



Earth Science

Water

On Level

Physical Changes in Water

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Physical Changes in Water

What makes water so special?

CORE CURRICULUM STATEMENTS

Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land.

Water is recycled by natural processes on Earth: evaporation: changing of water (liquid) into water vapor (gas); condensation: changing of water vapor (gas) into water (liquid)

Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity.

The material(s) an object is made up of determine some specific properties of the object (sink/float, conductivity, magnetism).

Properties can be observed or measured with tools such as hand lenses, metric rulers, thermometers, balances, magnets, circuit testers, and graduated cylinders.

Objects and/or materials can be sorted or classified according to their properties.

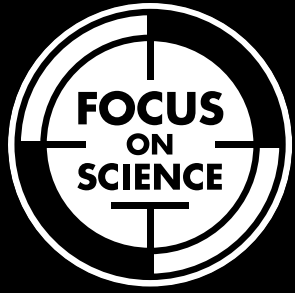
Matter exists in three states: solid, liquid, gas: solids have a definite shape and volume; liquids do not have a definite shape but have a definite volume; gases do not hold their shape or volume

Temperature can affect the state of matter of a substance.

Changes in the properties or materials of objects can be observed and described.

Energy exists in many forms, and when these forms change energy is conserved.

Energy and matter interact: water is evaporated by the Sun's heat; a bulb is lighted by means of electrical current; a musical instrument is played to produce sound; dark colors may absorb light, light colors may reflect light.



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Student Book

Physical Changes in Water

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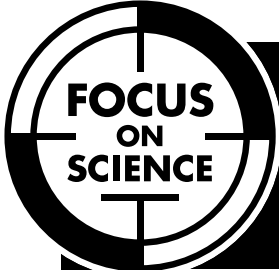
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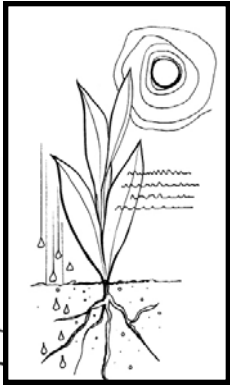
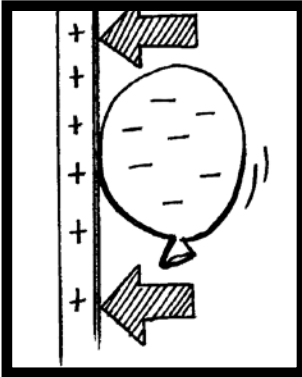
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Physical Changes in Water

by Chuck Pederson





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Curriculum materials for **your** content standards

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– Predict –

*What do you think you will
learn from reading this book?*

INTRODUCTION

Things Change

Have you ever noticed that everything changes? Some changes are fun. For example, babies learn how to walk. A seed becomes a flower. Some changes are less fun. You fall and bruise your knee, or a thunderstorm develops after a sunny day.

Other changes happen, too. A carpenter saws a board to build a house. You put water in the freezer, and it becomes ice. A potter molds wet clay into a beautiful pitcher. You mix sugar and lemon juice to create lemonade.

What do these changes have in common? They are **physical** changes.

physical: having to do with things that can be seen or measured

CHAPTER 1

What Is Matter?

To understand physical change, you must understand matter. All substances are made of matter. It is the stuff around you. Matter includes paper, metal, glass, air, toenails, the farthest star, a waterfall, and your pet cat.

In fact, almost everything in the universe is made of matter, whether you can see it or not. It is changing all the time.

People describe the physical **properties** of matter in many ways such as size, shape, color, texture, and **volume**. All matter takes up space. All matter has mass. Mass is the amount of matter in an object.

properties: qualities that something has
volume: the amount of space something occupies or takes up

People also describe materials by the types of the matter from which they are made. For example, paper is made from trees and other matter. Glass is made from melted sand.

Types of Materials	
Paper	newspaper, paper towels, books
Glass	bottles, windows, light bulbs
Plastic	keyboards, CDs, garbage cans
Metal	keys, doorknobs, belt buckles, wire

The physical properties of matter can be observed and measured. For example, you can heat water and then measure the temperature of the water when it boils to determine the boiling point of water.

– Apply –
Describe other objects by the properties of the matter from which they are made.

States of Matter

Most matter on Earth, including water, exists in one of three states—solid, liquid, or gas.

Solids

A block of wood is a solid. Matter that is solid has a certain size and shape. It does not change its size or shape unless something causes it to change.

Liquids

Milk is a liquid. Milk has size and volume. Milk does not have a particular shape, though. It takes the shape of the container it is in. Liquids can flow, be poured, and be spilled. Solids cannot.

Gases

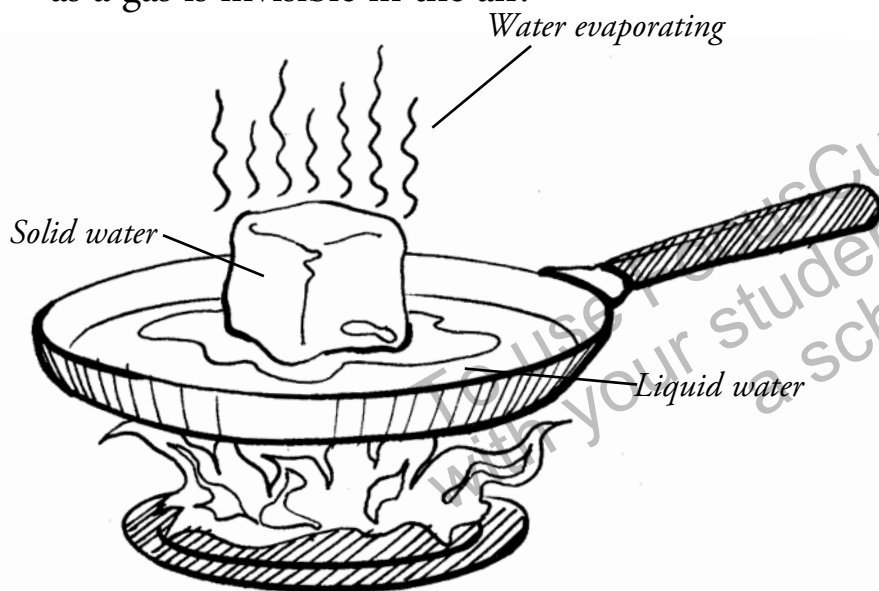
Gas is matter that has no shape or size of its own. The air around you is a mixture of gases.

– Restate –
Explain the physical properties of different states of matter.

Particles in Matter

Matter is made of tiny particles. They are so tiny you cannot see them. The particles in matter can move around. How fast they move depends on the matter's state.

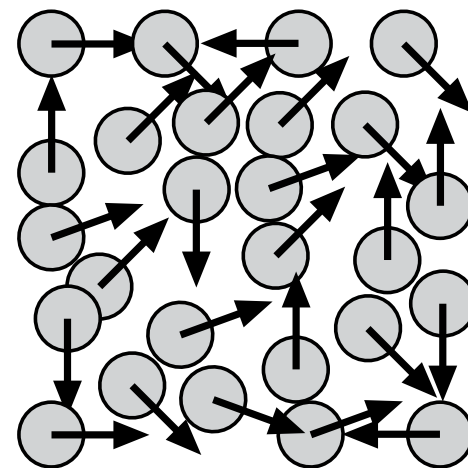
Particles in solid ice can move only a little. They are packed together tightly.



When a solid is heated, it begins to melt. If heated enough, the melted liquid turns into vapor.

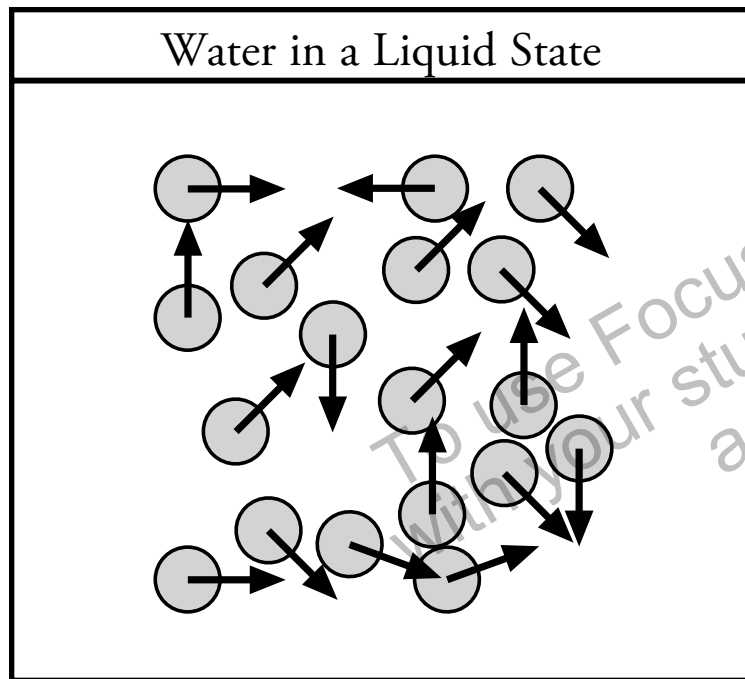
evaporate: to change into a gas or vapor

Water in a Solid State



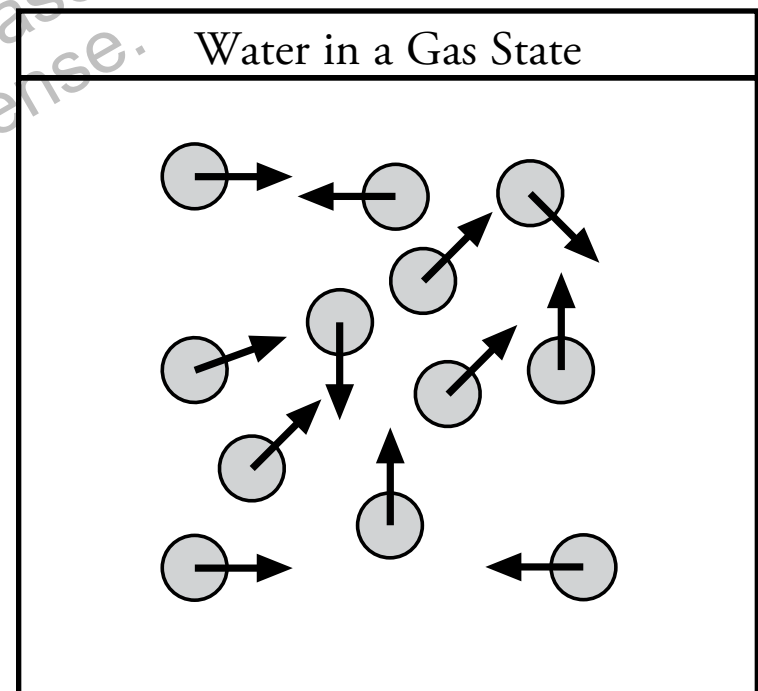
The particles in solid water are packed together. They can move very little and make a substance hard.

When ice is heated, the particles begin to move faster. When the ice melts, it becomes a liquid. This temperature is the melting point. Different solids have different melting points.



The particles in liquid water are able to move more.

If heating continues, some particles gain enough energy to break away from the liquid. They move into the surrounding air. This is called evaporation. With enough heat energy, water begins to bubble and escape as a gas. This is called boiling. All liquids have different boiling points. Water's boiling point is 212 degrees Fahrenheit or 100 degrees Celsius.



As a gas, the particles in water are furthest apart. They can move in all directions.

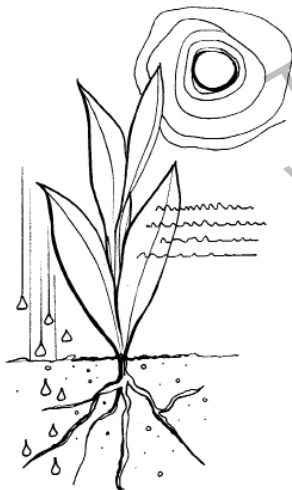
What Is Physical Change?

Physical change occurs when objects or substances change their states of matter. Some examples of properties that might change include color, shape, size, temperature, or weight. Others include density, flexibility, the ability to float or sink, shininess, and magnetism.

For example, think about an iron nail. It can be bent, but the nail is still iron, even though its shape has changed. You could use a hammer to straighten the nail again. Its shape has changed once more. But the nail is still iron.

Cooling, or subtracting heat energy, will also change the state of matter. If a gas cools enough, it **condenses**. If you have ever had a cold drink on a hot day, you have seen condensation. It is what forms the little water drops on the outside of your glass. The water vapor in the air condenses on the cold surface of the glass.

Continue to subtract heat energy, and the liquid becomes a solid. For water, this is the point at which it becomes ice. Water's freezing point is 32° F or 0° C.



Water condenses on the outside of a cold glass.

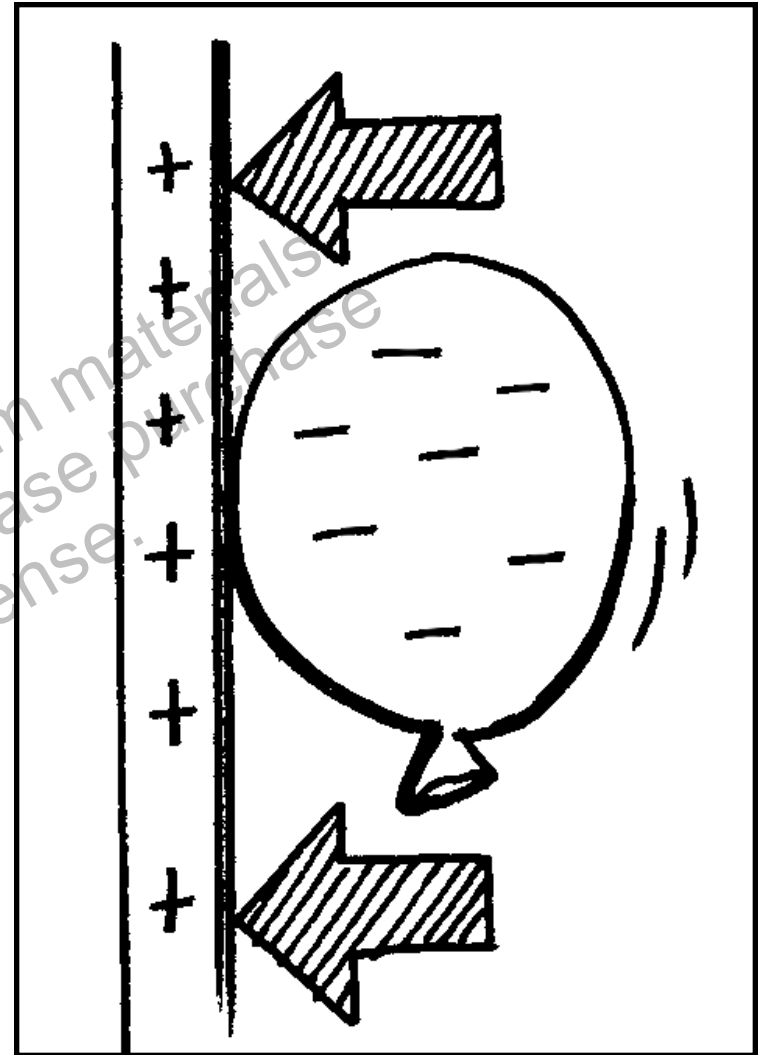
condense: to change from a gas to a liquid

Physical Verses Chemical Changes

Another type of change in matter is chemical change. Chemical changes are usually **permanent**. They not only change the way matter looks, feels, smells, or tastes, but they also change the substance into something different.

So what is the difference between physical and chemical change? Sometimes, seeing the difference is easy. For example, a piece of paper may be folded to change its shape and size. You can unfold the paper to its original shape and size. This is a physical change. If you burn the paper, it changes to ash, smoke, and gases and cannot be changed back to paper. A chemical change has taken place.

permanent: unchanging



Fog swirling around a bridge is condensed water vapor. When the air temperature is cool enough, fog forms near the ground. This is a physical change. The water changes state, but it is still water, not a different substance.

How Can You Tell the Difference?

Read the two questions below. If you can answer yes to either question, then it is a physical change. If you answer no to both questions, it is a chemical change.

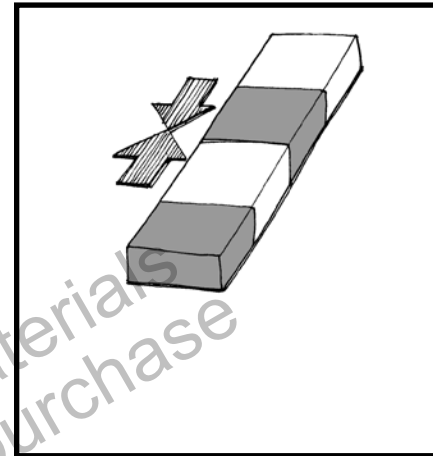
1. Are the physical properties the same after the change? For example, you bend a piece of wire. The shape has changed, but it is still wire. The answer is yes.

2. Can the substance go back to the way it was?

If sugar is dissolved in water, the sugar seems to disappear. If the cup is left in the sun, the water will evaporate. The sugar will remain behind. The answer here also is yes.

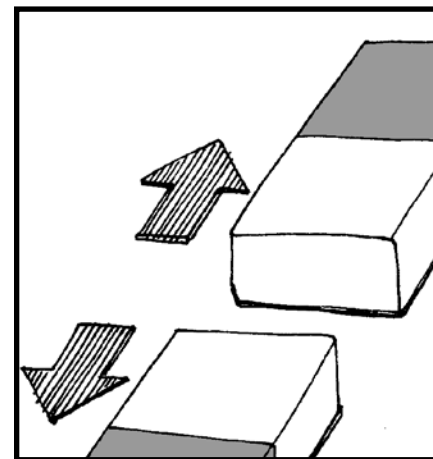
– Restate –

Explain the characteristics of a simple physical change.



Glass scatters when a window breaks.

Is this a physical change or chemical change?



Poor snowman! The sun is beginning to melt him.

Is this a physical change or chemical change?

Mixtures

Another type of physical change results in a mixture. Mixtures physically combine two or more substances. A physical force like shaking or stirring may combine them. For example, a tossed salad contains lettuce, tomatoes, and maybe some cheese. It is a mixture. There are several types of mixtures.

Diffusion

Diffusion occurs without shaking or stirring. The particles of a substance move throughout another substance until they are evenly distributed. This happens, for example, when a drop of dye is added to a glassful of water. Eventually, the dye is evenly spread through the water. You cannot distinguish the dye from the water.

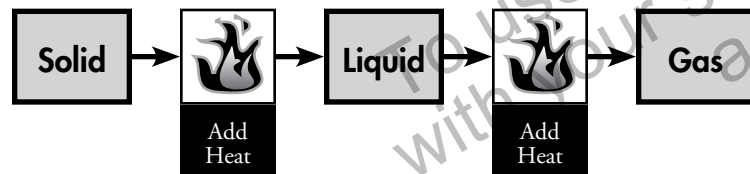
diffusion: a mixture with an even distribution of particles in a substance without shaking or stirring

Energy Flow

Understanding energy flow is helpful to understand physical change. To change matter from one state to another, heat energy is either added or removed.

Adding heat causes solid water to melt or to evaporate. Cooling, or removing heat energy, causes gases to become liquids.

They condense. Subtracting more heat causes liquid water to become solid.



Heating adds thermal energy and causes matter to change states.

Suspension

Suspensions are mixtures in which you can still see the different parts. Suspensions are mixed by stirring or shaking. The parts are easy to separate again. For example, a crisp green salad is a suspension. Its lettuce and other vegetables can be easily separated.



A salad is a type of mixture called a suspension. You can still see the individual parts of it.

Solution

Solutions consist of one substance completely dissolved in another. Iced tea mixed with sugar is an example.

suspension: a mixture whose different parts are clearly visible
solution: a mixture in which one substance is completely dissolved in another

Physical Change Is All Around

Physical change causes the physical properties of a substance to become different. Physical change includes bending, cutting, chopping, folding, crushing, stretching, or melting anything.

Physical change can be useful. It allows us to create a bacon, lettuce, and tomato sandwich. Physical change can also be a problem. Global climate change seems to be causing some ice at the poles to melt. The melting ice could cause worldwide flooding.

Can you think of other physical changes that are useful or cause problems?

– Summarize –

Write a paragraph that summarizes the main ideas in this book.

Glossary

condense—to change from a gas to a liquid

diffusion—a mixture with an even distribution of particles in a substance without shaking or stirring

evaporate—to change into a gas or vapor

permanent—unchanging

physical—having to do with things that can be seen or measured

properties—qualities that something has

solution—a mixture in which one substance is completely dissolved in another

suspension—a mixture whose different parts are clearly visible

volume—the amount of space something occupies or takes up

To Find Out More . . .

Want to learn more about physical changes?

Try these books

Physical Changes by Darlene R. Stille.
Compass Point, 2006.

States of Matter by Robert Snedden. Reed Educational and Professional Publishing, 2001.

Solids, Liquids, and Gases by Carol Ballard.
Heinemann, 2004.

Access these Web sites

Chem4Kids.com
http://www.chem4kids.com/files/matter_intro.html

Change Is Cool
<http://www.usoe.k12.ut.us/curr/Science/sciber00/8th/matter/sciber/physchng.htm>

Write for more information

Museum of Science and Industry
57th Street and Lake Shore Drive
Chicago, IL 60637-2093

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Assessments

Physical Changes in Water

Print pages 20–22 of this PDF for the assessments.

Check Understanding

Shade the circle next to the correct answer or write your answer on the lines provided.

1. The picture below shows water in its three states.



What type of change is taking place?

- Ⓐ physical, because the water is affected by temperature
- Ⓑ chemical, because the water cannot change back
- Ⓒ chemical, because the water is becoming a new substance
- Ⓓ physical, because the water can change back to another state

Note that question 2 has only three choices.

2. When heat is applied to matter, what happens to the particles in the substance?
- Ⓐ They move faster.
 - Ⓑ They stop moving.
 - Ⓒ They move slower.

3. Water can be described using many different physical properties. Identify one physical property of water.

Explain how you know it is a physical property.

4. When water boils, its state of matter changes from a

- Ⓐ gas to a liquid
- Ⓑ solid to a liquid
- Ⓒ solid to a gas
- Ⓓ liquid to a gas

Check Understanding

Shade the circle next to the correct answer or write your answer on the lines provided.

5. Physical changes occur every day in our lives. Identify two physical changes.

- 1) _____
- 2) _____

Explain how these changes are useful or problematic.

Note that question 6 has only three choices.

6. The data table shows the temperature of water in different states.

Water	Temperature
Boiling point	212° F
Freezing point	32° F
Melting point	

What can you conclude about the temperature of the melting point of water?

- Ⓐ The melting point is higher than the boiling point.
- Ⓑ The melting point is lower than the freezing point.
- Ⓒ The melting point is higher than the freezing point.

Assessment Scoring Guidelines

1. Answer D is correct.
2. Answer A is correct.
3. Color
It can be observed.

Shape
It can be observed and measured.
4. Answer D is correct.
5. Melting butter
It is useful because it helps us cook food.

Cutting a finger
It is problematic because it injures a person.
6. Answer C is correct.

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English Language Arts Activities

Physical Changes in Water

Print pages 24–28 of this PDF for the reading activities.

Use Context Clues

TRY THE SKILL

Some words have more than one meaning. Context clues, or the nearby words, can help you figure out the meaning in a sentence.

For example, the word *rose* can mean “went up” or “a type of flower.” Read the sentence below.

Mary smelled the red rose growing in the garden.

You can tell that this is a type of flower because the sentence mentions a garden. The sentence does not say anything about going up somewhere.

Read each sentence. Decide which meaning of the bold word is meant. Then shade the circle next to the correct meaning.

1. Jose saw he did not have enough **change** to buy the book.
 Ⓐ small coins
 Ⓑ become different
2. Liquids, gases, and solids are three states of matter.
 Ⓐ parts of America
 Ⓑ forms
3. The bat flew down from the tree.
 Ⓐ kind of animal
 Ⓑ sports equipment
4. Lana was the star of the play.
 Ⓐ shape with five points
 Ⓑ main actor
5. Van’s clay statue shows his artistic talent.
 Ⓐ demonstrates
 Ⓑ productions

Read for a Purpose

TRY THE SKILL

People read for many different reasons. Following are some of them:

- to gain information or understanding
- to learn how to do something
- to be entertained

Books that give information are called nonfiction books. Books that you read for entertainment are called fiction. Some nonfiction books can be entertaining while they give information.

For example, you read this book to gain information. You learned ways that physical change and chemical change are different. You have learned about different kinds of mixtures. This was a nonfiction book. The main reason the author wrote it was to inform you. The author hoped you would find it interesting, so you would be entertained. But that was a less important purpose of the book.

Titles often can tell you about the purpose of the book. If you can tell a book is nonfiction, you will learn information or how to do something. If a book is fiction, you will be entertained.

Read the titles below. Then answer the questions.

How to Create Physical Changes

Changes in Nature

Little Jack Changes His Mind

Matter and Physical Change

You Can Make Suspensions and Diffusions

1. Which two titles would you read to learn how to do something?

2. Which two titles would you read to gain information?

3. Which title would you read mainly to be entertained?

Similes and Metaphors

TRY THE SKILL

Similes and metaphors are figures of speech. They use language in special ways to draw pictures in readers' minds. They help make writing more interesting and easier to understand.

A simile compares two things that are different. It uses the words *like* or *as* in the comparison.

For example:

Particles are like a code.

The simile compares particles with a code.

A metaphor also compares two unlike things. However, it does not use the words *like* or *as*. A metaphor says something is something else.

For example:

Ice is a mirror.

The metaphor compares ice to a mirror. They are alike because they are both smooth and reflect light.

Read each sentence. Then shade the circle next to the correct explanation of the simile or metaphor.

1. A salad is like a vegetable garden.
Ⓐ A salad has dirt in it.
Ⓑ A salad tastes good with fertilizer on it.
Ⓒ A salad is bumpy and colorful.
2. Evaporation is a magic trick.
Ⓐ Evaporation happens invisibly.
Ⓑ Evaporation can make things appear and disappear.
Ⓒ Evaporation is imaginary.
3. Now write your own simile or metaphor.

Homophones

TRY THE SKILL

Some words sound alike but are spelled differently and mean different things. These kinds of words are called **homophones**.

Read the following homophones.

fur and *fir*

Notice that they sound the same but are spelled differently. Read the sentence below.

The girl rubbed her cat's fur.

***Fur* means "an animal's hair."**

The fir tree in the yard looked like a Christmas tree.

***Fir* is a type of evergreen tree.**

Now look at the following pair of homophones:

seen and *scene*

Lucille had not seen her sweater since last week.

***Seen* describes seeing something in the past.**

Marcel enjoyed scene two of the stage play.

A scene is part of a theater production.

Read each sentence and each pair of spellings below it. Write the letter of the correct spelling on the line. Check a dictionary for correct definitions if you need to.

1. What _____ the physical changes you saw?
A. are
B. our
2. By sawing a _____, the student created a physical change.
A. board
B. bored
3. The box is heavy, so it must have a lot of _____.
A. wait
B. weight
4. How _____ physical changes occur?
A. due
B. do
5. It is not always easy to tell _____ a change is physical or chemical.
A. weather
B. whether

Answer Key

Use Context Clues

1. A
2. B
3. A
4. B
5. A

Read for a Purpose

1. *How To Create Physical Changes and You Can Make Suspensions and Diffusions*
2. *Changes in Nature and Matter and Physical Change*
3. *Little Jack Changes His Mind*

Similes and Metaphors

1. C
2. A

Homophones

1. A
2. A
3. B
4. B
5. B