

Experiment: What's the Matter?

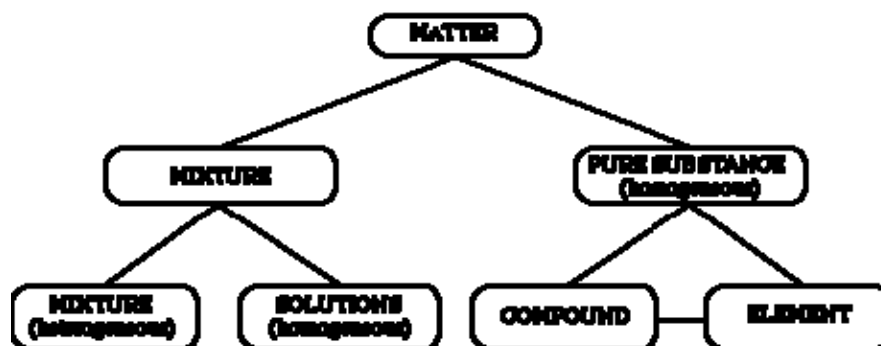
Chemical and Physical Properties and Changes

Objective:

The objective of this lab is to identify different classes of matter based on the physical properties of different elements and compounds and to determine whether the changes observed are physical or chemical changes.

Background and Scientific Principles:

Matter is divided into the four basic states of solid, liquid, gas, and plasma. Matter is classified based on composition. Homogeneous matter is matter that appears the same throughout a mixture. Heterogeneous matter is matter that has differing appearances throughout the mixture. The concept map below shows the relationship between some of the primary classes of matter.



Matter is identified by its characteristic physical properties. Physical properties are those that can be determined without altering the composition of the substance, such as, color, odor, density, strength, elasticity, magnetism, and solubility. Chemical properties are descriptions of the substance and its reactions with other substances to create new substances with new properties. These chemical properties are identified through chemical reactions. Evidence of a chemical reaction possibly occurring can be seen through a color change, temperature change, evolution of a gas, and the formation of a new substance. This lab will only focus on the physical properties of matter.

States of matter

- solids are rigid and have shapes
- liquids flows and take the shape of the container
- gases are less dense than liquid and occupy all parts of a vessel.

Physical and Chemical Properties

- A chemical property is the ABILITY of a substance to react with something else (air, water, acids, etc.)
- Chemical properties of substances are related to the kinds of chemical changes that the substances undergo.
 - Example: Iron reacts with atmospheric oxygen to form iron (II) oxide (commonly known as rust).
- Physical properties include color, density, hardness, melting point, boiling point or freezing point, electrical and thermal conductivities.
- Some physical properties of a substance depend on the conditions such as temperature and pressure in which they are measured.
 - Example CO₂ is gas at atmospheric pressure but at lower pressure is a solid.

Physical and Chemical Changes

- Physical change occurs when no new compound or molecule is formed. The element or the compound can be retrieved back to its original state. More common observation of a physical change is a change of physical state. An example is ice to water to steam.

- Chemical change occurs when a new compound or molecule is formed and one or more substances are used up. Evidence that chemical change has occurred is permanent change in color, gas evolution, and precipitation.

Solubility

- Solids can have partial to complete solubility in a solvent. A solid that completely dissolves is considered soluble. The solid "disappears" and no crystal remains.
- Partially soluble solids at times will appear less than the original volume. At times, colored compound that partially dissolve will color the solvent.
- Liquids that are soluble will dissolve into a homogeneous solution.
- Liquids that are partially soluble or insoluble will form layers. Insoluble liquid will go to the bottom of the solvent if it is denser than the solvent and float up to the top if it less dense than the solvent.

Questions you should be asking yourselves as you perform the experiment

- What are the physical characteristics of a metal, non-metal and a gas?
- What is the difference in observation of an insoluble solid vs. insoluble liquid.
- What is the difference between a physical change vs. chemical change?
- What patterns of evidence do you note in your observations of physical change? Chemical change?
- Do you note any difference in the physical and chemical changes of elements or compounds?

Materials and Supplies:

- | | |
|----------------------------------------------------|--------------------------------|
| • test tubes (stored cleaned and inverted in rack) | • Different samples of matter: |
| • stirring rod | ○ baking soda |
| • magnet | ○ iron filings |
| • magnifying glass | ○ flour |
| • water (for testing) | ○ sulfur |
| • vinegar (for testing) | ○ corn starch |
| • graduated cylinder | ○ sugar |
| | ○ salt |
| | ○ sugar |
| | ○ sand |
| | ○ cake mix |

General Safety Guidelines: Wear safety goggles. Some materials may cause skin irritation. Wear lab aprons.

Procedure:

1. Examine each sample. Record color, odor, and relative particle size in the data table. Use a magnifying glass if necessary.
2. With a magnet, test each sample for magnetic properties. To test with the magnet, place a small sample on a piece of paper. Take the magnet and *UNDERNEATH* the paper, draw the magnet across the sample (**The magnet should never be in direct contact with the sample.**) Record whether the sample is magnetic or not.
3. For this part, use the test tubes in the rack. Test the solubility in water of each sample by adding 5 mL (use a graduated cylinder) of water into test tube. Add a small amount (about 1/2 the size of a pea) of the sample to the water. Flick the test tube with your finger to help mix the sample in the water. (Note: If mixing does not occur, use a stirring rod.) Record observations.
4. Test the sample in vinegar by adding 5 mL of vinegar into a test tube. Add a small amount (about 1/2 the size of a pea) of the sample to the vinegar in the test tube. Flick the test tube with your finger to help mix the sample in the water. (Note: If mixing does not occur, use a stirring rod.) Record observations.
5. Dispose of all samples in the TRASH (the trash can has a black plastic liner). Do not dispose of anything in the sink (they are easily clogged).

Data Table and Calculations:

In the lab, be sure to use blue or black PEN (NO PENCIL) when you complete this data table. *NEVER* WHITE-OUT data. Enter data carefully so that you make no mistakes. Print neatly! Fill in the data table based on your *observations* in your comp book.

Sample	Color (Describe)	Odor (yes or no)	Particle Size (relative to other samples)	Magnetic (yes or no)	Solubility in H ₂ O (soluble, partially soluble, insoluble)	Reaction with vinegar (if yes, describe)	*Class of Matter (element, compound or mixture)
Baking soda							
Iron filings							
Flour							
Sulfur							
Cornstarch							
Sugar							
Salt							
Sand							
Cake mix							

*Class of Matter - at home, look up each of these substances in a dictionary, your text or on the internet. Determine if the substance is an element or compound or mixture.

LAB QUESTIONS

Answer all questions on the sheet and include in your comp book with your experiment write-up. For clarity and future use you must include the actual question or imply it in the answer.

Summary Questions:

1. Different kinds of matter are recognized by observing their: _____
2. Five characteristics or properties used to identify substances are: _____
3. Two kinds of changes that matter may undergo are: _____
4. A change in which a substance loses the properties by which we identify it is called a ____ change.
5. A change in which an element or compounds may change some of its physical properties but not its chemical properties is called a ____ change.
6. How did you determine which sample is the *most* soluble?
7. List the samples from highest to lowest solubility.
8. Which of the samples would be classified as a mixture?
9. What physical properties of matter were tested in this lab?

Conclusions:

1. A chemical change is one in which: _____
2. Compounds are formed as the result of _____ changes.
3. A physical change is one in which: _____
4. The formation of mixtures is a _____ change.

Related Questions:

1. Matter is defined as: _____
2. The three states or forms of matter are: _____
3. Mixing iron filings and sulfur is a: _____ change because _____
4. Heating a mixture of iron filings and sulfur produces a _____ change because _____
5. State whether the following are Physical (P) or chemical (C) changes:

a) Souring of milk _____	e) Dissolving salt in water _____	i) Boiling water _____
b) Rusting of iron _____	f) Magnetizing iron _____	j) Melting ice _____
c) Breaking glass _____	g) Burning of coal _____	k) Melting paraffin _____
d) Tarnishing of silver _____	h) Pulverizing sugar _____	l) Decaying of food _____
6. Does the application of heat to a substance always produce a chemical change? _____
Give examples to support your answer _____
7. Give an example of a chemical change produced by:

a) Light _____	b) Electricity _____	c) Heat _____
----------------	----------------------	---------------
8. Give an example of a chemical change which produces:

a) Light and Heat _____	b) Electricity _____	c) Mechanical energy _____
-------------------------	----------------------	----------------------------
9. How would you show that:

a) dissolving sugar in water is a physical change.	b) heating a platinum wire in air is a physical change.
----------------------------------------------------	---------------------------------------------------------