

BIOL1003-91: Lecture 1

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What is Biology?

- Genetically Modified Organisms (GMOs)
- Genetics/Physiology
- Genetically modified humans, etc

The Scientific Method

1. Characterization:
 - comes from years of data collected from experiments and published research
 2. Hypothesis:
 - a testable and falsifiable explanation of information gathered
 - may be expressed in words or mathematical equations
 3. Experiments:
 - design & conduct controlled experiments to test predictions of hypothesis
 - important to design experiment so the hypothesis can be falsified if it's incorrect
 4. Interpretation of Results:
 - compare results of experiment with those predicted by hypothesis
 - if results do not match, hypothesis is falsified, must be rejected or revised
 - if hyp prediction is correct, the hypothesis is supported
- Keynotes:
 - results have to be repeatable (statistically significant) 19/20 (0.05)
 - scientific “theories”
 - anecdotal evidence is not scientific
 - correlation of two variables does not imply causation

Chemical Bonds:

Covalent Bonds

- **Polarity:** Low
- **Formation:** bond formed b/w two non-metals that have a similar electronegativities. Neither atom is “strong” enough to attract electrons from the other. For stabilization, they share their electrons from the outer molecular orbit with others.

Ionic Bonds

- **Polarity:** High
- **Formation:** bond formed b/w a metal and non-metal. Non-metals (- ions) are “strongers” than the metal (+ ion) and can get electrons easily from the metal. The two opposite ions attract each others and form the ionic bond.

Hydrogen Bonds

- about 1/20 strength of covalent bonds
- found b/w water molecules and many other biological compounds (e.g. DNA)

Van der Waals Forces

- **London Dispersion:** When electrons all go to the same area at once, a *dipole* is formed momentarily. Even if a molecule is non-polar, this displacement of electrons causes a nonpolar molecule to become polar for a moment. This means that all the electrons are concentrated at one end and the molecule is partially negatively charged on that end. The negative end makes the surrounding molecules have an instantaneous dipole also, attracting the surrounding molecules' positive ends.
- **Dipole-Dipole Forces:** Occur in molecules that are permanently polar vs momentarily polar. In this interaction, a polar molecule attracts the positive end of another polar molecule with the negative end of its dipole.

Biological pH

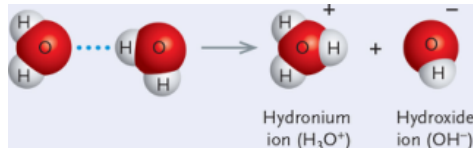


Figure 1: Hydrogen bond: positive ion has low pH, negative has high pH

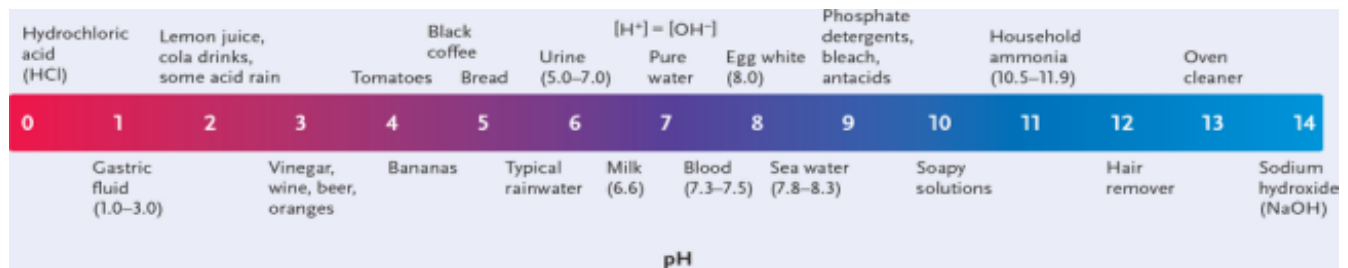


Figure 2: pH scale

Carbon Compounds

- all biological materials and cells are composed of carbon compounds with *covalent* bonds

Proteins (polypeptides)

- all proteins are polymers of amino acids (20 common amino acids in biology)
- amino acids are joined together with peptide covalent bonds

Nucleic Acids (DNA and RNA)

- all nucleic acid has nucleotides that contain a **base**, **sugar**, and **phosphate groups**

Fats (Lipids)

- water insoluble (hydrophobic: non-polar)
- mostly hydrogen and carbon
- make up cell membranes; phospholipid bilayer