Name: _____ Date: _____

# Guided Learning: Physical and Chemical Properties and Changes

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

- Differentiate between physical and chemical changes and properties.
- Identify extensive and intensive properties.

**Vocabulary:** chemical change, chemical property, extensive property, intensive property, physical change, physical property, precipitate, reactivity

**Warm-up question:**
A property is any characteristic of a material that can be observed or measured. Examine the material—wood—shown at right. In the space below, list as many properties of wood as you can.

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**Activity A: Physical properties**
Probably many of the properties that you listed are **physical properties**. A physical property is a property that can be observed or measured without changing the composition of the substances that make up the material. Melting point, boiling point, hardness, malleability, mass, density, volume, and magnetism are all examples of physical properties.

Physical properties can be separated into two different categories: **extensive properties** and **intensive properties**. A material's extensive properties change when the amount of the material changes. Consider the firewood shown above. If you cut a piece off the end of a piece of firewood, the wood's mass would decrease. So would its volume. Thus, both mass and volume are extensive properties.

Intensive properties do not change when the amount of a material changes. For example, after you cut off the end of a piece of firewood, the wood still has the same texture, hardness, and density. These are all examples of intensive properties.

1. The amount of heat energy contained by a material is physical property. Do you think this is an intensive or extensive property? Explain your answer. _____

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2. Water boils at 100 °C. Do you think this is an intensive or extensive physical property? Explain your answer. _____

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**Activity B: Physical changes**

When you cut up a piece of paper into smaller pieces of paper, you are changing the size of the paper, but you are not changing the substances that make up the paper. Thus, cutting is an example of a physical change. A **physical change** is any kind of change that alters one or more of a material's physical properties, but does not alter its **chemical properties**. In other words, a physical change doesn't alter any of the substances making up the material.

Other examples of physical changes include crumpling, freezing, melting, bending, heating, crushing, stretching, stirring, sanding, and dissolving in a solution.

**When this paper was crumpled, it underwent a physical change.**

1. List two ways that you could physically change an ice cube. _____

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2. Why is melting a stick of butter considered a physical change? _____

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**Activity C: Chemical properties**

Most of the time when you describe the properties of a material, you first think of its physical properties. For example, when you described the wood during the Warm-up activity, you may have described its color, texture, density, or shape. These are all examples of physical properties. However, you may have also described the fact that wood can burn. This is an example of a chemical property. A chemical property is any ability to produce change in the substances that make up a material.

**Flammability is a chemical property.**

Another example of a chemical property is **reactivity**. A substance's reactivity is how easily the material will react with other substances. For example, oxygen is a very reactive substance. It will react with iron to form rust. It will also react with hydrogen to form water. Nitrogen, on the other hand, has a very low reactivity. In fact, iron can be coated in nitrogen to prevent the iron from reacting with oxygen and rusting.

1. Give two examples of chemical properties. _____

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2. What is the difference between physical properties and chemical properties? _____

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**Rusting is a chemical change.**

**Activity D: Chemical changes**

As you have already learned, when a material undergoes a physical change, the substances making up that material do not change. So, if you hammer a strip of iron into the shape of a horseshoe, you are not changing the iron that the strip is made out of.

However, if you leave the horseshoe exposed to oxygen, the oxygen will react with the iron and form iron oxide (rust). This change is a **chemical change** because it has changed the substances making up the horseshoe. When this chemical change takes place, the horseshoe's color goes from a dark bronze to an orange-red shade. A change in color is a sign that a chemical change has taken place.

There are many other signs that a chemical change has occurred to produce a new substance, including:

- Light, heat, or sound is emitted (Example: a firework exploding)
- Production of gas (Example: effervescent tablet dropped in a glass of water)
- Change in odor (Example: spoiled milk)
- Formation of a **precipitate**, or a solid forming from a liquid (Example: build-up of calcium oxide on water pipes)
- Change in temperature (Example: chemical cold pack absorbing heat when opened)
- Change in form (Example: burned paper turning to ash)

1. This rooster is made of copper, an orange-colored metal. When it was placed outside, it turned green. Do you think a chemical reaction caused this change in color? Explain.

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2. What is the difference between chemical changes and physical changes? _____

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