Topic 2.2

How do we use properties to help us describe matter?

Key Concepts

- Physical properties describe how matter looks and feels.
- Chemical properties describe how substances can change when they interact with other substances.

Key Skills

Inquiry

Key Terms

physical properties
conductivity
density
lustre
solubility
texture
chemical properties
combustibility
decomposition
precipitate

Think of your favourite food. How would you describe it to someone who has never seen or tasted it before? Do you tell them how it smells? Do you talk about whether it's spicy, salty, sweet, or savory? Do you mention where people can get it and how much it costs?

You probably do some or all of these things. Maybe you refer to other features of your favourite food, such as its colour, its shape, or its texture (how it feels to the touch). In other words, you describe your favourite food by referring to its properties. Scientists describe matter the same way.

Starting Point Activity

1. With a partner, take turns describing three of the foods in the pictures. Come up with at least two additional properties for each of the foods.
2. As a class, list the properties used to describe the foods.
3. Use property words to describe your favourite food to your partner without using its name. Have your partner guess what it is, based on the properties you use.

BANNOCK
EXAMPLES OF PROPERTIES:
DOUGHY, SPONGY, DENSE

CUMIN
EXAMPLES OF PROPERTIES:
FRAGRANT, MUSKY, GOLDEN

GREEN APPLE
EXAMPLES OF PROPERTIES:
TART, CRISP

TAHINI
EXAMPLES OF PROPERTIES:
VISCOUS, BITTER

Physical properties describe how matter looks and feels.

physical property: any feature of matter that can be observed or measured without changing the type of matter it is

All matter can be described by its **physical properties**. Physical properties are features of matter that can be observed or measured without changing the type of matter that something is. **Table 2.2** lists some physical properties that are often used to describe matter.

Table 2.2 Examples of Physical Properties Used To Describe Matter

Physical Property	What is it?	Examples
	**Conductivity** describes how well a substance lets heat or electrical current move through it. Metals tend to be good conductors, and non-metals tend to be poor conductors.	• Copper is used to make electrical wires, because it is a good conductor of electrical current. • One reason glass is good to make windows is that it does not conduct heat very well.
	**Density** describes how compact a substance is, and is calculated by dividing its mass by its volume.	• Ice (solid water) floats on liquid water, because ice is less dense than liquid water. • Iron sinks in liquid water because iron is more dense than liquid water.
	**Lustre** describes how well the surface of a substance reflects light.	• Many people are attracted to lustrous metals such as silver, gold, and chrome because they are shiny.
	**Solubility** describes how much of a substance dissolves in another substance.	• Salt crystals dissolve in water to form the mixture salt water.
	**Texture** describes how the surface of a substance feels (its roughness, softness, or smoothness).	• Window glass has a smooth texture. • Brick has a rough texture.

conductivity: describes how well a substance lets heat or electrical current move through it

density: describes how compact a substance is, and is calculated by dividing mass by volume

lustre: describes how well the surface of a substance reflects light

solubility: describes how much of a substance dissolves in another substance.

texture: describes how the surface of a substance feels (its roughness, softness, or smoothness)

LEARNING CHECK

1. Explain what a physical property is, and give two examples.
2. Describe two physical properties of a) a pencil, b) a piece of paper, c) apple juice, and d) air.
3. Explain how the following people might depend on physical properties: a) a chef, b) a painter, and c) a carpenter.

INVESTIGATION LINK
Investigation 2A, on page 110

Inquiry Focus

Activity 2.4

LINKING PHYSICAL PROPERTIES OF OBJECTS WITH THEIR USES

In this activity, you will plan and conduct an experiment to identify the physical properties of common substances.

Safety

Before you begin work on your experiment, review pages xv and 100.

What You Need

samples of objects from your teacher (examples could include salt, copper wire, cork, aluminum foil, paper cup, Styrofoam cup, plastic paper clip, metal paper clip)

beaker

water

stirring rod

conductivity apparatus

What To Do

1. Work together in small groups.
2. Design a procedure to identify the physical properties of the substances provided by your teacher. Make sure you have your teacher approve your procedure before you begin your experiment.
3. Be sure to consider safety precautions and proper clean-up and disposal in your procedure.

   Hints:

   - Use **Table 2.2** to help you plan.
   - Some physical properties, such as density and solubility, are best measured as comparisons. For instance, ice is less dense than water. Sugar is more soluble than salt.
4. Design a table to record your observations.
5. Follow your procedure and record your results.
6. Clean up and put away all the equipment. Wash your hands.

What Did You Find Out?

1. Describe each of the substances you investigated using its physical properties.
2. Explain how the physical properties you have described make each object or substance suitable for its use.

Inquire Further

What other physical properties do you know or can you remember learning about before? (Lots of examples are possible.) Make your own version of **Table 2.2** that includes other physical properties of matter.

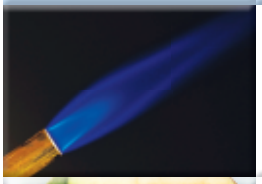
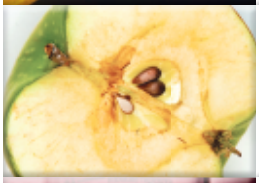
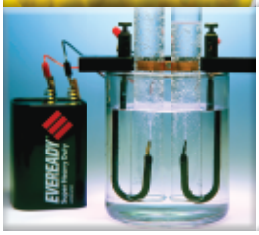
Chemical properties describe how substances can change when they interact with other substances.

chemical properties: describe how substances can change to produce new substances with new properties when they interact with other substances

Chemical properties describe how substances can change to produce new substances with new properties when they react with other substances. You can describe substances using their physical properties just by looking at them, but chemical properties can only be observed when substances interact.

The degree to which a substance can change is its reactivity. Reactivity can be useful in some cases and not in others. For instance, we depend on reactivity for the explosiveness of dynamite. On the other hand, we often store foods in glass containers because glass is not reactive at all. Table 2.3 lists some examples of chemical properties.

Table 2.3 Examples of Chemical Properties Used To Describe Matter

Chemical Property	What is it?	Examples
	**Combustibility** describes the ability of a substance to catch fire and burn in air.	• We burn wood and other fuels because of their combustibility.
	Reactivity with oxygen describes the change that can occur when a substance is exposed to oxygen.	• The flesh of some kinds of fruit turns brown when it is exposed to the oxygen in air.
	Reactivity with acids describes the change that can occur when a substance is exposed to acids.	• Some substances such as baking soda produce a gas when mixed with acids such as vinegar.
	Reactivity with other substances describes the change that can occur when one substance reacts with other substances.	• When some substances, are mixed together, they form a solid, called a **precipitate**, which is a new substance.
	**Decomposition** describes the change that can occur when a substance such as water is broken down into the parts that make it up.	• Chemical decomposition often happens when a substance interacts with energy such as electrical current or heat.

combustibility: describes the ability of a substance to catch fire and burn in air

precipitate: an insoluble solid substance that can form when certain dissolved substances are mixed together

decomposition: a kind of reactivity that can break down a substance into its parts

Inquiry Focus

Activity 2.5

IDENTIFYING CHEMICAL AND PHYSICAL PROPERTIES OF SUBSTANCES

In this activity, you will observe the chemical, as well as the physical, properties of some substances. Keep in mind that physical properties can be observed *before* there is any contact with other substances, while chemical properties can only be observed when substances react with each other.

Safety

What You Need

2 small spoons

10 mL graduated cylinder

1 resealable plastic bag

Substances A, B, and C

What To Do

1. Copy the table below in your notebook.

Data Table for Recording Physical and Chemical Properties

	Physical Properties	Chemical Properties
Substance A		
Substance B		
Substance C		
Mixture of substances (after)		

2. Describe the physical properties of substances A, B, and C. Record your observations in the table.
3. Mix one spoonful of substance A, one spoonful of substance B, and 10 mL of substance C into a resealable bag. Quickly seal it up.
4. Mix the substances in the bag by tilting it back and forth a few times. Record the chemical properties of the substances when they are mixed.
5. Record the physical properties of the substances after mixing.
6. When you are done, follow your teacher's instructions for cleaning up. Wash your hands.

What Did You Find Out?

1. Compile your list as a class, and add any new observations that you did not record.
2. How did the physical properties of substances A, B and C before mixing compare with the physical properties of the mixture of them?
3. Why does the table have a separate row for the physical properties of each of the substances but only one place to record the chemical properties of the substances?
4. How are chemical properties different from physical properties?

LEARNING CHECK

1. Explain what a chemical property is, and give two examples.
2. Identify the types of properties in this sentence, and give reasons: "Beeswax is soft and burns with a bright flame."
3. Use **Table 2.3** to determine which chemical property best describes propane, the gas used in a barbecue tank. Why is this property both useful and hazardous for people using propane?

INVESTIGATION LINK
Investigation 2A, on page 110

Skill Check

- ✓ Initiating and Planning
- ✓ Performing and Recording
- ✓ Analyzing and interpreting
- ✓ Communicating

Safety

- Do not taste or eat anything in the classroom.
- Clean up any spills immediately.

What You Need

- samples that will include table sugar, baking soda, salt, vinegar, aluminum foil, and others provided by your teacher
- test tubes and test tube rack
- water
- stirring rod
- conductivity apparatus
- other equipment as needed

Physical and Chemical Properties of Substances in the Home

How do the physical and chemical properties of substances in the home differ? What do they have in common?

What To Do

1. Your teacher will give your group six substances to investigate. Plan a procedure to identify four physical properties and two chemical properties of each substance. Choose properties from Table 2.2 and 2.3.
2. Make a table like the one below to record the results of your tests. Include a title for your table. Be sure to include enough rows for all the samples you will be testing.

Sample	Physical Properties	Chemical Properties
table sugar		
salt		

3. Have your teacher review your procedure, observations table, and list of equipment. Do not start your tests without your teacher's approval.
4. Carry out your procedure. Make sure that you do your tests exactly as you planned them. Don't add any steps without your teacher's approval.
5. Record your observations in your table. They may include descriptions (such as colour), yes/no answers (does it react with acid?) or ratings (such as the hardness of a substance compared to another substance).
6. Share your group's results with your teacher, who will record them in a class chart. Add any information that you have not already recorded in your own table.

What Did You Find Out?

1. Analyze your observations to determine if there are certain properties that seem to distinguish one substance from the others. For some substances, it may be one particular property. For other substances, it may be a combination of properties.
2. Evaluate your tests to determine whether they were useful for telling the substances apart, based on their properties. What improvements could you make?

Topic 2.2 Review

Key Concept Summary

- Physical properties describe how matter looks and feels.
- Chemical properties describe how substances can change when they interact with other substances.

Review the Key Concepts

1. K/U Answer the question that is the title of this topic. Copy and complete the graphic organizer below in your notebook. Fill in four examples from the topic using key terms as well as your own words.

2. T/I Look at the photo of paper clips. Describe at least three physical properties of paper clips that make them useful.

3. K/U Use words or a graphic organizer such as a Venn diagram to explain the difference between a physical property and a chemical property.

4. T/I Your teacher places a small sample of a white, crystalline substance in a beaker of water and it dissolves and disappears. Next, your teacher slowly and carefully heats a small sample of the substance and it begins to melt—you see a liquid forming. Your teacher leaves the heat on for long enough that you begin to detect a sweet odour. Then the white substance catches fire and burns.

a) Create a table or a concept map to organize the physical properties and the chemical properties of this white substance.

b) Describe the safety steps that your teacher would have taken, including the types of safety clothing used, to conduct all the tests safely.

c) In this case, your teacher knows what the white crystalline substance is. (It's table sugar.) However, imagine that your teacher didn't know the identity of the substance. Explain why the tests carried out could have been dangerous.

5. K/U You place a stone and a piece of wood into a large tub of water. The stone sinks and the wood floats. What physical property of these two substances determines if each substance sinks or floats? Write a sentence that compares this property for the stone, water, and wood. For help, refer to **Table 2.2**.

6. A Homes in Ontario have insulation in the walls to prevent the loss of heat to the outside during cold winter months. Which physical property determines which substances can be used to make insulation?