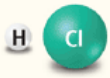
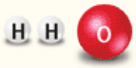
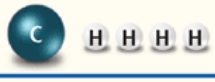
SECTION 1 (PP. 169-174): ELEMENTS COMBINE TO FORM COMPOUNDS.

Georgia Standards: S8P1b – *Describe the difference between pure substances (elements and compounds) and mixtures; S8CS5b – Understand that different models (such as physical replicas, pictures, & analogies) can be used to represent the same thing.*

1. **Compounds have different properties from the elements that make them.**
   A ***compound*** is a combination of two or more elements. What makes a compound different from a mixture is that atoms of the elements in a compound are held together by chemical bonds. The properties of a compound are often quite different from the properties of the elements that make them.

2. **Atoms combine in predictable numbers.**
   Compounds have a definite composition. Each compound contains a specific ratio of atoms held together by chemical bonds. The compound formed when one nitrogen atom combines with one oxygen atom (NO) is different from the compound formed when two nitrogen atoms combine with one oxygen atom (N_2O). Compounds are not like simple mixtures, which have no definite combination.

   A chemical compound is represented by a ***chemical formula***. Chemical formulas use the symbols for the elements to show the different elements that make up a compound. To show the ratios of the atoms of those elements in the compound, subscripts are used. A subscript is a number written to the right of the chemical symbol and slightly below the line. Carbon dioxide, for example, has two oxygen atoms for each carbon atom. The chemical formula for carbon dioxide, therefore, is CO_2. In the table below, notice the ratios of the atoms in each compound.

Compound Name	Atoms	Atomic Ratio	Chemical Formula
Hydrogen chloride		1:1	HCl
Water		2:1	H_2O
Ammonia		1:3	NH_3
Methane		1:4	CH_4
Propane		3:8	C_3H_8

   Different compounds, such as H_2O and H_2O_2, can be composed of the same elements. However, because they are different compounds, they have different properties.

SECTION 2 (PP. 175-183): CHEMICAL BONDS HOLD COMPOUNDS TOGETHER.

Georgia Standards: S8P1b – ***Describe the difference between pure substances (elements and compounds) and mixtures; S8CS5b – Understand that different models (such as physical replicas, pictures, & analogies) can be used to represent the same thing.***

1. **Chemical bonds between atoms involve electrons.**
   Chemical bonds are the glue holding the atoms in compounds together. Chemical bonds are the result of interactions between the electron clouds of two or more atoms.

2. **Atoms can transfer electrons.**
   Ions are formed when atoms gain or lose electrons. When one atom loses an electron, another atom picks up that electron, forming a negative and positive ion pair. A positive ion is attracted to a negative ion. This attraction is called an ***ionic bond***.

   Ionic compounds bear the name of the positive metal ion (*cation*) followed the root of the negative non-metal ion (*anion*), with the suffix –ide. The ionic compound made of lithium and chlorine is lithium chloride.

3. **Atoms can share electrons.**
   Atoms that share a pair of electrons have what is called a ***covalent bond***. Atoms form covalent bonds because they are more energetically stable when they have a certain number of electrons around their nuclei. Covalent bonds can form between two atoms of the same element or two atoms of different elements. A ***molecule*** is a group of atoms held together by covalent bonds. It has no electrical charge.

   In some cases, two atoms can form as many as four covalent bonds. Most often, the electrons shared in a covalent bond spend more time closer to one of the nuclei than the other. When electrons stay much closer to one nucleus than the other, this is a ***polar covalent bond***.

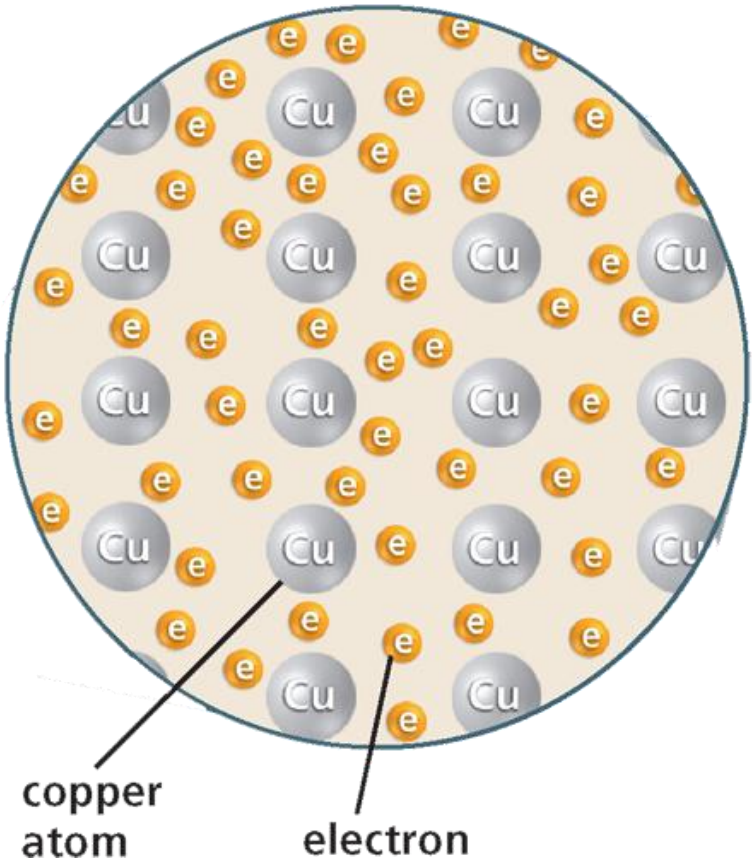
4. **Chemical bonds give all materials their structures.**
   The shape of the crystal formed by an ionic compound depends on the ration, shapes, and sizes of the ions. Covalent compounds do not form crystals; they form individual molecules.

   Molecules have characteristic shapes, or molecular structures. Molecular structure affects many properties of the compounds.

SECTION 3 (PP. 184-189): SUBSTANCES' PROPERTIES DEPEND ON THEIR BONDS.

Georgia Standards: S8P1d – ***Distinguish between physical and chemical properties of matter as physical (i.e., density, melting point, boiling point) or chemical (i.e., reactivity, combustibility)***

1. **Metals have unique bonds.**
   Metal atoms share electrons in all directions with other metal atoms in a type of bond called a metallic bond. The figure below shows how the electrons in a metal are shared by many metal atoms.



Properties of metals are determined by the mobility of electrons in a metallic bond. These properties include *conductivity*, *ductility*, and *malleability*.

2. **Ionic and covalent bonds give compounds certain properties.**
   Ions are tightly locked into place in the structure of a crystal, so ionic bonds are difficult to break. ***Ionic bonds*** generally

   - Have high melting and boiling points
   - Are hard and brittle and do not conduct electricity when a solid
   - Break up into negative and positive ions when dissolved and will conduct an electric current when in solution

   The molecules of ***covalent compounds*** are not held together as tightly;

   - Boiling and melting points of covalent compounds are relatively low.
   - Molecules stay intact when dissolved in water.
   - Molecule size and shape affect properties also.

3. **Bonds can make the same element look different.**
   Different forms of the same element, called ***allotropes***, can result from different covalent bonds. Carbon forms three different allotropes, all with different properties; diamond, graphite, and fullerene.