UNIT 2

Summary

ESSENTIAL QUESTION

How do the kinetic molecular theory and atomic theory help us explain the behaviour of matter?

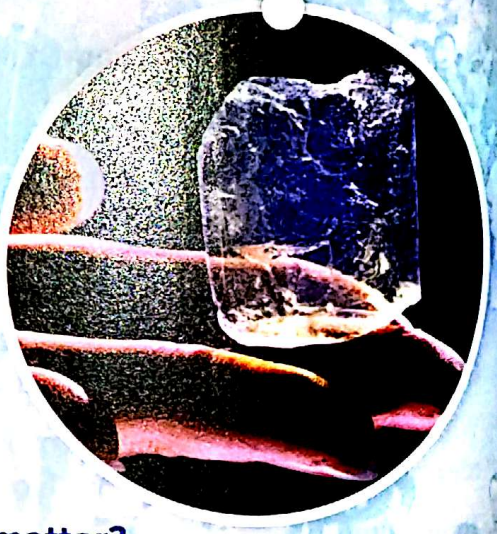
TOPIC 2.1:

How does matter affect your life?

- Everything—including you—is made up of chemicals.
- Chemicals in your daily life have characteristics that make them useful, hazardous, or both.
- Handling chemicals and equipment safely is important at school and at work.

Key Terms

matter



TOPIC 2.2:

What are some ways to describe matter?

- Matter can be described by its physical properties.
- Matter can be described by its chemical properties.
- Matter can be described based on physical and chemical changes.
- Matter can be classified based on how it responds to physical and chemical changes.

Key Terms

physical property	mass	volume	density
chemical property	physical change		chemical change

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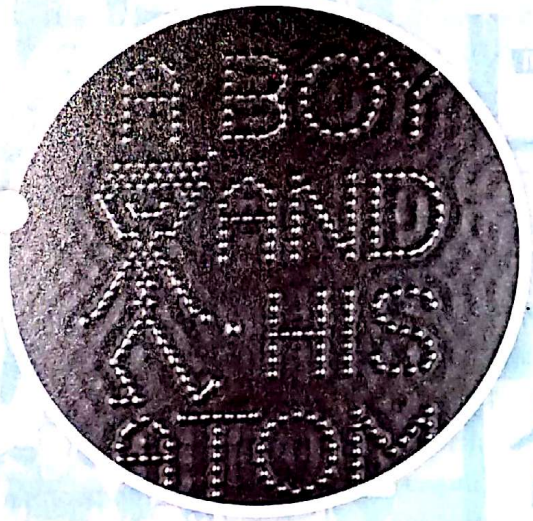
TOPIC 2.3:
How can we describe and explain the states of matter?

- Matter can be solid, liquid, or gas.
- Matter is made of particles in constant motion.
- Changes in state result from changes in particle motion.
- The kinetic molecular theory explains physical changes and properties.

Key Terms

model theory
kinetic molecular theory of matter



TOPIC 2.4:
How can we investigate and explain the composition of atoms?

- Dalton developed an early atomic theory.
- Many scientists contributed to the further development of atomic theory.
- An atom is made up of electrons, neutrons, and protons.
- Atomic theory continues to develop.

Key Terms

electrons nucleus protons
neutrons atom

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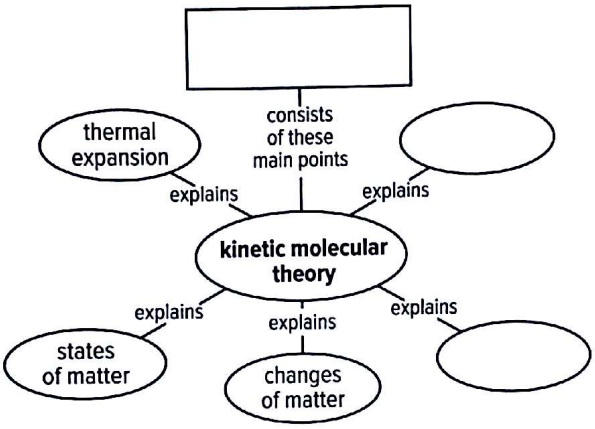
UNIT 2

Review

What Do You Know?
Connecting to Concepts

Visualizing Ideas

1. Use this incomplete concept map as a starting point to make your own concept map to show what you know about the kinetic molecular theory.



Using Key Terms

2. For each of the lists of terms below, write a sentence that shows your understanding of the terms and uses all of the terms in the list.
   a) mass, volume, density
   b) model, theory

Communicating Concepts

3. List three safety rules to follow when working in your school laboratory. Explain why each rule is important.
4. Identify each of the following physical properties as qualitative or quantitative.
   a) colour
   b) melting point
   c) density
   d) odour
5. Explain why density is more useful for identifying a substance than either mass or volume alone.
6. Draw simple diagrams to show how the particles are arranged in a solid, liquid, and gas.
7. Use the kinetic molecular theory to explain what happens when a pot of water "boils dry." Include a diagram.
8. Over time, ice cubes left in a freezer appear to shrink.
   a) Which term describes what is actually happening to the ice cubes?
   b) Use the kinetic molecular theory to explain this observation.
9. What are expansion joints and why are they needed? Use the kinetic molecular theory in your explanation.
10. Briefly explain why Thomson's experiments resulted in Dalton's model of the atom being revised.
11. Copy the following table into your notebook and complete it. Allow plenty of space for the sketches.

Model	Key features	Labelled sketch
Dalton's model		
Thomson's model		
Rutherford's model		
Bohr's model		

12. Compare each of the following pairs of particles in terms of their mass, charge, and location in the atom.
    a) proton and electron
    b) proton and neutron
13. Explain the difference between the terms *subatomic particle* and *elementary particle*. Give examples.

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What Can You Do?
Connecting to Competencies

Developing Skills

14. Use the following data to answer the question below.

Substance	Density (g/cm³)
water	1.00
cooking oil	0.93
corn syrup	1.36

The mass of an empty container is measured and found to be 55.75 g. The container is filled to the rim with water. Its mass is measured again and found to be 105.75 g. The container is emptied and dried with a paper towel to remove any traces of water. It is then filled with an unknown liquid. The new mass is 123.75 g. Is the unknown liquid cooking oil or corn syrup? Support your answer.

15. For an investigation, you and your lab partner are given a vial of an unknown substance that is a white powder at room temperature. You need to design a procedure to study the physical and chemical properties of the material to help identify it.

- **a)** Decide on what physical and chemical properties would be most useful to use. Explain why you chose those.
- **b)** Write out the procedure. Make sure to include detailed steps to follow to study each property.
- **c)** What safety icons should accompany the procedure? Describe any safety precautions a student should take when performing the tests.

16. The table on the right shows data from an experiment in which a certain amount of liquid was heated.

Time (min)	Temperature (°C)
0	25
2	35
4	45
6	55
8	65
10	75
12	85
14	95
16	99
18	100
20	100
22	100

- **a)** Use the data to plot a graph of temperature versus time.
- **b)** Identify the temperature at which a change of state has occurred, and name that change of state.
- **c)** Describe the particles of the liquid before the liquid was heated, while the liquid was being heated at 10 min, and after the change of state occurred.
- **d)** Make sketches to illustrate your descriptions in part c).
- **e)** Use the kinetic molecular theory to explain what is happening in this situation.
- **f)** Can you use the atomic theory to explain what is happening in this situation? Give reasons why or why not.
- **g)** At the start of this question, you read that a "certain amount" of liquid was heated. Does it matter if you don't know the precise amount? Use scientific understanding to support your opinion.
- **h)** Make an inference about what the liquid was. Support your inference with evidence from the data.

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17. In reality, the oxygen atoms that you can see in the image from the film "A Boy and His Atom" on the Topic 2.4 opening spread are about 120 pm, or 0.000 000 000 12 m, in diameter.
    a) Use a ruler to measure the width of one of the atoms in the large image of the "boy." How many times bigger are the atoms on the page than the real thing?
    b) Analogies in this unit compare familiar objects such as apples and the Earth or a puck and a hockey arena to help you understand the structure and size of an atom. Construct a similar analogy to help a friend understand just how small an oxygen atom is.

Thinking Critically and Creatively

18. Carbon dioxide and carbon monoxide are familiar gases with similar names. Both contain the same two types of atoms: carbon and oxygen. Both are colourless and odourless. The density of carbon dioxide is 1.96 g/L, and the density of carbon monoxide is 1.25 g/L. Carbon dioxide puts out flames and does not burn in air or in pure oxygen. Carbon monoxide burns easily in air and pure oxygen. Unlike carbon dioxide, carbon monoxide combines with the oxygen-carrying site in red blood cells, so the blood can't hold free oxygen anymore.
    a) Design a chart to compare the physical and chemical properties of carbon dioxide and carbon monoxide.
    b) Suppose you have a canister of carbon dioxide and a canister of carbon monoxide. Using your knowledge of WHMIS, design a label for each.
    c) Why is carbon monoxide so dangerous to human health?

19. Frozen carbon dioxide is called "dry ice." It is used in a number of ways, including as a coolant for transporting organs and blood, and as a way to make ice cream quickly. Unlike water, at room temperature solid carbon dioxide changes directly into a gas.

    a) Why do you think frozen carbon dioxide is also called dry ice?
    b) The freezing temperature of dry ice is −56.6°C. Why is dry ice a more effective coolant than ice?
    c) Name the change that dry ice undergoes at room temperature. Draw diagrams to model what is happening to the carbon dioxide particles according to the kinetic molecular theory.
    d) When placed in water at room temperature, dry ice changes to a gas much more quickly than it would in air at the same temperature. A dense fog is produced consisting of condensed water droplets. Why does adding dry ice to water increase the speed of the change?
    e) What safety precautions do you think people would need to take when handling dry ice? Give reasons for your answers.

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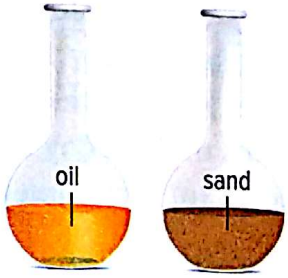
Understanding Big Ideas
Making New Connections

Applying Your Understanding

20. Liquids take the shape of their containers. The diagram below shows sand, which is a solid, taking the shape of its container. Does this mean that sand is a liquid? Explain why or why not in terms of the kinetic molecular theory.



21. For a chemical change to take place, atoms must interact. For atoms to interact, they must come into contact with one another. Which subatomic particle do you think plays the most important role in chemical changes of matter? Justify your response.

Thinking Critically and Creatively

22. Suppose your teacher asks, "What happens to the temperature of water as it changes state?"

- **a)** Suggest at least two questions to ask in order to clarify your teacher's question.
- **b)** Choose one of your clarifying questions. State two hypotheses in the form of "If...then..." statements that address this question.
- **c)** Briefly outline a procedure that could be used to test one hypothesis.
- **d)** Describe the methods you would use to record the data you would be able to collect from your experiment.
- **e)** Predict what you would discover if you carried out your experiment.

Connecting to Self and Society

23. Design a one-page quick reference guide for the general public about how to identify, handle, and dispose of household hazardous material. As part of the design, consider the following:

- ability to be quickly scanned for information
- visual appeal
- persuasiveness
- needs of the target audience

24. In 1996, a high school student wrote a science fair report about a chemical called dihydrogen monoxide. Some of its properties included the following:

- It is a key ingredient in most pesticides.
- It can cause painful burns to skin.
- It can cause illness and even death in either very low or very high amounts in the body.
- It contributes to most environmental problems and weather-related disasters.

Most of the people who read the report were so alarmed that they agreed the chemical should be banned.

- **a)** Assuming the above properties are true, do you agree that the chemical should be banned? Is there additional information that you would like before you decide? Explain your answer.
- **b)** Find out the common and standard chemical names for dihydrogen monoxide. Does your perspective change? Explain.
- **c)** Issues about dangerous chemicals are often reported on the Internet. List some questions you might ask to help you decide if an issue is being represented fairly or if it is being misrepresented.

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