

Changes and Matter

Name: _____

Date: _____

Information: Changes in Matter

Books are made of matter. You are made of matter. “Matter” is a fancy word for the “stuff” of which all objects are made. Every day, matter is changed in different ways. For example, paper can be changed in many ways—it can be torn, folded, or burned.

A chemical change is any alteration that changes the identity of matter. For example, by passing electricity through water it can be broken down into hydrogen and oxygen. Burning paper is a chemical change because after the change takes place, the paper has been changed into different substances (like ash, carbon dioxide, etc.).

A physical change is any alteration that does not change the identity of the matter. Shredding paper does not change the paper into a different substance. Dissolving salt in water is a physical change because after the change, the salt and water are both still there.

One more example: consider two *elements*—sodium and chlorine. Sodium is a metal so reactive that if you put a small piece of it in water, it will explode! Chlorine is a gas so toxic that it was used as a weapon in World War 1. If you put sodium metal and chlorine gas in the same container together all you have done is *mixed* them. Creating a *mixture* is a physical change because the original properties of explosiveness and toxicity are still there. But if you heat the container, you would see bright light and smoke. After the smoke clears you would notice white crystals coating the inside of the container. Those crystals are called sodium chloride—ordinary table salt! The explosive metal and the toxic chlorine have been chemically changed—instead of explosive and toxic, the resultant product is salty! That’s a chemical change!

Critical Thinking Questions

1. Explain why each of the following is a physical change.
 - a) boiling water until no water remains **Boiling the water simply changes the state of matter, but it is still H₂O before and after it is boiled.**
 - b) mixing sugar with coffee
The sugar is still sugar before and after you mix it with coffee. Neither the sugar nor the coffee changes into something entirely different.
2. Explain why each of the following is a chemical change.
 - a) a car rusting
When a car rusts, the iron metal in the car changes into something else (iron oxide) which has completely different properties.
 - b) food digesting
The chemicals in the food are broken down into other chemicals during digestion.

3. Identify each of the following changes as chemical or physical by placing a C or P in each blank.

__C__ a) acid rain corroding the statue of liberty __P__ d) melting steel
 __P__ b) dissolving salt in water __C__ e) dissolving steel in acid
 __P__ c) boiling salt water until just salt remains __P__ f) cracking ice

Information: Elements, Compounds, Mixtures

Examine the following tables. Following the name of each element or compound is the “chemical formula” of the element or compound; please see the periodic table for the meaning of some of the symbols (i.e. Na = sodium). *Italics* tell you that substance is organic.

Elements	Compounds
Sodium (Na)	Water (H ₂ O)
Chlorine (Cl)	<i>Methane (CH₄)</i>
<i>Carbon (C)</i>	Sodium chloride, salt (NaCl)
Oxygen (O)	<i>Carbon dioxide (CO₂)</i>
Hydrogen (H)	Hydrogen Peroxide (H ₂ O ₂)

Pure Substances	Mixtures
Salt (NaCl)	Salt water (NaCl and H ₂ O)
Hydrogen (H)	Sand
<i>Carbon dioxide (CO₂)</i>	Hydrogen (H) and Oxygen (O)
Water (H ₂ O)	Sodium (Na) and Chlorine (Cl)
Aluminum (Al)	Kool-aid (sugar, water, etc.)

Critical Thinking Questions

4. How are elements different from compounds?
Elements are composed of only one type of atom, but compounds are composed of more than one.
5. How are compounds different from mixtures? **Compounds are formed by a chemical change (i.e. two hydrogen and one oxygen atom bonding to form a water molecule), but mixtures are formed by a physical change (i.e. stirring salt and water together).**
6. How are pure substances different from mixtures?
Pure substances are not mixed with anything else, but mixtures are composed of two or more things physically (not chemically) combined.
7. Can something be both a mixture and a pure substance? Explain using examples from the tables.
No, there is nothing from the table that is in both categories.

8. Is it always possible to identify something as an element, compound, pure substance or mixture just by looking at it? Explain using examples from the tables.

No, some things look the same, but are not the same at the microscopic scale. For example, water (a compound) and salt water (a mixture) look exactly the same.

9. Formulate a definition for each of the following terms.

a) element:

Matter that is composed of only one kind of atom.

b) compound:

Matter that is composed of two or more kinds of atoms chemically combined together (that is, it is made by a chemical change occurring between two or more atoms).

c) mixture:

Matter that is composed of two or more pure substances physically combined together.

d) pure substance: Matter that is not mixed—either a pure element or a pure compound.

10. Categorize each of the following as an element, compound, mixture, or pure substance. If more than one label applies, then include both labels. (You will need more than one label sometimes.)

a) Mixture Popsicle

c) Element, Pure Substance Gold

b) Compound, Pure Substance Sugar

d) Mixture Dishwater

11. If you have a container with hydrogen gas and oxygen gas in it do you have water? Why or why not?

You do not have water because the hydrogen and oxygen atoms are simply mixed together; they are not bonded together.

12. Give an example of something that is an element. Your example should not already be on this sheet.

Any substance listed on the periodic table. For example, phosphorus or nitrogen.

13. Give an example of something that is a compound. Your example should not already be on this sheet.

Octane, hydrochloric acid, carbon monoxide, etc.

14. Give an example of something that is a mixture. Your example should not already be on this sheet.

Soda pop, salad, bread and butter, etc.

15. Using the earlier table, what do all organic substances have in common?

They all contain carbon.

Information: Homogeneous and Heterogeneous Mixtures

Examine the following table.

Example of Mixture	# of <u>phases</u> in mixture	How many kinds of <u>states</u> in mixture	Homogeneous or heterogeneous?
Salt water	1	2	Homogeneous
Oil and water	2	1	Heterogeneous
Sugar and salt (no water)	2	1	Heterogeneous
Sugar and salt in water	1	2	Homogeneous
Sand and water	2	2	Heterogeneous
Carbon dioxide, water, and ice	3	3	Heterogeneous
14 kt. gold (mixture of silver and gold)	1	1	Homogeneous

Critical Thinking Questions

16. What is the difference between a "phase of matter" and a "state of matter"? Define each term as best you can.

The "state" of matter tells us whether the substance is a solid, liquid, or gas. A "phase" of matter is a section of matter that is the same throughout. For example, in oil and water, there is one *state*—the liquid state—and there are two *phases*—the oil phase and the water phase.

17. What relationship exists between a homogeneous mixture and the number of phases in the mixture?

A homogeneous mixture must have only one phase.

18. What is the difference between homogeneous and heterogeneous mixtures?

A homogeneous mixture is the same throughout—one small sample of the mixture is an exact representation of the whole. A heterogeneous mixture has different parts—one small sample will not have the same composition as the rest of the mixture.

19. If you had to categorize elements as homogeneous or heterogeneous, what category would you put them in?

All elements are homogeneous. For example, one small piece of gold should have the same composition as a larger piece of gold.

20. If you had to categorize compounds as homogeneous or heterogeneous, what category would you put them in?

All compounds are homogeneous. For example, one drop of water will have the same composition as another drop—all H₂O molecules.

21. Categorize each of the following as homogeneous (homo) or heterogeneous (hetero).

hetero a) salad hetero b) ice water hetero c) dishwater homo d) 14 kt. Gold