a gram. For example, a dissolved oxygen reading of 8 ppm means there are 8 milligrams of oxygen for every 1000 milliliters of water.

$8/1000 \text{ gram} \div 1000 \text{ milliliters} =$

$8/1,000,000 \text{ (8 parts per million)}$

Concentrations of certain substances are also measured in parts per billion, parts per trillion and so on. These are very small amounts but certain substances can be harmful even at these very low concentrations.



Water Quality Indicators

We will now
take a look at
the water
quality
indicators.



ALKALINITY

Alkalinity refers to the water's ability to neutralize acids.

Alkalinity is produced by minerals such as limestone.



Limestone is a type of ocean sediment composed of calcium carbonate.

Limestone bedrock areas often have caves and sinkholes, known as Karst.

Water with low alkalinity is usually acidic.



Ammonia

Ammonia is produced by the decay of organic matter and animal waste.

Ammonia is toxic to most aquatic life, especially at high pH.

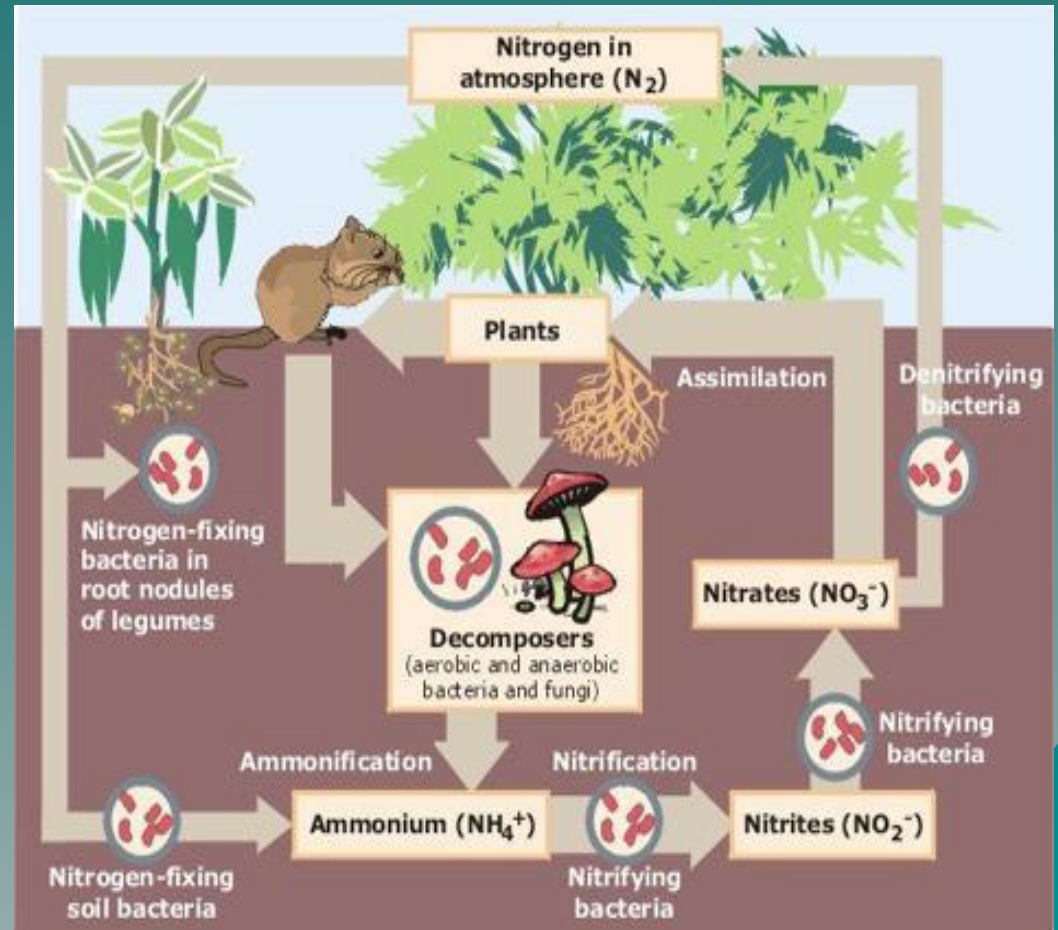
Bacteria readily convert ammonia to **nitrate**.

(a plant nutrient)



Ammonia

Ammonia is a form of nitrogen and part of the Nitrogen Cycle.



BACTERIA

Most bacteria are important in nutrient and other organic cycles.

Excess nutrients cause algal blooms. As algae die and decay, the high bacterial load rapidly consumes dissolved oxygen.



Certain types of bacteria indicate animal and human waste pollution.

***Escherichia coli* are coliform bacteria found in the intestines of warm-blooded organisms. Most strains are harmless but one *E. coli* strain can cause severe diarrhea and kidney damage.**

DISSOLVED OXYGEN

Dissolved oxygen is a product of photosynthesis and diffusion.



The warmer the water, the less oxygen it can hold.

DISSOLVED OXYGEN

Most organisms need at least 5 or 6 ppm of oxygen in order to survive.



Even cold water rarely contains more than 15 ppm. Summer is often a time of oxygen stress for aquatic organisms.

CONDUCTIVITY

Conductivity measures the water's ability to conduct an electrical current.

Pure water is a poor conductor.

CONDUCTIVITY

The addition of dissolved solids, especially salts, increases the conductivity of water.

Electrical current is measured using a conductivity meter.



HARDNESS

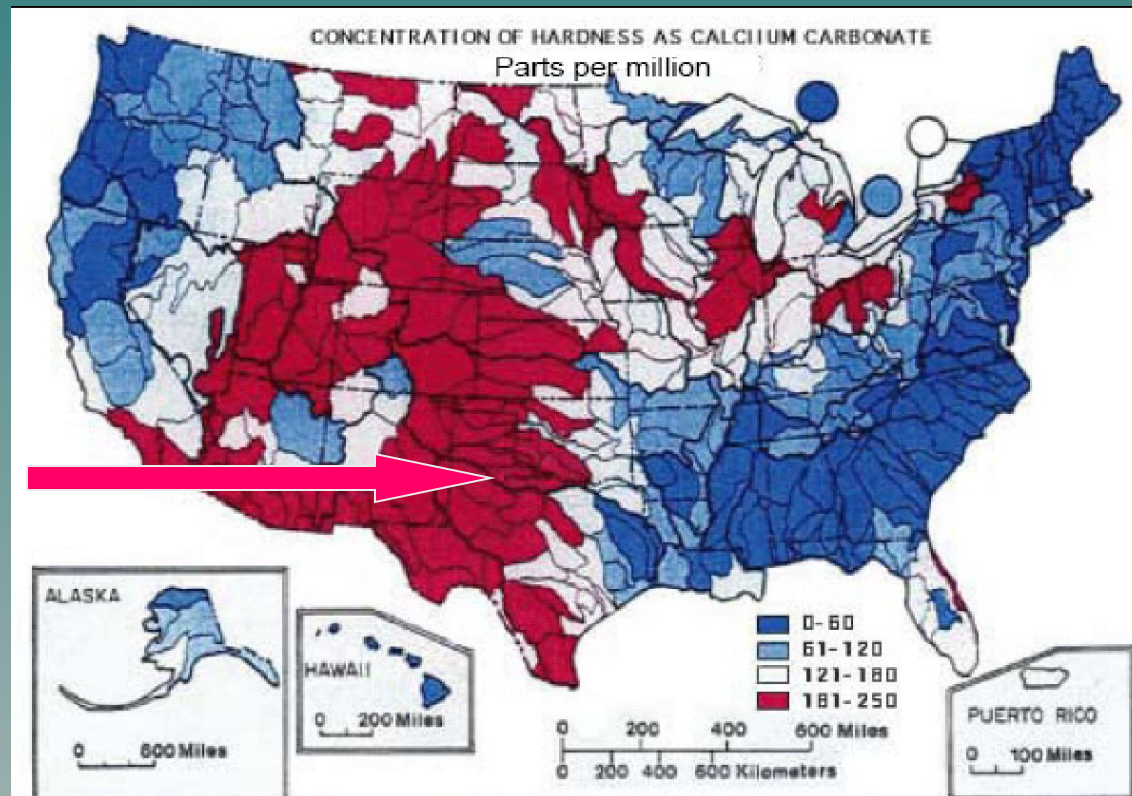
Hardness refers to the concentration of calcium and magnesium in water.

Hard water has high concentrations of these elements. Soft water has low concentrations.

Water hardness often originates from limestone.

HARDNESS

Area of the U.S. with limestone bedrock have hard water.



Hard
Water

NITRATE

Nitrate is a primary plant nutrient.

Nitrate is water soluble and moves easily from surface to groundwater.

Excess nitrate causes algal blooms that reduce water quality.



Under normal conditions, the nitrogen cycle keeps the amount of available nitrogen in balance with the demands. However, excessive use of fertilizers and nutrient rich sewage release have created a surplus of nitrate. The result is eutrophication from excess algae and bacteria with reduced dissolved oxygen.

PESTICIDES

These chemicals are very complex.

Effects on aquatic organisms – Moderately to highly toxic to mammals, mollusks, aquatic insects, amphibians and fish.



pH

pH is the measure of the hydrogen ion (H^+) concentration.

The pH scale is zero to 14. Seven is neutral, below seven is acidic, and above seven is basic (or alkaline).

Most aquatic organisms exist within a pH range of 5.5 to 9.5.

Carbon dioxide reacts with water to form a weak acid called carbonic acid.

The pH Scale



pH tolerance
for most
aquatic life

Phosphate

Phosphate's concentrations in clean water is generally low; however, phosphorus is used extensively in fertilizer and other chemicals.

Phosphate

The primary sources of phosphates to surface water are detergents, fertilizers, and natural mineral deposits.



Phosphate

High levels of phosphate can over stimulate the growth of aquatic plants and algae.

This in turn, will cause high DO consumption and death to fish and many aquatic organisms.

Sediment

Erosion causes
loose soil to
enter the
waterways



Sediment

Suspended sediment blocks sunlight to plants and reduces dissolved oxygen.

As sediments settle, they can smother bottom (benthic) organisms.

TEMPERATURE

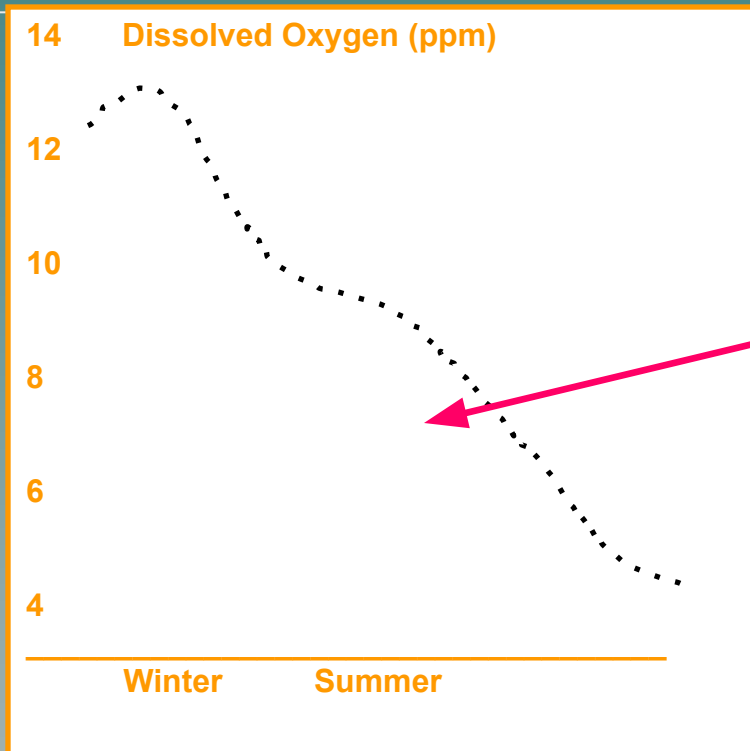
Temperature is measured in Fahrenheit and Celsius degrees.

Temperature can be measured using field thermometers but digital probes are much more accurate.

Most aquatic organisms live within a temperature range of +32° F (+0° C) to 90° F (32° C).

Rapid temperature change and temperature extremes can stress aquatic organisms.

Temperature affects the oxygen-carrying capacity of water.



As the water warms, the amount of dissolved oxygen decreases.

TOTAL DISSOLVED SOLIDS (TDS)

TDS is the measure of the material dissolved in water.

This measure is related to hardness, salinity and conductivity.

Hard water has more TDS than soft water.

TOTAL SUSPENDED SOLIDS (TSS)

TSS is the measure of the sediment suspended in the water.

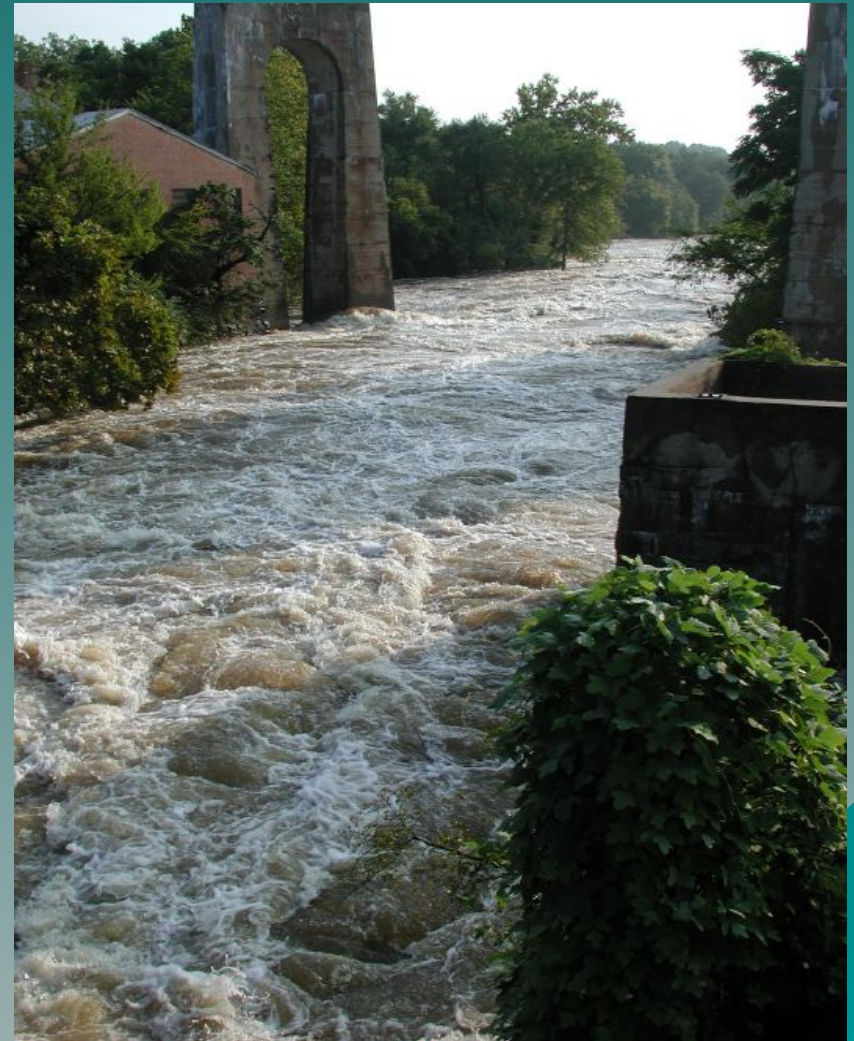
TSS is related to turbidity.

Water with high TSS usually has high Total Dissolved Solids (TDS) as well.

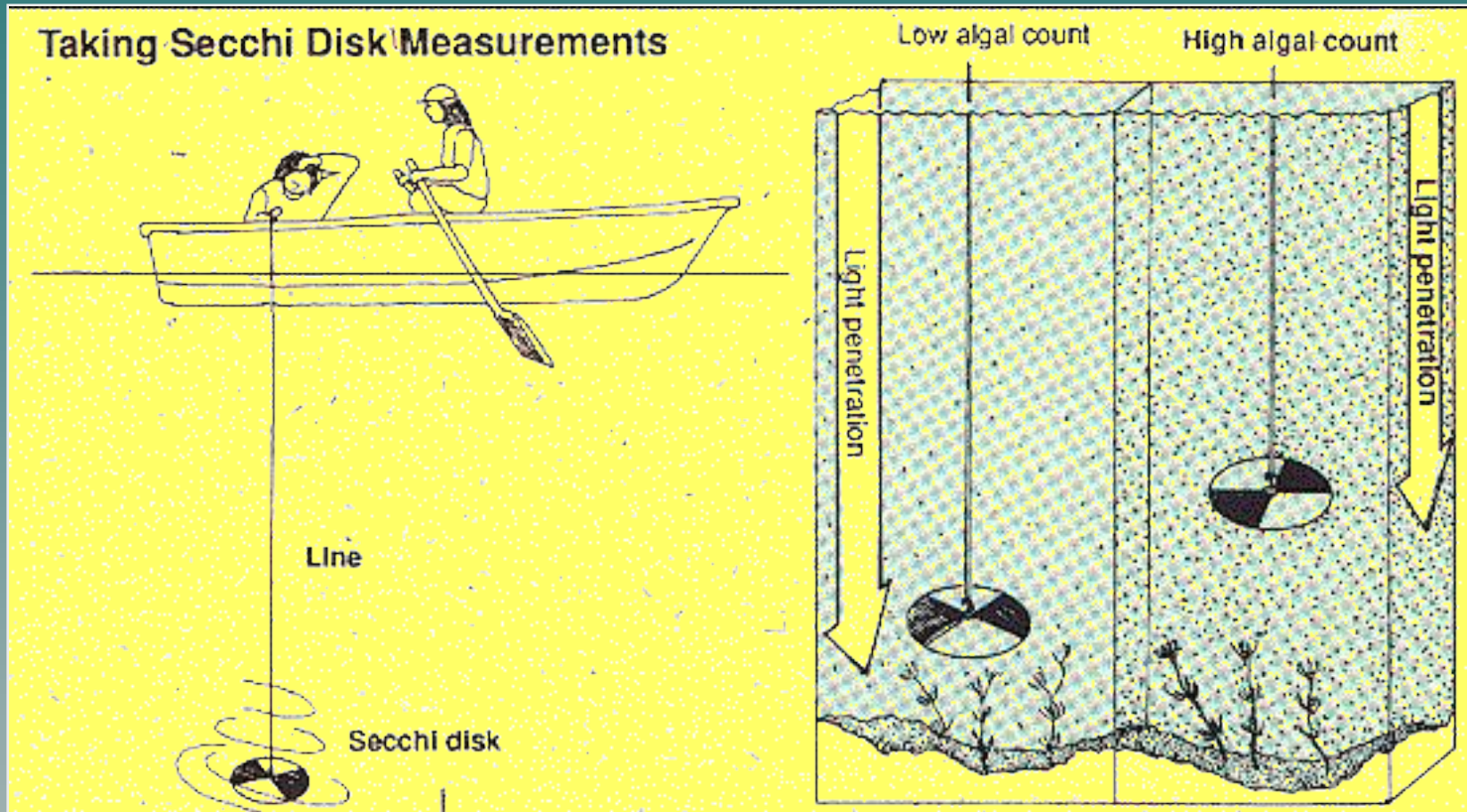
TURBIDITY

Turbidity refers to water clarity.

Sediments suspended in the water increase turbidity.



A secchi disk is one type of instrument used to measure turbidity.



TOXIC CHEMICALS

Toxic chemicals usually come from industry and energy production.

The effects are often not known until years after they have entered the environment.

Toxic chemicals include heavy metals (lead, mercury), organic compounds (DDT, PCB), inorganic substances (arsenic) and others.

