Physical & Chemical Changes

Some of the most useful and powerful properties of matter are those related to how and why matter changes. There are countless changes in matter that affect us every day: for example, applying heat to an egg, burning gasoline, freezing water, and mixing oil and vinegar, to name a few. Observing, understanding and categorizing kinds of change are an important first step to making use of change.

PRACTICE

1. Which changes result in new substances? Which do not?
Observations

RECALL!
An observation is information that you get through your senses. You observe that a rose is red and has a sweet smell. You may also note that it has sharp thorns on its stem. You may count the petals on the flower and the leaves on the stem and measure the length of the stem.

When people describe the qualities of objects and events, the observations are qualitative. The colour of the rose, the odour of the flower, and the sharpness of the thorns are all qualitative observations.

QUALITATIVE DATA
- information that you get through your senses

Observations based on measurements or counting are quantitative since they deal with the quantities of things. The length of a rose’s stem, the number of petals, and the number of leaves are quantitative observations.

QUANTITATIVE DATA
- information based on measurements or counting
Although the kind of observations are often gathering quantitative evidence clearly and accurately. Although the kind of observations are often dictated by the question asked at the beginning of the investigation, both qualitative and quantitative evidence is often gathered. Do not make the mistake of forgetting to record qualitative evidence when you are gathering quantitative evidence.

Physical Change

Changes of state - melting, freezing, evaporation, condensation, sublimation, deposition - are physical changes. Dissolving is also a physical change. When you dissolve sugar in water, the sugar particles spread out, but they are still there, as sugar particles. You can reverse the process by evaporating the water and collecting the sugar.

NOTE!
Most physical changes are easy to reverse.

<table>
<thead>
<tr>
<th>Physical Change</th>
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<tbody>
<tr>
<td>PHYSICAL CHANGE</td>
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<tr>
<td>● substance remains the same but changes state or form</td>
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<tr>
<td>● chemical properties do not change</td>
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<tr>
<td>● generally easy to reverse</td>
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<tr>
<td>● dissolving, melting, ...</td>
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February 9, 2013 2DCHEM - Physical & Chemical Changes
Physical Change

PRACTICE
2. Copy and complete the diagram showing the physical changes that water undergoes as it changes states.

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Chemical Change

Burning, cooking, and rusting are all examples of chemical changes. A chemical change always involves the formation of a new substance. For example, if you have ever mixed vinegar and baking soda you have experienced a chemical change. The bubbles that form are carbon dioxide gas – a new substance.

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Chemical Change

CHEMICAL CHANGE
- produces new substances with different chemical properties
- breaks compounds into atoms
- burning, cooking, rusting, ...

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NOTE!
While some chemical changes are easy to categorize others are not so easy. So how do you distinguish between the two? While there are clues that can help you decide whether a chemical or physical change has occurred it is important that you do not come to a conclusion too quickly. All of these clues suggest that a new substance has been produced, but any one of them could also accompany a physical change. You must consider several clues in order to determine what type of change has taken place.

PRACTICE
3. There are 6 distinctive clues (either alone or together) that indicate a chemical change has occurred. What are they?

CHEMICAL CHANGE CLUES
1. a new colour appears
2. a new odour appears
3. heat/light is given off/absorbed
4. bubbles of gas are formed
5. a solid material (precipitate) forms
6. the change is difficult to reverse

Physical & Chemical Changes – DYK?
Many chemical changes, such as those that occur when something burns, cannot be reversed. However, some chemical changes can be reversed. When you recharge a battery, you use electricity to reverse chemical changes that took place inside the battery to supply power.

PHYSICAL & CHEMICAL CHANGES
- some are reversible, while others are not
Exothermic & Endothermic Reactions

The explosion of dynamite, the freezing of water, and the burning of wood are all processes in which thermal energy (heat) is given out to the surroundings. Physical and chemical changes that release heat to the surroundings are said to be exothermic. For example, consider the combustion of gasoline:

\[
\text{gasoline} + \text{oxygen} \rightarrow \text{carbon dioxide} + \text{water} + \text{heat}
\]

On the other hand, other physical and chemical changes take place only when energy is continuously supplied to the surroundings. Reactions that absorb heat from the surroundings are said to be endothermic. For example, consider the melting of ice:

\[
\text{ice} + \text{heat} \rightarrow \text{water}
\]
Exothermic & Endothermic Reactions

ENDOTHERMIC REACTION
- chemical reaction that absorbs heat (energy) from the surroundings

Check Your Learning

1. Classify each of the following as a physical or chemical change.
   (a) Dry ice, solid carbon dioxide, sublimes at room temperature. **P**
   (b) Salt dissolves in water. **P**
   (c) Iron rusts in a damp environment. **C**
   (d) Gasoline burns in the presence of oxygen. **C**
   (e) A dead organism slowly decomposes. **C**

Check Your Learning

2. When sodium carbonate is added to water, the sodium carbonate **dissolves**. When hydrochloric acid is added to the solution, the solution **fizzes**. What kinds of changes have occurred? Explain.

   **dissolves** = change of state = physical
   **fizzes** = bubbles of gas are formed = chemical
The mint-cola fountain experiment may be one of the most popular science novelties of all time. It begins by dropping mints into a bottle of carbonated cola drink. Within a few seconds, a giant fountain of cola comes whooshing out of the bottle.

**QUESTION**

How does it work? (3 reasons)

- carbon dioxide (dissolved in the cola)
- surface tension
- pits in the surface of the mint