How are physical and chemical properties different?

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

Activating Strategy 2: An Accurate Description

Display several objects that have differences in color, odor, texture, size, shape, and state.

Allow students to examine the objects. Then, ask them to describe each object in terms of its color, odor, texture, size, shape, and state.

Ask students why it is important to use a variety of properties when describing objects.

Properties of Matter

- The properties of a substance are those characteristics that are used to identify or describe it
- A substance has characteristic properties which are independent of the amount of the sample [simply speaking, it doesn't matter how much of the substance you have, these properties are the same]
- Properties can be classified as Physical or Chemical

Physical Properties of Matter

- Properties that are observable, measurable, and will keep the same composition (nothing new is created)
- Some Physical Properties include:

Color	Luster	Solubility
Size	Hardness	Conductivity
Odor	Condensing	Boiling point
Density	Melting point	

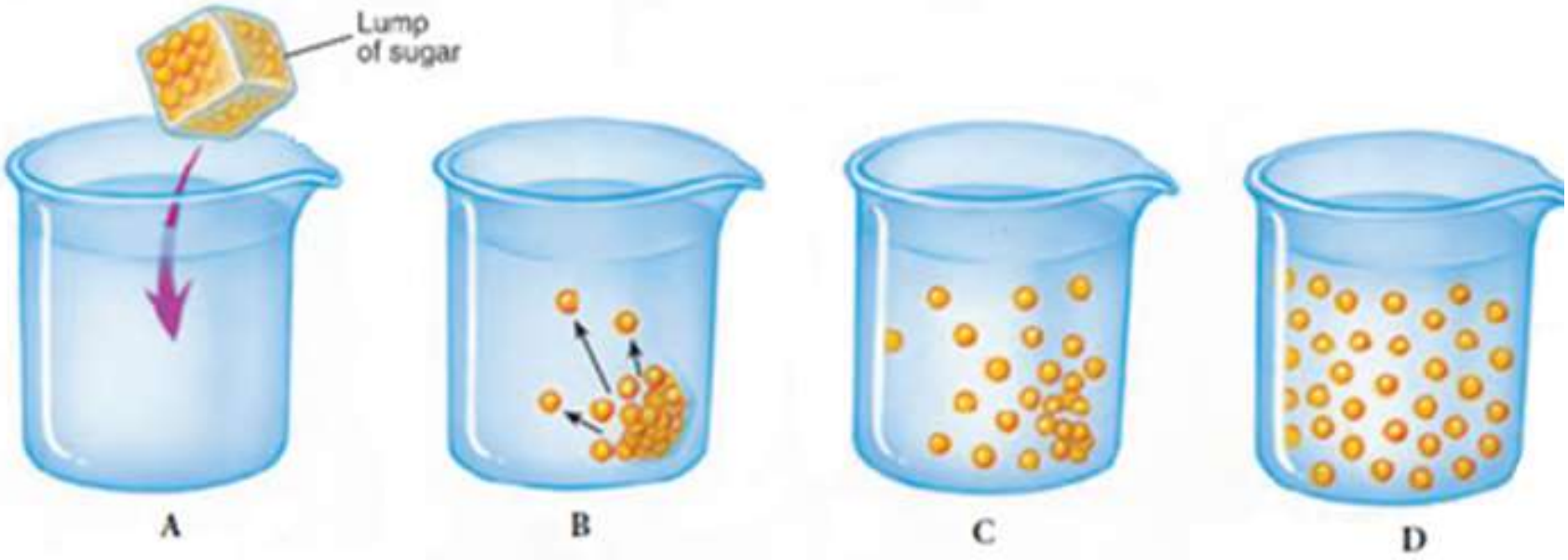
Physical Properties of Matter

- Some physical properties are easier to understand than others such as Color, Size, Odor, Luster (Shine), and Hardness

- Changes in state of matter such as melting, boiling, freezing, and condensing do not create a new substance and retain their original composition and is therefore a physical property

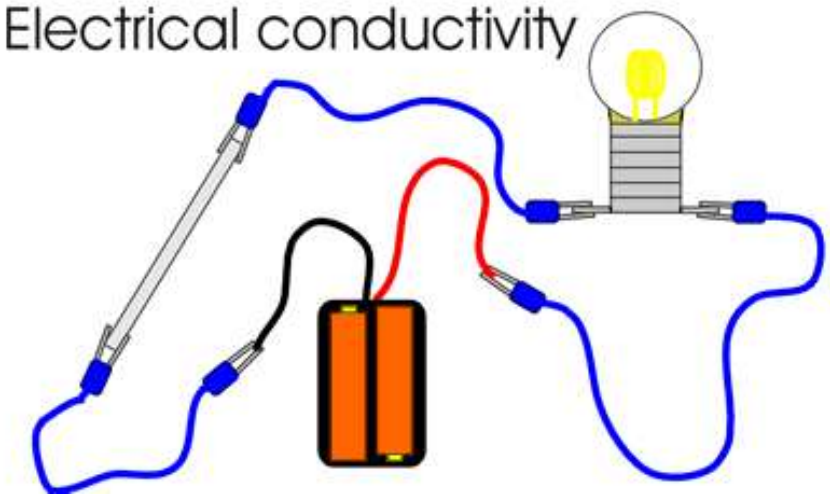
Physical Properties of Matter: Solubility

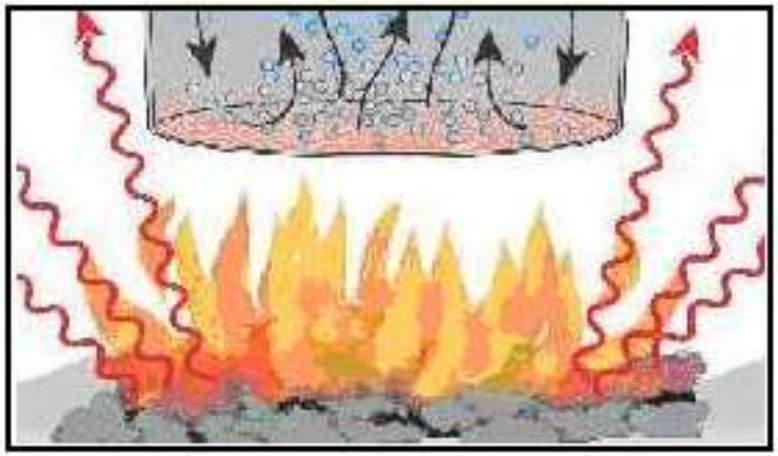
Solubility is the ability of a substance to dissolve in another substance. Flavored drink mix dissolves in water. Or, as the image shows, a lump of sugar dissolving in water.



Physical Properties of Matter: Conductivity

Conductivity is the ability to conduct or transmit heat, electricity, or sound.





Physical Properties of Matter: Density

- Density is the amount of matter (mass) in a given space (volume)
- Density equals Mass divided by Volume (D=M/V)
- For example, a golf ball and a table-tennis ball have similar volumes. But a golf ball has more mass than a table-tennis ball does. So, the golf ball has a greater density.

Physical Properties of Matter: Density of Solids

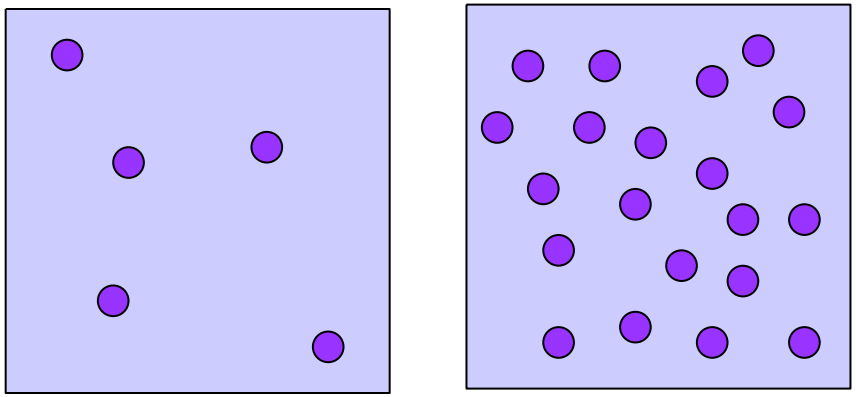
Which would you rather carry around all day: a kilogram of lead or a kilogram of feathers?

At first, you might say feathers. But both the feathers and the lead have the same mass. However, the lead would be less awkward to carry around than the feathers would. Why?

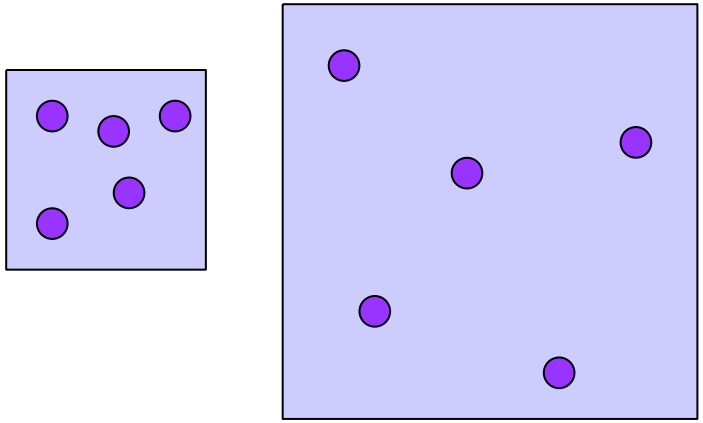
The feathers are much less dense than the lead. So, it takes a lot of feathers to equal the same mass of lead.

Physical Properties of Matter: Density of Solids

Which square is more dense? Why?



Which square is more dense now? Why?



Physical Properties of Matter: Density of Solids

- Knowing the density of a substance can also tell you if the substance will float or sink in water.
- If the density of an object is less than the density of water, the object will float. Likewise, a solid object whose density is greater than the density of water will sink when the object is placed in water.
- Explore the Density of Solids and Water using the PhET simulation on density and buoyancy

Physical Properties of Matter: Density of Liquids

- Like all substances, liquids have different densities
- It is easy to see the differences in the density of liquids because more dense liquids will sink and less dense liquids will rise
- If you pour together liquids that don't mix and have different densities, they will form liquid layers.
- Making Liquid Layers: http://www.youtube.com/watch?v=-CDkJuo_LYs

Physical Properties of Matter: Density of Liquids

- Check out this picture. Which layer has the highest density?
- Which layer has the lowest density?
- Imagine that the liquids have the following densities:

  $10 g/cm^3$ $3 g/cm^3$

  $6 g/cm^3$ $5 g/cm^3$

- Which number would go with which layer?

Physical Properties of Matter: Density of Liquids

Try with your neighbor!

- Which liquid has the highest density?
- Which liquid has the lowest density?
- Which liquid has the middle density?

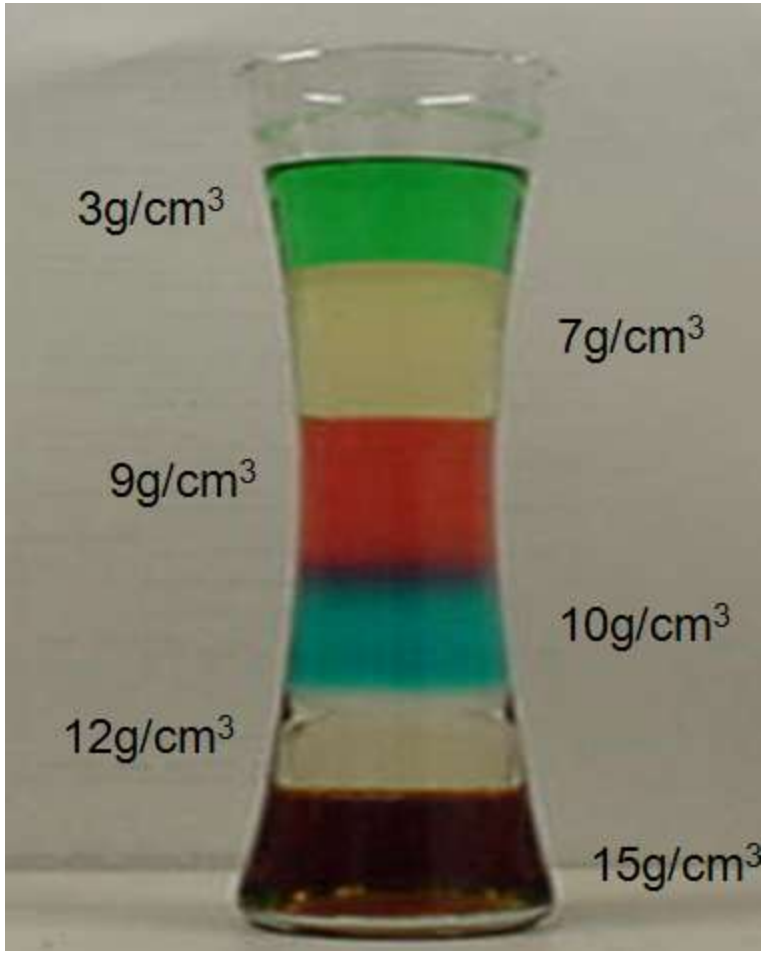
Physical Properties of Matter: Density of Liquids

Try on your own!

- Imagine that the liquids on the right have the following densities:

$15 g/cm^3$	$10 g/cm^3$
$3 g/cm^3$	$9 g/cm^3$
$7 g/cm^3$	$12 g/cm^3$

- Match the colors to the correct densities.



How would you describe a piece of wood before and after it is burned? Has it changed color? Does it have the same texture?

The original piece of wood changed, and physical properties alone cannot describe what happened to it.

Chemical Properties of Matter

- Chemical properties are only observable during a chemical reaction and allows for change (something new is created)
- The property is the ability to change whereas the change is the action itself
- Some chemical properties include: Reactivity, Combustibility, Flammability

Chemical Property of Matter: Reactivity

- Reactivity describes how easily something reacts with something else
- Reactivity can also be described as the ability of a substance to combine with another substance and form a new substance
- Reactivity of Metals Video Clip
- Short clips showing the various reactions of elements with water

Chemical Property of Matter: Combustibility

- Combustibility is a substance or material that is able or likely to catch fire and burn
- Flammability is often described as a chemical property as well. Flammability occurs at a lower temp than combustibility
- Video clip showing various combustion reactions
- Whoosh Bottle Combustion Reaction video clip

How does a physical change differ from a chemical change in matter?

S8P1e. Distinguish between changes in matter as physical (i.e., physical change) or chemical (development of a gas, formation of a precipitate, and change in color)

Activating Strategy:

Watch the two video clips showing two ways to change a sheet of paper. Describe your observations and the differences on your Notes sheet.

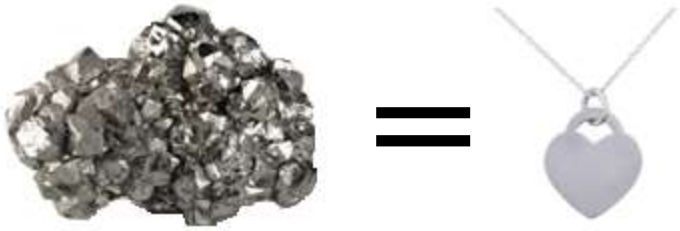
http://www.youtube.com/watch?v=1vNxjGMF6o8

http://www.youtube.com/watch?v=TUVScBf8Znw

Physical Change in Matter

- A physical change is a change that affects one or more physical properties of a substance.
- The identify of the substance stays the same
- No new substance is formed
- Physical changes are more easily reversed

Physical Change in Matter



Imagine that a piece of silver is pounded and molded into a heart-shaped pendant.

This is an example of a physical change. Why?

Only the shape of the silver has changed. The piece of silver is still silver.

Physical Change in Matter

Some Examples of Physical Change:

- Melting
- Breaking
- Bending
- Cutting
- Freezing
- Crushing
- Boiling
- Dissolving
- Condensing
- Evaporating
- Changing State

Physical Change in Matter Activity

- Select one activity below or use your own to demonstrate a physical change
  - Sugar Cube Activity [see resources]
  - Clay Transformation [see resources]
  - Paper Origami [see resources]

Distributed Summarizing:

On your notes sheet, identify and describe a physical change that you have made or observed in the past few days.

When instructed, share your physical change with a partner and explain why it is an example of a physical change.

Chemical Change in Matter

- A chemical change happens when one or more substances are changed into new substances that have new and different properties
- Most chemical changes are difficult to reverse
- Some chemical changes can be reversed by more chemical changes

What is the difference between a chemical property and a chemical change?

- A chemical property of a substance determines whether a chemical change can occur
- A chemical change is the actual process of changing
- Let's look at an old car as an example

What is the difference between a Chemical Property and a Chemical Change?

- The iron used to make the old car above has the Chemical Property of Reactivity with Oxygen. The Chemical Change occurs only when the car is left out and is exposed to oxygen and it rusts.
- Why then does the bumper on the car still look shiny and new?
- The bumper is coated with chromium. Chromium has the Chemical Property of Non-reactivity with Oxygen.

Chemical Change in Matter

Some Clues that a Chemical Change occurred:

Fizzing

Change in color

Production of heat

Emission of light

Development of gas

Formation of a precipitate

Foaming

Change in odor

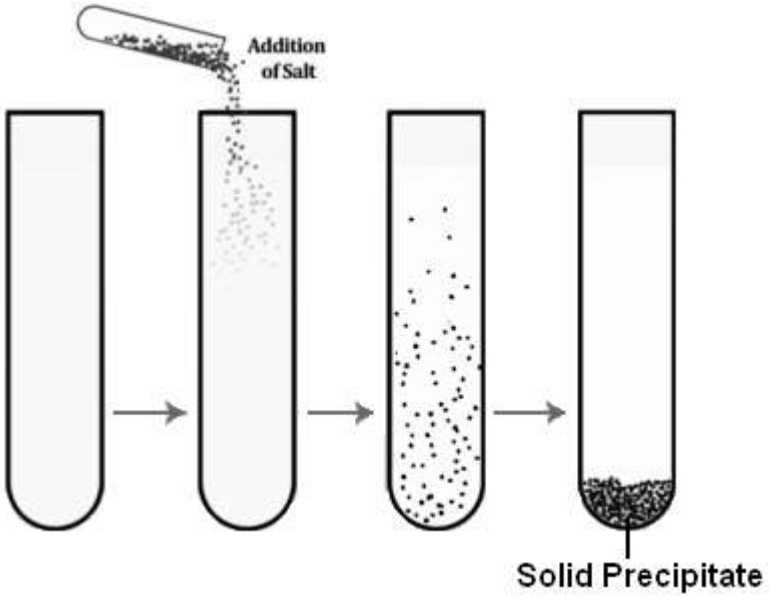
Sound given off

The signs are not definite. More than one clue should be used to determine chemical change

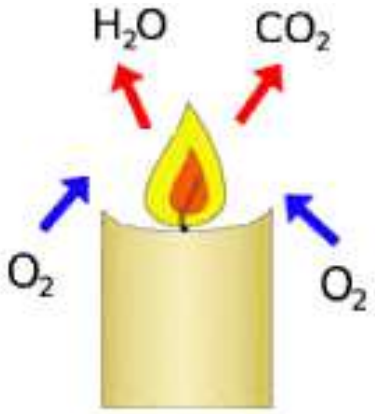
Emission of Light

Fizzing and Foaming

Formation of a Precipitate

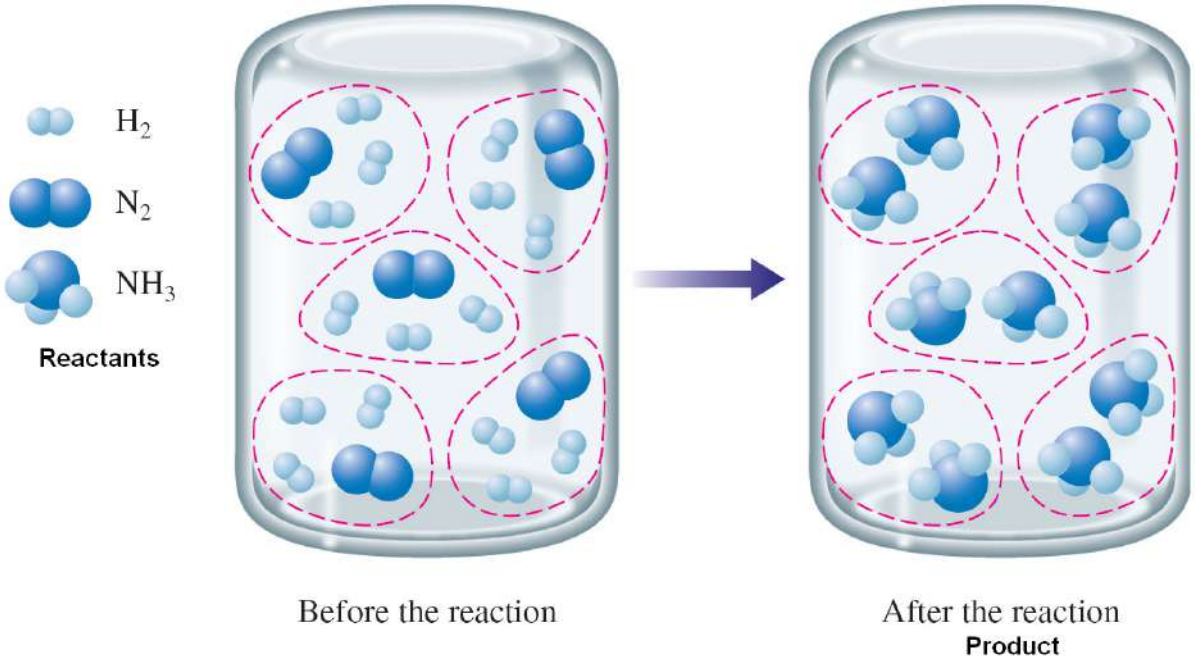


Development of Gas



Chemical Change in Matter

- Substances before a chemical change are “reactants”. After a chemical change the new substances are formed. They are called “products.”
- The product cannot go back to its original reactants.



Chemical Change: Baking a Cake Example

- To bake a cake, you combine eggs, flour, sugar, and other ingredients.
- However, when you bake the batter, you end up with something completely different.
- The result is a cake that has properties that differ from the properties of the ingredients.

Chemical Change: Baking a Cake Example

What clues could you use to determine there was a chemical change?

- You smell the cake baking
- You see the batter rise
- You see the cake brown
- You can see air pockets made by gas bubbles that formed in the batter when it is finished baking
- A new substance is formed that cannot be reversed

Examples of Chemical Change in Matter

Burning
Cooking/Frying
Using a battery
Fermenting
Decomposition
Photosynthesis
Rusting
Fireworks
Digestion
Respiration

Distributed Summarizing:

On your notes sheet, identify and describe a chemical change that you have made or observed in the past few days.

When instructed, share your chemical change with a partner and explain why it is an example of a physical change.

Physical & Chemical Change in Matter

- When matter undergoes change, it always involves energy going into or out of the system
- Whether the change is physical or chemical, the total amount of matter always stays the same, even though the materials my appear much different after the change as compared to before

Physical and Chemical Changes Study Jams Video