

Properties of Matter

Unit: Matter

MA Curriculum Frameworks (2016): HS-PS1-11(MA)

Mastery Objective(s): (Students will be able to...)

- Describe the properties of mixtures and pure substances.
- Classify substances as heterogeneous or homogeneous mixtures, compounds, or elements according based on information about those substances.
- Identify methods of separating mixtures based on differences in properties.

Success Criteria:

- Substances are correctly identified as mixtures (heterogeneous or homogeneous), compounds or elements.
- Suitable methods for separating mixtures are chosen based on differences in chemical or physical properties.

Tier 2 Vocabulary: physical, chemical, property, mixture, compound, element

Language Objectives:

- Demonstrate understanding of the key terms “homogeneous mixture,” “heterogeneous mixture,” “compound,” and “element.”

Notes:

physical properties: characteristics of the substance that can be measured or observed without changing the identity of the substance. *E.g.*, boiling point, freezing point, density, size, shape, color, *etc.*

chemical properties: characteristics of the substance having to do with how the atoms and molecules that make up substance can be combined with or changed into other substances. These properties can only be measured through changes to the identity of the substance. *E.g.*, chemical reactivity, flammability.

physical change: any change that alters the physical properties of the substance, such as freezing, boiling, tearing, crushing, *etc.*

chemical change: any change that alters the chemical properties (identity) of the substance, such as burning, cooking, rusting, decaying, *etc.*

Use this space for summary and/or additional notes:

Note that the difference between a physical change and a chemical change can be subtle. For example, if you have a solution of sugar dissolved in water and you let the water evaporate, this would be a *physical* change because the sugar and water molecules are each unchanged by the process.

However, if you have a solution of salt dissolved in water and you evaporate the water, this would be a *chemical* change, because when salt dissolves in water, the ionic bonds between the sodium and chloride ions break and the ions remain separate while the salt is in solution. When you evaporate the water, ionic bonds form between the sodium and chloride ions, which creates the ionic compound sodium chloride.

There is no way to see this difference. This means you need to understand chemical bonds and the processes of forming and breaking them in order to be able to decide whether a change is physical or chemical!

Mixtures vs. Pure Substances

mixture: two or more different substances sharing the same space or volume.

Mixtures can be separated based on differences in physical properties.

Mixtures can be:

homogeneous: every sample of the mixture is the same, no matter what part of the mixture it's taken from. (*homo* = same) *E.g.*, salt water. Gatorade

heterogeneous: samples taken from different parts of the mixture may be different. (*hetero* = different) *E.g.*, chocolate chip cookies, orange juice.

pure substance: a pure substance is a substance that cannot be separated or broken down by any physical change. A pure substances can be a:

compound: a substance made out of different kinds of atoms that are chemically bonded together. Compounds can be broken down through chemical changes. Anything that can be described by a chemical formula is a compound. *E.g.*, H_2O , $C_6H_{12}O_6$, $NaCl$ (table salt), C_3H_8O (rubbing alcohol).

element: a substance made out of only one kind of atom. Elements cannot be broken down through chemical changes. The periodic table lists all of the known elements according to their properties, which means any substance on the periodic table is an element. *E.g.*, iron, gold, oxygen, aluminum.

Use this space for summary and/or additional notes:

Separating Mixtures

Mixtures can be separated based on differences in the physical properties of the different substances that make up the mixture. Some processes used for separating mixtures include:

filtration: separating substances by size—larger ones are trapped on the filter and smaller ones can pass through.

distillation: separating substances that have different boiling points by heating to a temperature at which one boils and the other does not.

evaporation: evaporating or boiling off water (or another solvent) to leave behind a solid.

crystallization: separating substances that have different freezing points by letting one form a solid (freeze), but not the other.

centrifugation: separating substances according to their densities by spinning them at high speeds.

chromatography: separating substances by how quickly or slowly they move through another substance.

Homework Problems

For each of the following changes, state whether the change is chemical or physical and explain how you know.

1. water boiling
2. iron rusting
3. cooking an egg
4. breaking glass
5. tearing up a piece of paper
6. burning a piece of paper

Use this space for summary and/or additional notes:

Properties of Matter

Page: 109

Big Ideas

Details

Unit: Matter

7. making crushed ice in a blender

8. garbage turning into compost

9. leaves changing color

Classify the each of the following types of matter as a heterogeneous mixture, homogeneous mixture, compound, or element.

10. pure water (H_2O)

16. carbonated soda

11. helium

17. ice water (pure H_2O , but both liquid and solid)

12. chocolate-chip cookies

18. aluminum

13. salt water

19. chicken noodle soup

14. orange juice

20. chicken broth

15. 14-karat gold (note: pure gold is 24K)

21. glucose ($\text{C}_6\text{H}_{12}\text{O}_6$)

22. How would you separate a mixture of sugar, sand, and hollow plastic beads?

Use this space for summary and/or additional notes: