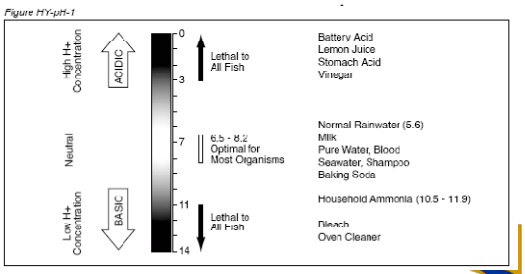
Temperature

- *Measured with a thermometer*
- *Units are °C*
- *Range is <0 to ? (in Phoenix?)*
- *Important because:*
  - *Temperature influences the amount and diversity of aquatic life*
  - *Helps us better understand other hydrology measurements like*
    - *Dissolved Oxygen (DO)*
    - *pH*
    - *Electrical Conductivity (EC)*
  - *Water temperature affects air temperature via evaporation & condensation*
  - *Possible indication of:*
    - *mixing of nutrient-rich waters*
    - *spawning*

pH

- ***pH is a measure of the acid content of water.***
- *Measured with a **pH meter** or pH paper*
- *Units are pH units – are a logarithmic scale of hydrogen ion concentration*
  - ***Small change in pH can mean a big change in water quality***



Transparency (Turbidity)

- *Transparency is a measure of how clear the water is*
- *Units are length, usually cm*
- *Range is 0 to >100 cm*
- *Measured with either a secchi disc or a **transparency tube***
- *Important because:*
  - *suspended particles in water behave similarly to dust in the atmosphere*
  - *an increase in suspended particles reduces the depth to which light can penetrate*
  - *this affects plants' ability to photosynthesize*
  - *sediments can come from both natural and human sources*

Dissolved Oxygen (DO)

- DO is a measure of molecular oxygen (O_2) dissolved in water
- The amount of dissolved oxygen the water will hold is called the solubility of dissolved oxygen. Factors that affect solubility are:
  - Water temp (Increase in temperature, decrease in DO)
  - Atmospheric pressure (higher elev., lower pressure, DO decreases)
  - Salinity (increase in salinity, DO decreases)
- Units are mg/L or ppm
- Dissolved oxygen can range from 0-18 mg/L, but most natural water systems require 5-6 mg/L to support a diverse population
- Measured with a **DO kit** or a DO probe
- Important because:
  - amount of DO in water determines what can live there
  - some organisms require higher oxygen levels than others
  - DO is affected by what lives in the water

Electrical Conductivity (EC)

- *We call the amount of mineral and salt impurities in the water the **total dissolved solids (TDS)***
- *We measure TDS and parts per million (ppm).*
  - *This tells us how many units of impurities there are for one million units of water by mass.*
- *We use an indirect measure to find the TDS of water. One way to measure impurities is to see if it conducts electricity.*
- *We use an EC meter to measure electrical conductivity.*
- *Units are µS/cm (microSiemens per cm). This is the same as a micromho.*
- *Range is 0 to >2000 µS/cm*
- *We need to convert from µS/cm to TDS, and this requires a conversion factor. This conversion factor varies from 0.54 to 0.96, but 0.67 is commonly used for an approximation.*

TDS (ppm) = Conductivity (µS/cm) x 0.67

Electrical Conductivity (EC)

Conductivity (µS/cm)	TDS (ppm)	Conductivity (µS/cm)	TDS (ppm)
0	0	1050	704
50	34	1100	737
100	67	1150	771
150	101	1200	804
200	134	1250	838
250	168	1300	871
300	201	1350	905
350	235	1400	938
400	268	1450	972
450	302	1500	1005
500	335	1550	1039
550	369	1600	1072
600	402	1650	1106
650	436	1700	1139
700	469	1750	1173
750	503	1800	1206
800	536	1850	1240
850	570	1900	1273
900	603	1950	1307
950	637	2000	1340
1000	670	>2000	>1340

Estimated conversion from conductivity (µS/cm) to TDS based on average conversion factor of 0.67

Alkalinity

- *Related to pH but different*
- *Alkalinity is a measure of pH buffering capacity of the water*
- *What happens to the pH of water if acid is added?*
- *The answer depends on:*
  - *How much buffering capacity (alkalinity) is in the water*
  - *How much acid is added*
- *Measured with an alkalinity test kit*
- *Expressed as amount of calcium carbonate ($CaCO_3$) in the water*
- *Units are ppm or mg/L (1 ppm = 1 mg/L)*

Alkalinity – some examples

- *If water has a high alkalinity and acid is added, the alkalinity **neutralizes** the acid. Some of the alkalinity will be used up, so the alkalinity will go down. If more acid is added the alkalinity will continue to decrease. Eventually, when the alkalinity is low enough, adding acid will cause the pH to decrease.*
- *When water has a high alkalinity we say it is **well buffered.** It resists a decrease in pH when acidic water such as rain or snowmelt enters it.*
- *Alkalinity comes from dissolved rocks, particularly limestone and soils with $CaCO_3$. It is added to the water naturally as water comes in contact with rocks and soil. Water dissolves the $CaCO_3$, carrying it to lakes and rivers.*
- *If water has an alkalinity below about 100 mg/L as $CaCO_3$, it is **poorly buffered** and **pH sensitive**. A big rainfall or snowmelt could add enough acid to lower the pH in a sensitive system. This could harm the organisms that live there, esp. at certain times of the year (fish or insect larvae hatching)*

Nitrate (NO_3^-) - background

- *Nitrogen can have many chemical forms in water bodies:*
  - *Molecular nitrogen (N_2)*
  - *as organic compounds (both dissolved and particulate)*
  - *as numerous inorganic forms such as*
    - *ammonium (NH_4^+)*
    - *Nitrite (NO_2^-)*
    - *Nitrate (NO_3^-)*
- *Nitrate (NO_3^-) is usually the most important inorganic form of nitrogen because it is an essential nutrient for the growth and reproduction of many algae and other aquatic plants*
- *Nitrogen is a "limiting nutrient" because in low amounts, plants use up all the available nitrogen in the water and cannot grow or reproduce anymore. So it "limits" the amount of plants in the water.*

Nitrate (NO_3^-) - measurement, units and range

- *Nitrate (NO_3^-) is very difficult to measure directly, whereas nitrite (NO_2^-) is easier to measure*
- *Nitrate kits convert the nitrate (NO_3^-) in the water sample to nitrite (NO_2^-)*
- *You will add a chemical to the water sample to accomplish this conversion, and then a second chemical is added that reacts with the nitrite (NO_2^-) to cause a color change*
- *The measurement gives a combined concentration of nitrite (if present) and nitrate (which was converted to nitrite (NO_2^-))*
- *Units are mg/L*
- *Most natural waters have nitrate levels under 1.0 mg/L nitrate-nitrogen, but concentrations over 10 mg/L are found in some areas. This affects whether you use a low-range or high range test in the kit*