Name: _____ Date: _____

Guided Learning: Classifying Matter

Learning goals
After completing this activity, you will be able to …

- Differentiate between elements, compounds, and mixtures.
- Classify matter as pure substances or mixtures.

Vocabulary: atom, chemical formula, chemical symbol, compound, element, heterogeneous mixture, homogenous mixture, mixture, pure substance

Warm-up questions:

1. How are the marbles pictured at top right different from the marbles pictured below them?

_____

_____

_____

2. What are some different ways you could classify, or organize, the different marbles in the collection of marbles shown top right?

_____

_____

_____

Activity A: Pure Substances
Just like the marbles shown here, some matter is made up of all the same material. Other matter is made up of many different materials. Scientists classify matter into two broad categories based on this difference. Matter that is made up of the same substance throughout is a **pure substance**. Matter that can be separated into different substances by physical methods is a **mixture**.

You interact with thousands of different substances every day. Steel, aluminum, and water are all examples of substances you probably touch on a daily basis. Are these mixtures or pure substances? Let's start with an aluminum soda can. Aluminum is an **element**, or a substance that cannot be broken down into simpler substances.

If you cut a chunk of aluminum into smaller and smaller pieces, you would eventually end up with an extreme tiny particle called an aluminum **atom**. All of the atoms in the aluminum can are aluminum atoms. Thus, aluminum is all made up of the same substance—aluminum atoms. This makes aluminum a pure substance.

Now, let's consider water. Water is composed of two elements: hydrogen and water. Because of this, water is considered to be a **compound**, or a substance that is made from two or more elements. The elements that make up water have bonded together to form a molecule. The only way to break this bond is through a chemical reaction. Because the elements making up water cannot be separated through physical means, water—like aluminum—is a pure substance.

Elements are represented by **chemical symbols**. Each symbol is one or two letters long, with the first letter capitalized and the second letter lowercase. Symbols for common elements include O for oxygen, H for hydrogen, C for carbon, Fe for iron, Cu for copper, Au for gold, and Al for aluminum.

Compounds are represented by **chemical formulas**, which contain symbols for two or more elements. Subscripts are small numbers that tell you how many atoms of each element are in a molecule of the compound. For example, the chemical formula for water is H_2O. This formula tells you that a water molecule has two hydrogen atoms and one oxygen atom.

1. Gold is an element. If you cut up the gold bars shown at right into smaller and smaller pieces, what is the smallest piece you can end up with before the substance ceases to still be gold?

_____

2. Is gold a pure substance or a mixture?

_____

3. What is the difference between an element and a compound? _____

_____

4. What does the chemical symbol H represent? _____

5. Carbon dioxide contains carbon and oxygen and has the chemical formula CO_2. How many atoms of carbon and oxygen are in a molecule of CO_2?

Carbon: _____ Oxygen: _____

Activity B: Mixtures

A mixture is a combination of substances that can be separated by physical means such as filtering, melting, evaporating, or dissolving in water. If you melted steel down, you could separate it into several different elements, including iron, chromium, and carbon. These elements are not bonded together to form a compound. Instead, they are simply mixed together within the steel. Thus, steel is an example of a mixture.

The substances in a mixture maintain many of their original physical properties. For example, sugar tastes the same whether it is eaten dry or mixed in water. Iron filings are still magnetic, even when mixed in sand. In contrast, elements that are chemically combined in compounds do not retain their physical properties. For example, salt is a compound of sodium, an explosive metal, and chlorine, a poisonous gas. These two dangerous substances combine to form a stable compound that is an important nutrient for living things.

Many substances around you are mixtures. For example, salt water is a mixture of salt and water. If you evaporate the water, the salt will be left behind. Both steel and salt water are examples of **homogenous mixtures**. Substances in a homogenous mixture are so evenly distributed that it is hard to distinguish one substance in the mixture from another. Other homogenous mixtures include milk and blood.

Other mixtures are **heterogeneous mixtures**. You can easily distinguish different substances in heterogeneous mixtures. Salads, soil, and the different colored marbles shown in the Warm-up are all examples of heterogeneous mixtures. Unlike homogenous mixtures that usually must be separated through means such as melting or evaporating, many heterogeneous mixtures can be separated by hand or by filtration. For example, you could separate the sand and loam in soil by using tweezers or filtering the soil with different sized screens.

1. Why is steel considered to be a mixture and not a pure substance? _____

   _____

   _____

2. What is the difference between homogenous mixtures and heterogeneous mixtures?

   _____

   _____

3. Give an example of a homogenous and a heterogeneous mixture not listed in the text:

   Homogeneous mixture: _____

   Heterogeneous mixture: _____