

## Everyday Compound or Poison?

All elements found on the periodic table have certain distinct properties. Elements are single types of atoms, while atoms are the fundamental building blocks of all matter. Gold, for instance, is a soft, naturally occurring metal known for being beautiful and desired. Gold is malleable, and while it is found naturally in the environment, it is often reworked and incorporated into fine jewelry. Oxygen is a necessary and naturally occurring element. It's an invisible, odorless gas that's a crucial part of the air we breathe and necessary for our bodies to function properly. Often, elements like those noted are combined in varying ways to create new chemical substances.

Chemical substances react in certain ways and also have certain discernible properties. For instance, when an oxygen atom and two hydrogen atoms come together they form water, which is essential to life. When the atoms of a specific substance are regrouped, a new substance is formed with often vastly different properties from the original substance. Occasionally something completely harmless, or even necessary, can become dangerous or lethal when its molecules (a grouping of two or more atoms) are regrouped.

The components of table salt are a good example of how different substances can look when their atoms are rearranged. Common table salt, also known as sodium chloride, is an interesting chemical compound because, while it is commonly consumed by humans, when you separate its elements—sodium and chlorine—you are left with something quite different from the edible seasoning known as salt.

The components of salt are sodium and chlorine, both of which are harmful for human consumption and even contact. Sodium requires great care when being handled. If it comes into contact with water, the reaction can be flammable, while powdered sodium has the potential to be combustible (explosive) in oxygen or air.

Chlorine, meanwhile, is an extremely caustic and dangerous substance. Chlorine is used primarily as a cleaning agent; it is commonly used in swimming pools to render them sanitary, but is mixed with other chemicals and diluted for these purposes. This is what makes it safe for people to swim in swimming pools.

Chlorine has also had other, more dangerous uses in the past. Chlorine is a toxic gas that is extremely harmful to the respiratory system and may also react with certain flammable materials. When chlorine reacts with the mucous of the lungs, it can create a potentially lethal compound known as hydrochloric acid. During World War I, chlorine gas was used by Germany as a chemical weapon. It only takes a few deep breaths of the gas, at a certain potency, to cause death.

Hydrochloric acid, a clear solution of hydrogen and chlorine in water, has other uses, however, including household cleaning and food processing. It's also found naturally in the body's gastric acid. Hydrochloric acid is found in food-grade purification levels in products such as aspartame, fructose and citric acid, as well as in gelatin production.

Another, perhaps more familiar, example of atoms being regrouped to form a different compound is carbon monoxide and carbon dioxide. These gases are mentioned often and frequently mistaken for one another, but each serves very different purposes. The scientific difference between the two compounds is the number of oxygen atoms bonded with the carbon atom. But the general difference—the one we notice as humans—is quite significant.

Both carbon monoxide and carbon dioxide are colorless, odorless gases. Carbon monoxide occurs naturally in animal metabolism, plant photosynthesis, volcano eruption, forest fires and other combustion. It also comes from manmade processes like operating a stove. When carbon monoxide accumulates in a contained area, it can become lethal to humans. People who directly inhale enough carbon monoxide will lose consciousness and eventually die.

Carbon dioxide, on the other hand, occurs naturally in the atmosphere. One way carbon dioxide is produced is through the breathing processes of humans and animals. Carbon dioxide is also emitted in the burning of fossil fuels. Additionally, carbon dioxide can be found in lakes and at the bottom of the ocean.

While carbon dioxide occurs naturally and is not known to be as harmful as carbon monoxide, it can still be dangerous to humans when inhaled in certain quantities.

Slight chemical changes can radically modify the characteristics of a compound, and we don't have to look to radically different elements to find enormous differences. Sometimes only a small difference in chemical composition results in a very important alteration.

Name: \_\_\_\_\_ Date: \_\_\_\_\_

1. What happens when the atoms of a substance are regrouped?

- A gold becomes malleable
- B the atoms break apart and disappear
- C a new substance is formed
- D the substance stays the same

2. The creation of carbon monoxide is an effect. What is one cause?

- A the regrouping of the atoms in table salt
- B the burning of fossil fuels
- C cleaning swimming pools
- D operating a stove

3. Table salt can be separated into sodium and chlorine. Sodium is explosive. Chlorine is a gas that can kill people.

What can be concluded from the statements above?

- A A harmful compound can become harmless when its elements are separated.
- B A harmless compound can become harmful when its elements are separated.
- C Breaking a compound into its separate elements has no noticeable effects.
- D Breaking a compound into its separate elements can create carbon dioxide.

4. Based on the information in the passage, what is true of gases?

- A Some, but not all, gases are harmful to humans.
- B Any gas with carbon in it is not harmful to humans.
- C All gases are harmful to humans.
- D No gases are harmful to humans.

5. What is this passage mainly about?

- A Germany's use of chlorine in World War I as a chemical weapon
- B hydrochloric acid, aspartame, fructose, citric acid, and gelatin production
- C the similarities and differences between carbon dioxide and carbon monoxide
- D changes in chemical compounds and the effects of those changes

6. Read the following sentences: "When the atoms of a specific substance are regrouped, a new substance is formed with often vastly different **properties** from the original substance. Occasionally something completely harmless, or even necessary, can become dangerous or lethal when its molecules (a grouping of two or more atoms) are regrouped."

What does the word **properties** mean above?

- A extremely large amounts
- B places where experiments are done
- C qualities or characteristics
- D elements or compounds

7. Choose the answer that best completes the sentence below.

Oxygen by itself is not harmful; \_\_\_\_\_, it can become harmful when combined with carbon.

- A however
- B for instance
- C in summary
- D namely

8. What is hydrochloric acid?

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9. What is hydrochloric acid used for?

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10. Should people make changes to chemical compounds? Support your answer with evidence from the passage.

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## Teacher Guide &amp; Answers

Passage Reading Level: Lexile 1240

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8. What is hydrochloric acid?

**Suggested answer:** Hydrochloric acid is a solution of hydrogen and chlorine in water.

9. What is hydrochloric acid used for?

**Suggested answer:** Hydrochloric acid is used for household cleaning and food processing.

10. Should people make changes to chemical compounds? Support your answer with evidence from the passage.

**Suggested answer:** Answers may vary, as long as they are supported by the passage. Students arguing that people should not make changes to chemical compounds may point out the dangers of doing so. For example, breaking salt into its component elements, sodium and chlorine, creates two harmful substances. On the other hand, students may argue that combining elements can be helpful. One example is hydrochloric acid, a combination of hydrogen, chlorine, and water that is used for household cleaning and food processing.