- Ionic strength.
- Zwitter ions.
- Viscosity.
- Surface tension.

IONIC STRENGTH

- The **ionic strength** of a solution is a measure of the concentration of ions in that solution.
- Ionic compounds, when dissolved in water, dissociate into ions.
- The total electrolyte concentration in solution will affect important properties such as the dissociation or the solubility of different salts.
- One of the main characteristics of a solution with dissolved ions is the ionic strength.

- Ionic compounds are natural constituents of both inland and marine systems, and are not harmful unless levels exceed or fall below the tolerance range of aquatic organisms. Indeed, some constituents of ionic compounds are essential elements, necessary for the survival of aquatic organisms.
- Salts are ionic compounds composed of cations (positive charge) and anions (negative charge). Common salt ions include:

Cations: Na^{+} Ca^{2+} Mg^{2+} K^{+}

Anions: Cl^{-} HCO_3^{-} CO_3^{2-} SO_4^{2-}

Way to Measure of Ionic Strength

- Ionic strength is a function of concentration and charge of all ions in a given solution (see Equation).
- Direct measurement of ionic strength is seldom used in ecological studies. Causal assessors are more likely to have access to measures which generally correlate with ionic strength.

$$\frac{1}{2}\sum_{i=1}^{n} c_i z_i^2$$

Equation 1. Ionic strength is typically calculated as the product of a given ion's concentration, c_i, and its charge, z_i, summed over all ions in solution, divided by two (IUPAC Quantities, Units and Symbols in Physical Chemistry, 1993), and measured either as mass per unit volume (i.e., mg/L) or in moles (i.e., mmol/L).

Sources for ions in natural waters

TABLE 4-10 Characteristics of Subsurface Waters of Low Mineral Content Associated with Common Rock Types

Rock types	Water characteristics
Granite, rhyolite	Low total ion content; dominant ions Na^+, HCO_3^-; pH 6.3 to 7.9; SiO_2 content moderate to high
Gabbro, basalt	Moderate total ion content; dominant ions Ca^{2+}, Mg^{2+}, HCO_3^-; pH 6.7 to 8.5; SiO_2 content high
Sandstone, arkose, graywacke	High total ion content; dominant ions Ca^{2+}, Mg^{2+} Na^+, HCO_3^-; pH 5.6 to 9.2; SiO_2 content low to moderate
Siltstone, clay, shale	High total ion content; dominant ions Na^+, Ca^{2+}, Mg^{2+}, HCO_3^-; SO_4^{2-}, Cl^-; pH 4.0 to 8.6; SiO_2 content low to moderate
Limestone, dolomite, marble	High total ion content; dominant ions Ca^{2+}, Mg^{2+}, HCO_3^-; pH 7.0 to 8.2; SiO_2 content low
Slate, schist, gneiss	Low to moderate total ion content; dominant ions HCO_3^-; Ca^{2+}, Na^+; pH 5.2 to 8.1; SiO_2 content low

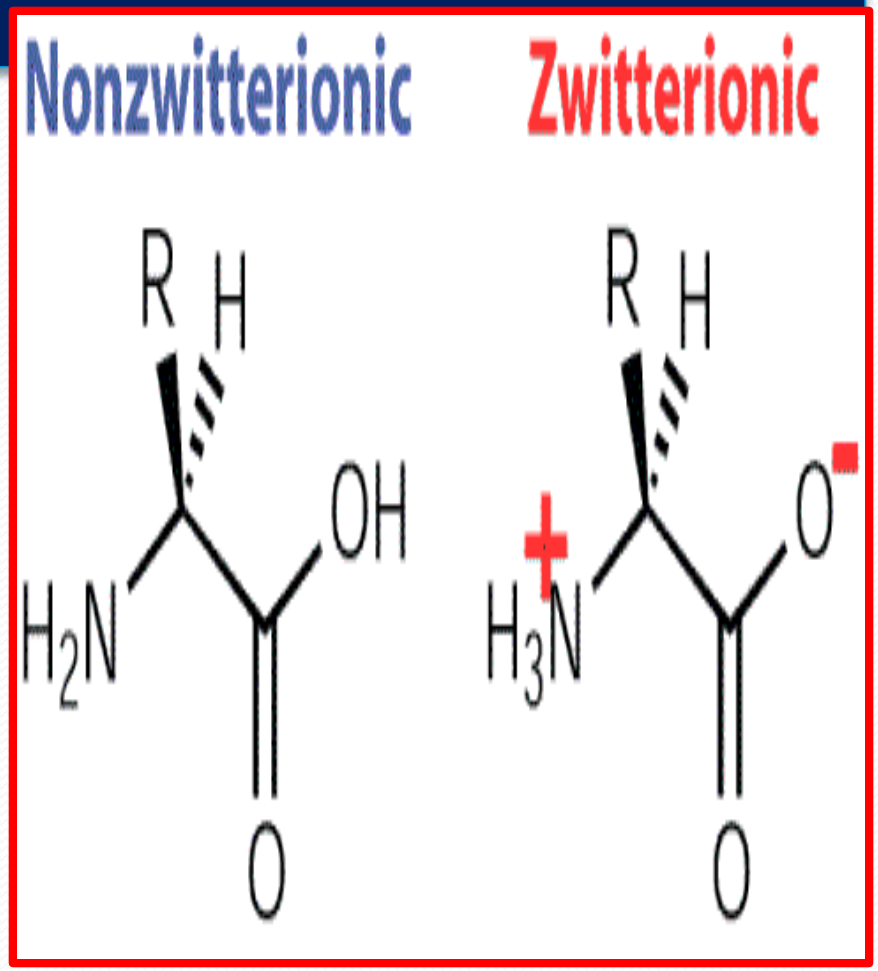
Source: Data from White et al. (1963).

ZWITTERION

- In chemistry, a **zwitterion** is a neutral molecule with a positive and a negative electrical charge at different locations within that molecule. Zwitterions are sometimes also called **inner salts**.
- Amino acids are the best-known examples of zwitterions.
- Amino acids are white crystalline solids with high melting points and high water solubilities
- The two charged groups, the basic amino group and the carboxylic acid, at the two ends lead to internal proton transfer – zwitterions

ZWITTERION

- By changing the pH you can affect the net charge on the zwitterions
- The pH point at which there is no net charge on the zwitterions is called the *isoelectric point*



VISCOSITY

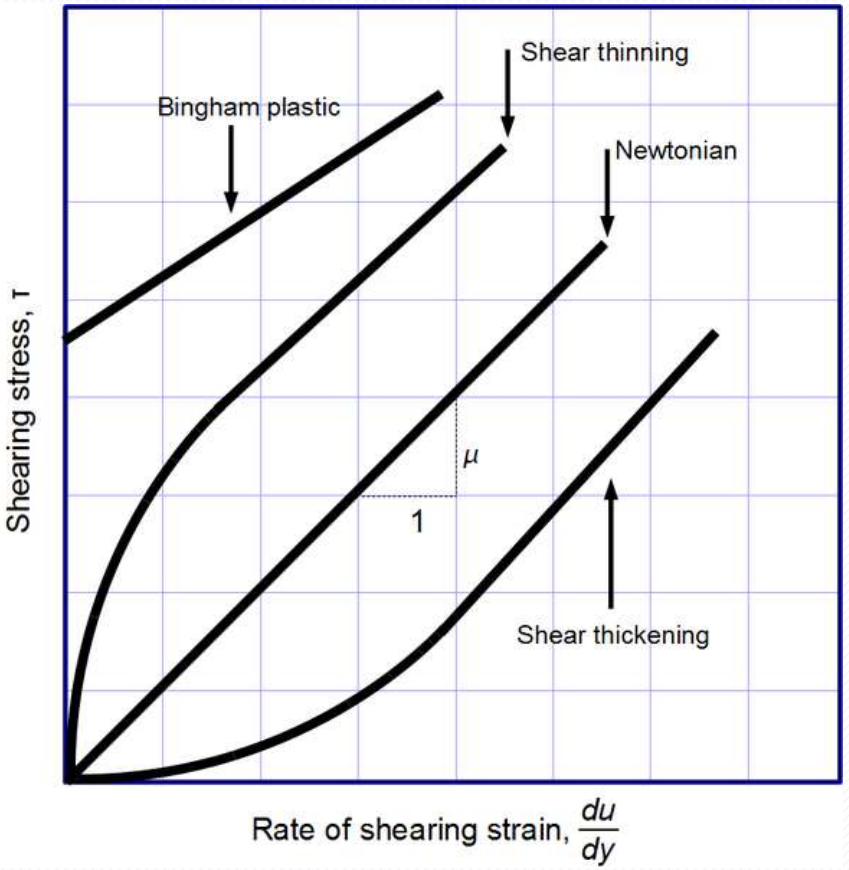
- Some of the most delicious treats are liquids that flow thickly and smoothly: Maple Syrup, Chocolate Milk, Caramel Sauce, Etc.
- The property that describes a liquid's [illegible]s is called **viscosity.**
- **High-viscosity = Thick liquids**
- **Low-viscosity = Thin liquids**
- A **fluid** is any substance that flows.

VISCOSITY

- Viscosity describes a fluid's internal resistance to flow and may be thought of as a measure of fluid friction.
- **Viscosity Units:**
- Dynamic Viscosity
- Kinematic Viscosity
- Fluidity
- Non- standard Units

VISCOSITY TYPES

- **Newtonian**: fluids, such as water and most gases which have a constant viscosity.
- **Shear thickening**: viscosity *increases* with the rate of shear.
- **Shear thinning**: viscosity *decreases* with the rate of shear. Shear thinning liquids are very commonly, but misleadingly, described as thixotropic.
- **Thixotropic**: materials which become *less* viscous over time when shaken, agitated, or otherwise stressed.



- **Rheopectic**: materials which become *more* viscous over time when shaken, agitated, or otherwise stressed.

SURFACE TENSION

- **Surface tension** is a contractive tendency of the surface of a liquid that allows it to resist an external force.
- It is revealed, for example, in the floating of some objects on the surface of water, even though they are denser than water, and in the ability of some insects (e.g. **water striders**) to run on the water surface.
- This property is caused by **cohesion** of similar **molecules**, and is responsible for many of the behaviors of liquids.

SURFACE TENSION

- Surface tension has the dimension of force per unit length, or of energy per unit area.
- The two are equivalent - but when referring to energy per unit of area, people use the term surface energy - which is a more general term in the sense that it applies also to solids and not just liquids.
- ***Applications of Surface tension***
- Antiseptics like dettol have low surface tension, so that they spread faster.
- Surface tension prevents water from passing through the pores of an umbrella.
- A duck is able to float on water as its feathers secrete oil that lowers the surface tension of water.