

PROGRESSIONS:  
PEER-LED TEAM LEARNING

## Module 2: Chemistry of Life

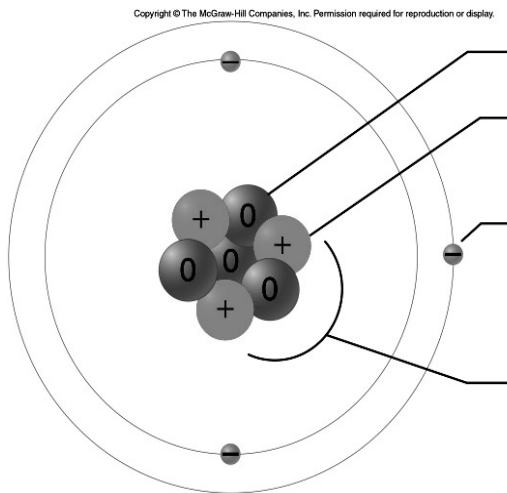
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### I. Introduction

Living systems obey chemical and physical laws. This module focuses on chemical principles that are necessary for understanding life processes. For example, energy transformations in the cell occur by the formation and breaking of chemical bonds. These chemical reactions result in the reorganization of sub-atomic particles. We begin this module with investigations of matter, elements and compounds. Prepare for your workshop by reading in your textbook (Chapter 2, pages 56-65) and completing the Pre-Workshop Activities below. Show your work on these pages.

### II. Pre-Workshop Activities

**Activity A. Label the following diagram using the terms in the box and answer the questions below:**



Atomic nucleus  
Proton  
Neutron  
Electron  
Electron shell

What is the atomic number of the above atom? \_\_\_\_\_

What is the atomic mass of the above atom? \_\_\_\_\_

**Activity B. Match the correct term with its description:**

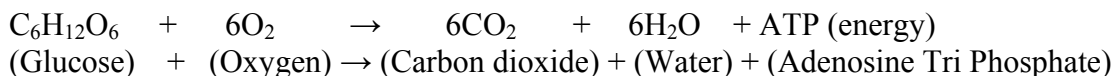
1. Ion \_\_\_\_\_ Formed by donating or accepting an electron
2. Isotope \_\_\_\_\_ A positively charged atom

- 3. Ionic bond \_\_\_\_\_ General term for a charged atom
- 4. Covalent bond \_\_\_\_\_ Formed by sharing of electrons
- 5. H-bond \_\_\_\_\_ Two atoms of oxygen come together to form this
- 6. Polar covalent bond \_\_\_\_\_ Variant form of an atom with a different number of neutrons
- 7. Anion \_\_\_\_\_ Found within a water molecule
- 8. Cation \_\_\_\_\_ Found between water molecules
- 9. Molecule \_\_\_\_\_ A negatively charged atom

**Activity C. Fill in the blanks using the terms provided:**

**Acidic**                      **Solvent**                      **Basic**                      **Solute**  
**Products**                      **Hydrophilic**                      **Reactants**                      **Hydrophobic**

1. Consider the following metabolic reaction:



Glucose and oxygen are \_\_\_\_\_.

Carbon dioxide and water are \_\_\_\_\_.

2. The pH of gastric (stomach) secretions is around 2. These secretions are said to be \_\_\_\_\_.

3. The pH of the duodenum (small intestine) is around 8 or 9. This environment is said to be \_\_\_\_\_.

4. In a sugar solution, sugar crystals make up the \_\_\_\_\_ and water makes up the \_\_\_\_\_.

5. Water loving molecules are known as \_\_\_\_\_ whereas water repelling molecules are said to be \_\_\_\_\_.

**Activity D.**

The symbolism used in biology and chemistry is often like trying to learn a new "foreign" language. In the table below are the symbols for most of the common elements found in the human body. Life requires only about 25 chemical elements with carbon, oxygen, hydrogen, and nitrogen making 96% of living matter. Fill in the names of the elements in Table 1 and then list a biological molecule known to contain that element or a biological function for that element; here's where you can test your base of knowledge.

Symbol	Element	Biological Molecule or Function
<b>O</b>		
<b>C</b>		
<b>H</b>		
<b>N</b>		

<b>Ca</b>		
<b>P</b>		
<b>K</b>		
<b>S</b>		
<b>Na</b>		
<b>Cl</b>		
<b>Mg</b>		

Table 1. The major biological elements and their biological functions.

### Activity E.

Fill in the following chart for the major subatomic particles of an atom.

<b>Particle</b>	<b>Charge</b>	<b>Mass</b>	<b>Location</b>

Table 2. The Major Subatomic Particles.

## III. Workshop Activities

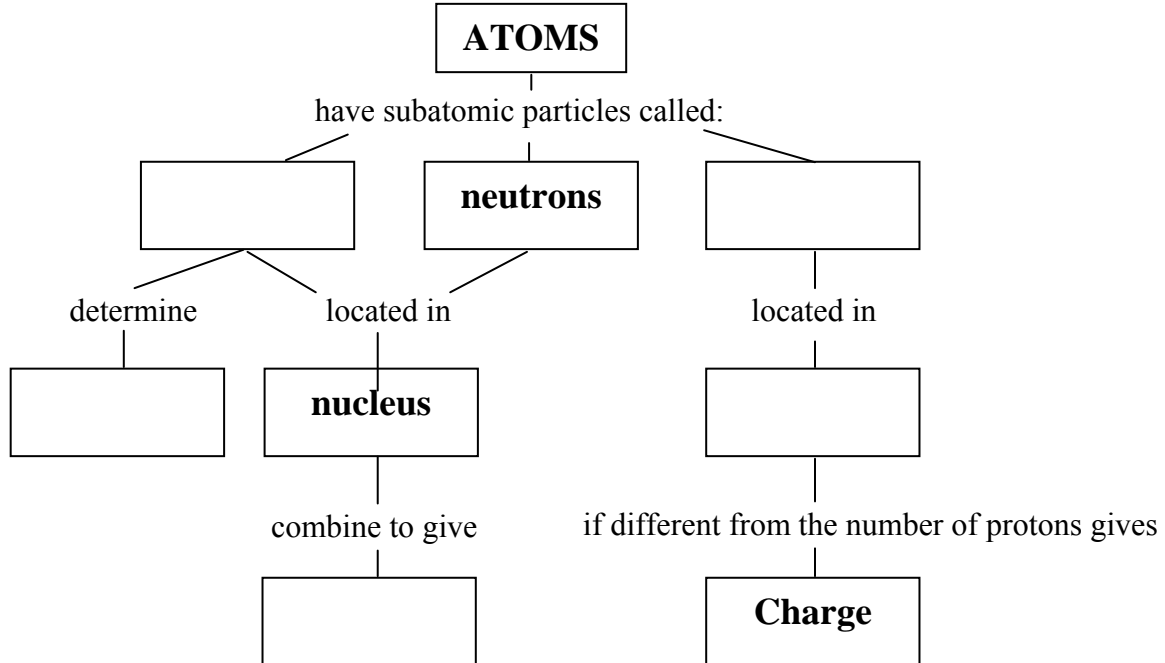
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### Activity A. Subatomic structure

A. Each pair of students should select one of the elements below. First draw the nucleus and add the appropriate number of protons and neutrons. Second, draw the electrons in shells around the nucleus. Make sure the distribution follows the correct pattern of filling. Share your answers when you are done.

<b>Element</b>	<b>Atomic number</b>	<b>Atomic mass</b>
Hydrogen (H)	1	1
Carbon (C)	6	12
Nitrogen (N)	7	14
Oxygen (O)	8	16
Chlorine (Cl)	17	35
Sodium (Na)	11	22


**Activity B. Concept Map.** Complete the following using the vocabulary from the pre-workshop activities.



**Activity C: Chemical Bonding.** Answer the following questions to review your knowledge:

1. In chemical bonds, what electrons are involved for each atom?

2. What happens to the valence electrons (what do they do?) in each of the following bonds?

Non-polar covalent bond:

Polar covalent bond:

Ionic bond:

3. Give at least one example of a structure formed from each kind of bonding in living things.

TYPE OF BOND	EXAMPLE IN LIVING THINGS	ELECTRICAL PROPERTY OF THE MOLECULE
Polar Covalent bond		
Covalent bond		
Ionic bond		
H-bond		

#### Activity D. Water and Hydrogen bonding

1. What kind of chemical structure is water? (Circle all terms that apply)

**Atom    Compound    Molecule    Macromolecule    Organic    Inorganic    Polar**

2. Describe the distribution of electrons in the structure and relate it to its electrical properties.

3. Why is water an excellent solvent?

4. Water is an excellent solvent. Yet, many molecules do not dissolve in water. Why?

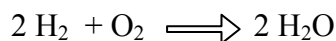
5. Draw several water molecules labeling the covalent bonds and the hydrogen bond. Make sure the alignment of the molecules is consistent with electrical attractions among the molecules.

### Activity E. pH

1. What is the pH of a solution when the number of  $H^+$  ions equals the number of  $OH^-$  ions? (Hint: neutral pH)
2. If you dissolved HCl in water, what would happen to the balance between  $H^+$  ions and  $OH^-$  ions? What would happen to the pH value of the solution? What happens to the balance and pH when NaOH is dissolved in water?

### Activity F. Chemical Reactions.

1. Chemical reactions are represented by equations. For the equations below, identify the reactants and the products.



2. The following equation has arrows going in both directions. Explain what this means. What are the reactants and products in each case?

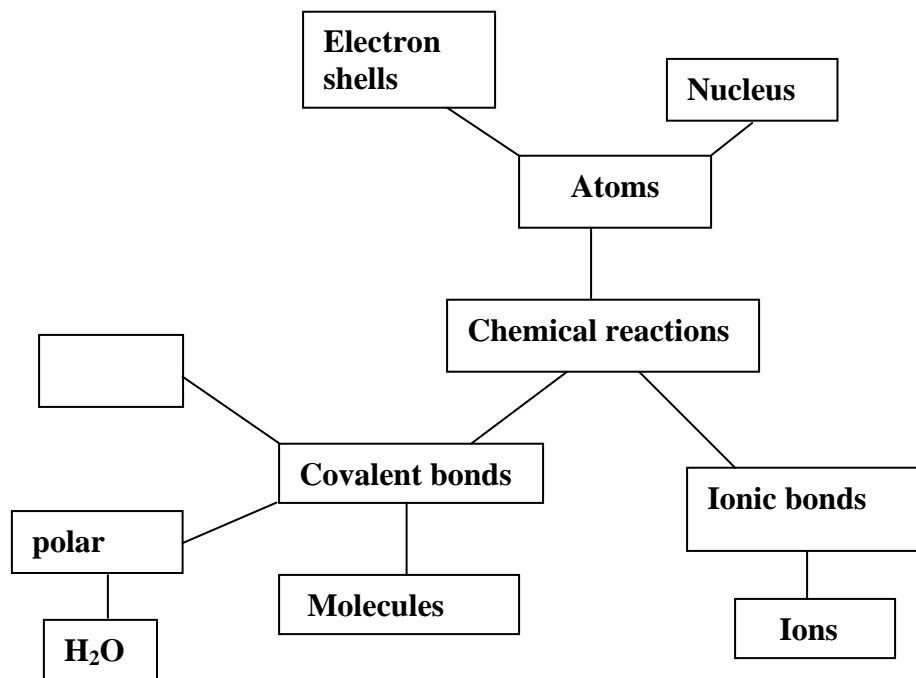


**Activity G. The Big Picture.** Work in groups of 2-4 students for this activity. Complete as much of the following activity as you can in the time allotted. Use the skeleton of a concept map shown on the next page:

1. Add connecting statements for the concepts that are listed.
2. Build on the skeleton by adding the concepts listed below along with connecting statements that show relationships among the concepts.

3. Compare your concept map with other groups. Make additions and corrections.

### Concept Map: Formation of Simple Molecules



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