Physical and Chemical Properties
A physical property is a characteristic of a material that can be observed or measured without changing the composition of the material.

Examples

- Viscosity
- Conductivity
- Malleability
- Hardness
- Melting and Boiling point
- Density
Viscosity

- The resistance to flow. The thicker a liquid, the higher the viscosity (the slower a liquid moves).

What has higher viscosity, water or honey?

- Viscosity usually decreases when a liquid is heated.

What is more viscous, oil in a hot wok or oil in a cold wok?
Conductivity

• The ability to allow heat to flow.
• Metals are good conductors; they have a high conductivity. (they also conduct electricity well)
• Wood is a poor conductor.

Which spoon would you use to stir boiling water and pasta?
Malleability

- The ability of a solid to be hammered without shattering.
- Most metals are malleable. Solids that shatter when struck are called brittle.

What is more malleable, gold or glass?
Hardness

- Hardness is the ability to scratch a material. Hard materials can scratch other softer materials.
- Many grinding wheels contain diamond particles because diamond is a very hard material.

In order to sharpen this hunting knife, how hard must the grinding stone be?
Melting and Boiling Points

- **Melting point** - the temperature at which a substance turns from a solid to a liquid.

- **Boiling point** - the temperature at which a substance turns from a liquid to a gas.
Density

- The ratio of mass of a substance to its volume \(D = \frac{M}{V}\)
- Density can be used to test the purity of a substance. (remember the King and his crown story)

The coin on the left is pure silver. The coin on the right is fake. How could you prove that?
What can you do with the knowledge about a material’s physical properties?

1. They help to identify a material by comparing the results to known materials.
   (Ex.- finding red paint chips at a crime scene and comparing them to a data base of known car paint)

2. They help you to choose one type of material over another to perform a task.
   (Ex.- you would not want to construct a shelter out of cellulose packing peanuts)
They can help to separate mixtures by:

**Filtration**

The process that separates materials based on the size of the particles.

(Ex.- drip method to brewing coffee separates liquid from coffee grounds)

**Distillation**

The process that separates substances in a solution based on their boiling points.

(Ex.- Boiling seawater to evaporate and collect the fresh water for drinking. Sea salts are left behind)
How do you recognize physical changes?

- When some of the properties of the material change but the substances in the material remain the same.

**Examples**

- Melting butter
- Crumpling paper
- Slicing a tomato
- Cutting hair

- Some physical changes can be undone, some cannot.
Chemical Properties
What is a chemical property?

• The ability to produce a change in the composition of matter.
• They can be observed only when one substance in a sample of matter is changed into another substance.

Ex.- whenever something is burned, that substance becomes something completely different. The ability to burn is a chemical property.
Flammability

- The ability to burn in the presence of oxygen.
Reactivity

• How easily a substance combines chemically with another substance.

Oxygen easily reacts with many other elements. What other element is oxygen reacting with in this photo?
How Can You Recognize Chemical Changes?

- **A change in color** - Ex. The green patina on an old copper roof.

- **Production of a Gas** - Ex. Using baking powder and water in a cake mix. $CO_2$ is produced which helps the cake rise.

- **Formation of a Precipitate** - (any solid that forms and separates from a liquid). Ex. Adding vinegar to milk causes the proteins to clump together.

(The Law of Conservation of Mass states that even though chemical changes occur, matter is neither created or destroyed in the process)
Is a change in color always an indicator of a chemical change?
Is the formation of a gas always an indicator of a chemical change?
Physical v. Chemical Changes

• Before you decide whether a chemical change has actually taken place, ask yourself this question: *Are different substances present after the change takes place?* If not, it is a physical change (the composition of the matter stays the same).