

Characteristics of Water, Acids & Bases

Learning Outcome B2 & B3

Learning Outcome B2

- Describe the characteristics of water and its role in biological systems

Student Achievement Indicators

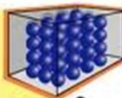
- Describe the role of water as a solvent, temperature regulator, and lubricant
- Describe how the polarity of the water molecule results in hydrogen bonding

Background Information (Science 10 Review)

- Matter is composed of tiny particles called atoms.
- In solids these atoms are packed closely together and are unable to move, they only vibrate in place
- In liquids these atoms are further apart and are able to move past one another.
- In gases these atoms are far apart from each other.
- Gases have the most energy.

Changes of State

Frozen water molecules vibrate, but can't switch places.



Water molecules in the liquid state slide over each other.

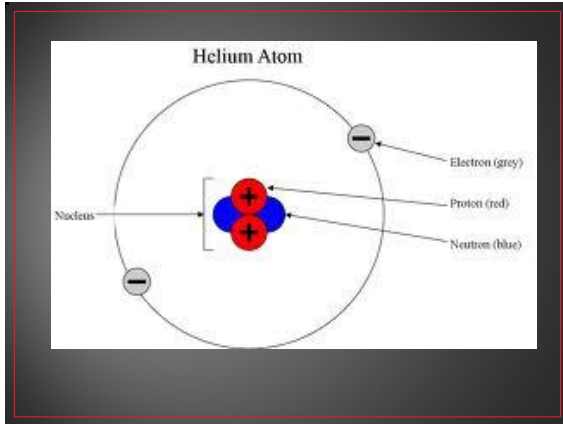


Water molecules in the gaseous state move randomly throughout their container.



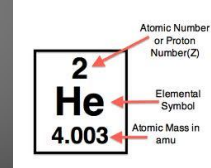
Background Information (Science 10 Review)

- Atoms are made up of:
 - Protons – positive charge
 - Neutrons – neutral charge
 - Electrons – negative charge



Background Information (Science 10 Review)

- Protons and neutrons are located in the nucleus, and the electrons are located in shells surrounding the nucleus.
- The nucleus contains most of the mass of an atom, but contains very little of the volume.
- The atomic number of an atom tells you how many protons the atoms has.

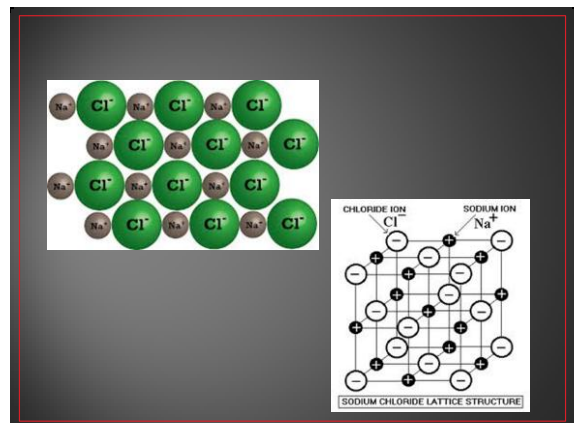
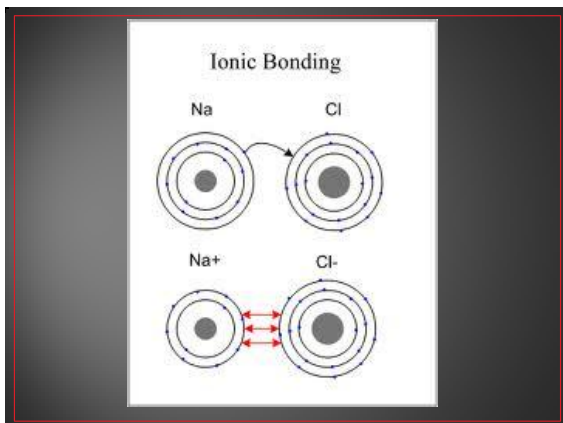


Background Information (Science 10 Review)

- The atomic mass tells you how many protons and neutrons an atom of a specific element has.
- Atoms that have the same atomic number but different atomic masses are known as isotopes (they have different numbers of neutrons).
- You can calculate the number of neutrons by subtracting the atomic number from the atomic mass.
- Different elements have different levels of reactivity; this is due to the number of electrons in their outer shell.

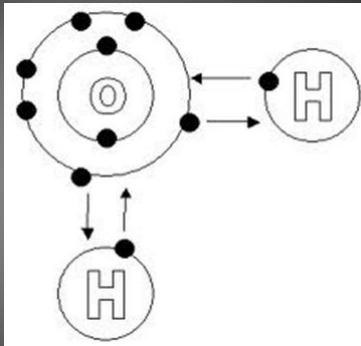
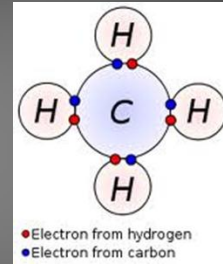
Background Information (Science 10 Review)

- Elements in the Noble Gas family have full outer shell and are unreactive
- Other elements want to either gain or lose electrons until they have full outer shells and are no longer reactive.
- Metals, elements on the left hand side of the periodic table tend to lose electrons while elements on the right hand side of the table tend to gain electrons.
- An atom of an element that loses an electron is called a cation and has a positive charge
- An atom of an element which gains an electron is called an anion and has a negative charge.
- When a cation and anion come near each they form an ionic bond.
- An ionic bond is when electrons are transferred.



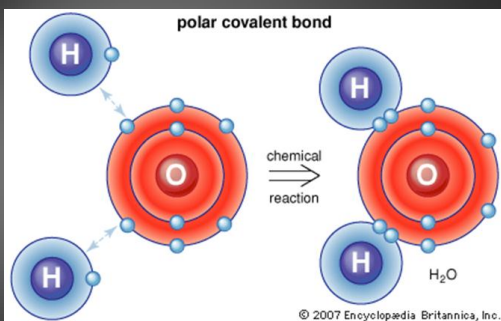
Background Information (Science 10 Review)

- The other type of chemical bond is a covalent bond and this occurs when electrons are shared by two non-metals.
- When these atoms are close together, this is known as electronegativity.
- This type of bond is stronger than an ionic bond and the atoms involved are closer together.



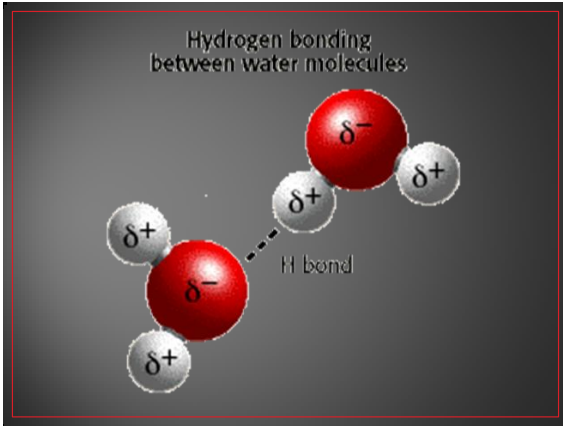
Properties of Water

- In a covalent compound sometimes electrons are not shared equally.
- This type of compound is said to be polar
- Water is an example of a polar covalent compound
- The oxygen is more electronegative so it pulls the hydrogen atoms.
- This makes the oxygen slightly negative and the hydrogen slightly positive.



Properties of Water

- Different ends of the water molecule are attracted to each other, and this creates hydrogen bonding.
- Slightly positive hydrogen's are attracted to the slightly negative oxygen atoms.
- Hydrogen bonding accounts for many of the properties of water:
 - ✓ Cohesion – ability of water to form droplets
 - Plays a role in the regulation of body temperature through sweating
 - Allows the body to form lubricants that prevent the ripping and tearing of internal organs
 - ✓ High specific heat capacity – allow us to regulate body temperature
 - ✓ Excellent solvent



Learning Outcome B3

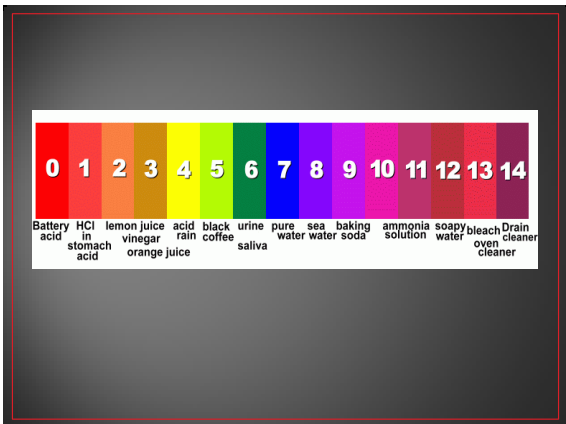
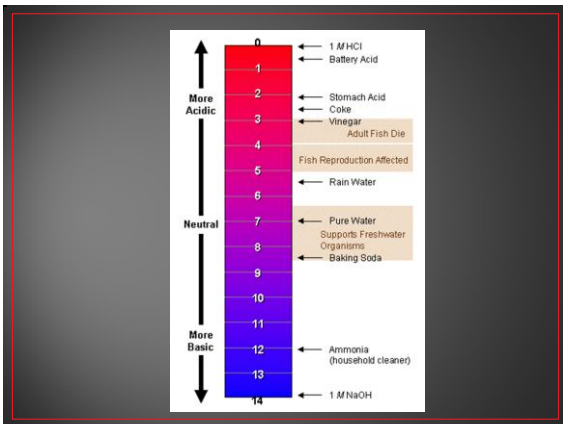
- Describe the role of acids, bases, and buffers in biological systems in the human body

Student Achievement Indicators

- Differentiate among acids, bases, and buffers
- Describe the importance of pH to biological systems in the human body

pH

- A solution with an equal number of hydrogen (H^+) ions and hydroxide (OH^-) ions is said to be neutral
- When there are more H^+ ions the solution is said to be positive and have a pH of less than 7.
- When there are less hydrogen ions than hydroxide ions the solution is negative and has a pH of greater than 7.

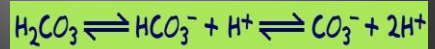


pH

- The pH scale is calculated from the concentration not the number of hydrogen ions, therefore a pH of 8 has 10x more hydrogen ions than a pH of 9.
- Examples of acids:
 - ✓ acetic acid (vinegar)
 - ✓ citric acid (lemon juice)
- Examples of bases:
 - ✓ human blood (pH of 7.4 – slightly basic)
 - ✓ milk of magnesia
 - ✓ oven cleaner

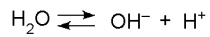
pH

- When equal acids and bases are added to one another they neutralize one another.
- The maintenance of constant internal pH in the human body is incredibly important and it is accomplished by a system of buffers.
- An example of a buffer for an acid would be basic and an example of a buffer for a base would be acidic.
- An example in the body is the bicarbonate buffering system that helps maintain blood pH



Dissociation of Water

- Water can break down into hydrogen ions and hydroxide ions.



Sometimes the oxygen atom *steals* the electron entirely from hydrogen

