Structure and Properties of Matter

Everything in our physical world is made of matter. Whether it's a synthetic or natural object, a bowl of cereal, a bike pump or a torrent of hail, it has essential physical properties that define its character as matter.

When we use matter or react to it, we think about it in all sorts of different ways. If we are playing basketball, we think about where the ball is going to go in physical space and how we can control it. If we are making a sandwich, we think about different combinations of flavors and how to make the sandwich taste as good as possible by combining those flavors. If we are deciding what to wear in the morning, we think about the visual qualities of different clothes, imagining what the most appealing combination might be.

As scientists, we can think about matter in two categorical ways. We can think about its physical properties, and we can think about its chemical properties.

Physical properties have to do with the matter itself; chemical properties have to do with how that matter exists in relation to the matter around it.

In the case of, say, a basketball, as scientists, we might think about properties like its appearance (round, knobby texture, orange color), buoyancy (Does it float? Yes.), or conductivity (no, it can't carry an electrical current). Other physical properties, some immediately observable and some only discernible under testing, are boiling point, density, ductility, hardness, magnetism, malleability, mass, melting point, and odor.

These include physical properties we can test using just our five senses and properties we test more rigorously using scientific tools. We can change some of the physical properties of matter, while others are fixed, unless we alter them with the interference of other substances. For instance, we can take a big block of cheddar cheese and chop it into tiny pieces, even put it in a blender, and turn it into cheese puree. That changes the cheese's texture, but not its color. Also, the cheese still has the same level of facility in carrying electrical current. You won't be able to stretch the cheese like a rubber balloon or use it to scratch glass, like a diamond. The blended cheese will still have the same mass as the original block of cheddar. Put it on some nachos and have a snack.

Another category is matter's chemical properties. Chemical properties are defined by one kind of matter's reaction to other conditions, or types of matter on a chemical level. The product of a chemical reaction is irreversible. When wood burns in a fire, for instance, it changes from wood into ash and smoke. That ash and smoke will never be wood again.

You can usually tell when a chemical change is taking place because there will be a telltale signal. If a substance is changing color, giving off heat, foaming, fizzing, or bubbling, or producing sound or new light, it's probably undergoing some kind of chemical reaction!

Next time you're watching fireworks, take a second to appreciate how many chemical changes and reactions are taking place moment by moment, one right after the other—sometimes right on top of one another. While we can appreciate that chemical changes are always happening all around us, it's fascinating to see a display of chemical change that's designed to express itself so dramatically!

Fireworks are a unique art form based on manipulating the changing chemical properties in reactive matter. Chemists who design fireworks have the fun job of creating exciting-looking-and-sounding chemical reactions between substances. Their first priority is safety, of course. Firework specialists, or pyrotechnicians, are responsible for unleashing those reactions in a carefully choreographed sequence, specially designed to make the show as tense and exciting as possible.

One thing all matter has in common is that its basic building block is the atom. Raisins are made up of atoms. Glass windows and chandeliers are made of atoms. Your parents are made up of atoms. Leonardo Da Vinci's painting the *Mona Lisa* is made up of atoms. The air we breathe is made up of atoms.

Atoms are so tiny that we can't see them—even with the aid of powerful microscopes. Different fundamental types of matter—we call them elements, and they're all listed on the Periodic Table of the Elements—are made up of atoms with different but discrete chemical structures. There are about one hundred elements, and together those elements compose everything in the known physical universe.

Atoms are made up of even smaller component structures. Again, there's no way for us to observe these structures physically. That's what sets them apart from the physical properties of matter, which, as we know, are discernible to our five senses. But those physical properties

all answer to their basic chemical makeup. The buoyancy of raisins in a bowl of cereal isn't just a random trait. It's because the type of atoms in a raisin is constructed to behave in certain ways in relation to the atoms around it.

On the Periodic Table of the Elements, scientists have, over time, placed different essential atomic types of matter into different groups, based on their atomic or chemical makeup. Those basic materials can combine in practically infinite ways. It's exciting to think about the creative and organic possibilities that matter holds for the future.

Name: _____ Date: _____

1. What two categorical ways of thinking about matter are discussed in the passage?

A solid and liquid
B natural and unnatural
C physical and chemical
D beneficial and harmful

2. What is compared and contrasted with the physical properties of matter in the passage?

A a painting by Leonardo Da Vinci
B the Periodic Table of Elements
C the appearance of a basketball
D the chemical properties of matter

3. If a substance is producing sound or new light, it is probably undergoing a chemical reaction. The explosion of fireworks produces sound and light.

Based on this information, what is a likely conclusion?

A The explosion of fireworks is an example of a chemical reaction.
B The explosion of fireworks is an example of a physical reaction.
C Chopping a big block of cheese into pieces is an example of a chemical reaction.
D Chopping a big block of cheese into pieces creates light.

4. A glass bowl falls on the floor and breaks into little pieces. What kind of change has taken place?

A a physical change
B a chemical change
C a psychological change
D a biological change

5. What is the passage mostly about?

A fireworks
B matter
C scientists
D magnetism

6. Read this sentence: "In the case of, say, a basketball, as scientists, we might think about **properties** like its appearance (round, knobby texture, orange color), buoyancy (Does it float? Yes.), or conductivity (no, it can't carry an electrical current)."

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

A problems or difficulties
B increases or expansions
C qualities or characteristics
D changes or transformations

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

Matter can be thought of in two categorical ways, _____, physical and chemical.

A instead
B namely
C earlier
D later on

8. What is an example of a physical property?

_____

_____

_____

_____

9. What is an example of a chemical change?

10. Which is easier to observe, the physical or chemical properties of an object? Support your answer with evidence from the passage.

Teacher Guide & Answers

Passage Reading Level: Lexile 1130

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Matter can be thought of in two categorical ways, _____, physical and chemical.

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8. What is an example of a physical property?

Suggested answer: Students may name any physical property mentioned in the passage. Examples include mass, buoyancy, and color.

9. What is an example of a chemical change?

Suggested answer: Students may name any chemical change mentioned in the passage. Examples include burning and changing color.

10. Which is easier to observe, the physical or chemical properties of an object? Support your answer with evidence from the passage.

Suggested answer: Answers may vary, as long as they are supported by the passage. For instance, students may respond that physical properties are easier to observe because they often do not require anything besides the object itself to see. Observing a chemical property requires the presence of additional matter or a change in conditions. A person can tell at a glance that a stick is brown (a physical property), while they would have to try setting it on fire to determine that it is flammable (a chemical property).