Activity Preparation for Chapter 3

Activity/Investigation	Advance Preparation	Time Required	Other Considerations
Try This! (page 59) (TR page 70)	• 2 days before – Purchase an apple. • Day of – Display cut apple for class.	• 5 min to demonstrate; 60 min for observations	• Caution students not to apply masking tape directly to skin.
What's Going On? Increase Surface Area (page 59) (TR page 71)	• 2 days before – Buy sugar cubes. – Gather materials. – Photocopy **BLM 3–3 Factors Affecting Rate of Change** (optional). • Day of – Distribute materials and apparatus.	• 30 min	• Consider using plastic beakers to avoid the possible hazard of broken glass. • Consider providing students with a mortar and pestle or a plastic bag and rolling pin to crush the sugar cubes.
Test It! Big or Small: Faster or Slower? (page 60) (TR page 72)	• 2 days before – Buy effervescent antacid tablets. – Collect materials and apparatus. – Photocopy **Master 3 Centimetre Grid Paper**, **BLM 3–3 Factors Affecting Rate of Change**, **BLM 3–4 Making a Bar Graph**, **BLM 3–5 Making a Bar Graph in Microsoft® Excel** (optional), and any assessment masters you plan to use. • Day of – Review with students how to use the apparatus. – Set out materials.	• 60–75 min	• You may wish to divide this activity between two classes, the first for planning and the second for carrying out the procedure. • Not all antacids will effervesce. For best results, select a brand containing sodium bicarbonate and an acid such as ASA (e.g., Alka-Seltzer®). • Use plastic beakers to avoid the possible hazard of broken glass.
Try This! (page 61) (TR page 74)		• 30 min	• No materials are required for this thought experiment.
Test It! Concentrated or Dilute: Faster or Slower? (page 62) (TR page 77)	• 2 weeks before – Verify availability of magnesium ribbon and hydrochloric acid in desired concentrations. – Review the school's procedures for cleaning up acid spills. • 1 to 2 days before – Prepare three concentrations of hydrochloric acid. Label the corresponding beakers solution 1, 2, or 3. – Cut magnesium ribbon into 0.5 cm lengths. – Photocopy any assessment masters you plan to use. • Day of – Set out materials.	• 60 min	• You may wish to conduct this activity as a teacher demonstration due to the dangers associated with strong acids. • Since diluting acids is dangerous, it is highly recommended to purchase them at the desired concentration. If you must dilute the acid, never pour water into a concentrated acid. This will generate a tremendous amount of heat and the reaction can cause a dangerous splash. If you must dilute a concentrated acid with water, pour the acid slowly and gently into the water. • Concentrations under 1 Mol/L are recommended.
Test It! Hot or Cold: Faster or Slower? (page 66) (TR page 82)	• 2 days before – Buy effervescent antacid tablets. – Collect materials. – Set out a large beaker of water so that it will reach room temperature. • Photocopy **BLM 3–7 Making a Line Graph**, **BLM 3–8 Making a Line Graph in Microsoft® Excel** (optional), **Assessment Master 4 Lab Report Rubric**, **Assessment Master 10 Using Tools and Equipment Rubric**, and any other blackline masters you intend to use. • Day of – Set out materials. – Heat water if not providing students with hot plates.	• 40–60 min	• Consider providing students with hot water and ice water to save time and eliminate risks related to using a hot plate. You can dispense hot water from a kettle, the spout of a coffee urn, or possibly from a tap. • When possible, use plastic beakers to avoid the possible hazard of broken glass. • Provide digital thermometers for students who find graduated thermometers difficult to read. • Qualitative or relative temperatures may be used instead of measuring temperatures.

Activity Preparation for Chapter 3

Activity/Investigation	Advance Preparation	Time Required	Other Considerations
Try This! (page 69) (TR page 87)	• 1 day before – Book a room where eating food is permitted. – Check that no students are allergic to the ingredients in crackers. – Buy plain crackers. • Day of – Double check for allergies.	• 15 min; 2 min if assigned as homework	• Consider assigning this activity as homework. Alternatively, book a room where eating food is permitted (e.g., cafeteria). • Have water on hand for students who need a drink afterward.
Teacher Demonstration: A Catalyst in a Chemical Change (page 70) (TR page 88)	• 2 weeks before – Obtain materials. • 1 day before – Prepare the solutions if not available in the required concentrations. – Photocopy **BLM 3–10 Teacher Demonstration: A Catalyst in a Chemical Change**. • Day of – Preheat the Rochelle salt and hydrogen peroxide solutions to 65°C.	• 15 min	• Prepare the solutions as follows: – Dissolve 50.8 g of solid Rochelle salt in 600 mL of water to get a 0.3 Mol/L solution. – Dilute 40 mL of 30% hydrogen peroxide in 160 mL of water to get a 6% solution. Alternatively, buy a 6% solution at the drug store. If prepared in advance, ensure it is sealed to prevent its decomposition into water and oxygen. Refrigeration will slow down the decomposition rate. – Dissolve 2 g of solid cobalt chloride in 30 mL of water to get a 0.3 Mol/L solution. • Preheat the Rochelle salt and hydrogen peroxide solution about 10 minutes before class.

Materials Needed for Chapter 3

Activity/Investigation	Apparatus	Materials	Blackline Masters
Try This! (page 59) (TR page 70)	• knife	• apple	**Recommended** BLM 1–1 Predict, Explain, Observe, Explain
What's Going On? Increase Surface Area (page 59) (TR page 71)	• 2 – 50 mL beakers • felt-tip marker • mortar and pestle (optional) • stopwatch (optional)	• 2 sugar cubes • 50 mL water	**Optional** BLM 3–3 Factors Affecting Rate of Change
Test It! Big or Small: Faster or Slower? (page 60) (TR page 72)	• 3 – 100 mL beakers • stopwatch • plastic bag or mortar and pestle	• water • 3 identical effervescent antacid tablets	**Recommended** Master 3 Centimetre Grid Paper BLM 3–4 Making a Bar Graph OHT A–10 and OHT A–11 Test It! Big or Small: Faster or Slower? Assessment Master 3 Lab Report Checklist Assessment Master 4 Lab Report Rubric Assessment Master 11 Fair Test Checklist Assessment Master 12 Fair Test Rubric **Optional** BLM 3–5 Making a Bar Graph in Microsoft® Excel OHT A–8 Identifying Physical Changes and Chemical Changes

Materials Needed for Chapter 3

Activity/Investigation	Apparatus	Materials	Blackline Masters
Try This! (page 61) (TR page 74)			**Optional** Assessment Master 2 Co-operative Group Work Rubric
Test It! Concentrated or Dilute: Faster or Slower? (page 62) (TR page 77)	• stopwatch	• Solution 1: 20 mL dilute hydrochloric acid (0.1 Mol/L or 5%) • Solution 2: 20 mL medium-concentration hydrochloric acid (0.2 Mol/L or 10%) • Solution 3: 20 mL concentrated hydrochloric acid (0.5 Mol/L or 20%) • 3 pieces of magnesium ribbon	**Recommended** OHT A–12 and OHT A–13 Test It! Concentrated or Dilute: Faster or Slower? Assessment Master 7 Safety Checklist **Optional** Assessment Master 8 Safety Rubric Assessment Master 11 Fair Test Checklist
Test It! Hot or Cold: Faster or Slower? (page 66) (TR page 82)	• 3 – 100 mL beakers • hot plate • thermometer • stopwatch • ruler • tongs (optional)	• 120 mL water • handful of ice • 2 identical effervescent antacid tablets	**Recommended** OHT A–14 to OHT A–16 Test It! Hot or Cold: Faster or Slower? BLM 3–7 Making a Line Graph Assessment Master 4 Lab Report Rubric Assessment Master 10 Using Tools and Equipment Rubric **Optional** Master 1 Narrative Lab Report Master 3 Centimetre Grid Paper BLM 3–8 Making a Line Graph in Microsoft® Excel Assessment Master 17 Narrative Lab Report Checklist
Try This! (page 69) (TR page 87)		• plain crackers (2 per student)	
Teacher Demonstration: A Catalyst in a Chemical Change (page 70) (TR page 88)	• 2 – 600 mL beakers • overflow tray • thermometer • hot plate • beaker tongs	• 600 mL 0.3 M Rochelle salt solution • 200 mL 6% hydrogen peroxide solution • 30 mL 0.3 M cobalt chloride solution	**Recommended** BLM 3–6 Teacher Demonstration: A Catalyst in a Chemical Change

CHAPTER 3 Rates of Change (page 56)

SUGGESTED TIMING
15 min

Overall Expectations

CIMV.01 – understand how chemicals in common household and workplace materials interact
CIMV.02 – investigate the types and rates of interactions between commonly used materials through laboratory activities
CIMV.03 – analyse how material interactions affect our daily lives

Activity Planning Notes

Read the Chapter Opener as a class. Have students answer and then discuss question 1 on page 56. Provide some other examples of fast and slow physical and chemical changes. You might mention that students will learn about catalysts, which help speed up reactions. Catalysts used in making shampoo speed up the polymerization of alpha olefins and result in making hair "silky." Catalysts make plastic wrap "cling." Catalysts remove sulfur from fossil fuels so they burn cleaner. Polyethylene is the plastic found in garbage bags, electrical insulation, and squeezable ketchup bottles. To make polyethylene, ethylene gas is passed over a catalyst. Students will learn more about catalysed changes in section 3.5.

Explain that the visual shows two processes: the physical process of eroding the riverbank and the chemical process of rusting the car. Erosion involves two processes: one physical (water washes away particles), and the other chemical (acid in the water reacts with limestone). Remind students that they learned about how acid erodes limestone and other corrosive chemicals in Chapter 1.

Have students complete and then discuss questions 2 and 3.

Reading Icon Answer (page 56)

1. Students should underline: make their products as quickly and cheaply as possible; slow the rotting and spoiling processes.

Check your Understanding Answer (page 56)

2. rainstorms

Making Connections Answers (page 56)

3. a) green car
   b) It shows more rust.

Technology Links

- For information about acid rain, go to **www.mcgrawhill.ca/books/Se10** and follow the links to Acid Rain.
- For information about catalysts used in making shampoo, go to **www.mcgrawhill.ca/books/Se10** and follow the links to It's All in the Catalyst.

3.1 How Fast Is It, and How Can You Tell? (page 57)

SUGGESTED TIMING	MATERIALS	BLACKLINE MASTERS
30 min	• coffee, fresh ground • water • large beaker or petri dish • bicycle tire and pump • exercise or beach ball • perfume (optional)	BLM 3–1 Burning Rate of Candles

Specific Expectations

CIM1.04 – identify the factors that alter the rate of physical processes and chemical reactions

Key Terms Teaching Strategies

Have students complete some or all of the following activities to help them learn and remember the key terms:

- Write the definition and some examples in their Science Log. You may wish to have students keep a glossary at the back of their Science Log.
- Begin a mind map with "rate of change" in the centre. Have students add to the mind map as they work through the chapter.

Help students remember the key term by posting it on a science word wall.

Activity Planning Notes

Assess students' prior knowledge by brainstorming examples of rates of change they are familiar with. Record their ideas on the chalkboard.

Read the information on page 57 together. Have students highlight the definition of rate of change. Then ask volunteers to help perform a few demonstrations and have the class define the rate of change in each.

- Stir coffee in a beaker of water. Use a beaker or a petri dish on an overhead projector so that everyone can see.
- Pump up a bicycle tire.
- Deflate an exercise or beach ball.
- Spray perfume or open a bag of fresh coffee grounds. Note: Do not spray perfume if there are students with allergies to perfume.

After students have completed and discussed question 4 on page 57, have them review the list they brainstormed and replace any that do not represent an amount of change over time. They can use these examples to answer question 5.

You may need to reinforce the difference between rate and rate of change. Change is key to the latter term. Examples of each term are provided in the student resource. Heart rate and highway speed help students relate rate to their everyday lives, but they are not rates of change. A heart slowing down represents a rate of change. For example, slowing after exercise from a rate of 140 beats per minute to a rate of 70 beats per minute, over 5 minutes, represents a rate of change of 14 beats/min.

Have students complete and then discuss **BLM 3–1 Burning Rate of Candles** to practise doing calculations related to rate of change. You may wish to make an overhead transparency of this blackline master to help guide students through the process.

Consider using the following blackline master:

- **BLM 3–1 Burning Rate of Candles**

Accommodations

- If students are having difficulty brainstorming, provide a more structured approach using the alphabet. Have students think of a rate of change that begins with each letter of the alphabet. For example, an ant hill grew 2 cm/day; a fire burns 3 logs/h. Browsing in a dictionary may also spark ideas.
- Students with weak math skills could be paired with students who have stronger skills.

Check Your Understanding Answers (page 57)

4. amount of change; period of time

5. a) to **d)** Look for four examples, such as:

- candle burns 1 cm/h
- candle burns 5 g/h
- I grew 10 cm in 2 months
- temperature drops 10°C in 3h
- my grades improved 8% this term

Alternative Activity

- Have students measure a rate of change (e.g., the melting of an ice cube).

Ongoing Assessment

- Use the Check Your Understanding questions as a formative assessment.

3.2 Surface Area and Rate of Change (page 58)

SUGGESTED TIMING

30 min
5 min to carry out; 60 min to observe for Try This! on page 59
30 min for What's Going On?
60–75 min for Test It!
30 min for Try This! on page 61

MATERIALS

- 200 mL water (food colouring optional)
- 100 mL shallow pan
- 100 mL tall cup
- fan (optional)
- modelling clay
- tape

BLACKLINE MASTERS

Master 3 Centimetre Grid Paper
BLM 1–1 Predict, Explain, Observe, Explain
BLM 3–2 Cube Templates
BLM 3–3 Factors Affecting Rate of Change
OHT A–8 Identifying Physical Changes and Chemical Changes
OHT A–9 Surface Area
OHT A–10 and OHT A–11 Test It! Big or Small: Faster or Slower?
Assessment Master 2 Co-operative Group Work Rubric
Assessment Master 3 Lab Report Checklist
Assessment Master 4 Lab Report Rubric
Assessment Master 11 Fair Test Checklist
Assessment Master 12 Fair Test Rubric

Specific Expectations

CIM1.03 – distinguish between chemical reactions and physical processes, using appropriate scientific terminology
CIM1.04 – identify the factors that alter the rate of physical processes and chemical reactions
CIM2.01 – select and use appropriate lab equipment and apply WHMIS safety procedures for the handling, storage, disposal, and recycling of laboratory materials
CIM2.02 – conduct experiments to investigate how materials can interact chemically
CIM2.03 – conduct experiments to investigate how materials can interact physically
CIM2.04 – conduct experiments to determine the factors affecting rates of chemical reactions and physical processes
CIM2.05 – communicate the results of investigations using a variety of oral, written, and graphic formats
CIM3.01 – research the interactions of materials that are used in daily life
SIM2.01 – formulate testable questions on science-related claims and conduct investigations based on the concept of a fair test
SIM2.03 – interpret research data, including analysis for accuracy and bias as appropriate, using a range of strategies for reading for information
SIM2.04 – organize and communicate information collected from lab investigations and information research using graphic organizers
SIM3.01 – formulate testable questions about science-related claims and representations in the media
SIM3.02 – develop procedures to assess these claims and representations, using information research and/or laboratory investigations

Key Terms Teaching Strategies

Have students complete some or all of the following activities to help them learn and remember the key term:

- Write the definition of surface area in their Science Log.
- Use **BLM 3–2 Cube Templates** to give students a tactile experience with surface area.

Help students remember the key term by posting it on a science word wall.

Activity Planning Notes

Illustrate that surface area increases evaporation rate by pouring 100 mL of water into two containers: a shallow pan labelled Lake 1, and a cup labelled Lake 2. Ask the students which lake has more water open to the air. A fan blowing across the water may help students visualize this concept. Read the text with the students and then ask which lake will have the greater evaporation rate.

You may wish to use **OHT A–9 Surface Area** and a cube to guide students through the calculations on page 58 as a class. You might use a cube of modelling clay or prepare paper cubes using **BLM 3–2 Cube Templates**.

Ask the class how they could further increase the surface area of the cubes. Perform another calculation based on their suggestion. Ask students to imagine the surface area if the cubes were broken down until they were as small as grains of sand.

Have students complete the activities in the student resource in the order that they are presented.

Ask if any students have put out a kitchen fire with baking soda. If they did, they used surface area to speed up extinguishing the fire. Sodium bicarbonate forms carbon dioxide gas when heated. This gas helps put out a fire. Explain that a large surface area of the powder is required to put out a fire and that a solid block of baking soda would not form gas quickly enough to be useful.

Hand out **BLM 3–3 Factors Affecting Rate of Change** and have students read about surface area and then fill in an example. You may wish to refer students to this blackline master as they work through the chapter.

Consider using the following blackline masters and overhead transparency:

- **BLM 3–2 Cube Templates**
- **BLM 3–3 Factors Affecting Rate of Change**
- **OHT A–9 Surface Area**

Accommodations

- Allow students to use calculators to calculate surface area.
- Have students use **BLM 3–2 Cube Templates** and cut out and assemble the cubes using tape. They can use the cubes to help do the calculations on page 58. Alternatively, students could manipulate cubes of modelling clay, blocks, or centimetre cubes.

Answers (page 58)

1. $1\ m^2$
2. 6
3. $6\ m^2$
4. $0.25\ m^2$
5. $1.5\ m^2$
6. 8
7. $12\ m^2$
8. two times larger

Try This! Activity (page 59)

Purpose

- Students observe the oxidation of a sliced apple in order to visualize the effect of surface area on the rate of reaction.

Science Background

The iron in an apple reacts with oxygen in the air, not completely unlike rusting. This oxidation is supported by the enzyme polyphenol oxidase (PPO), also called tyrosinase. Levels of this enzyme, or the fruit's acidity, may explain why some apples brown faster than others. Browning oxidation is apparent in other foods such as potatoes, bananas, and peaches.

Changing the pH by adding vinegar or lemon juice will slow down the browning, but even uncut apples will eventually go brown since there is air inside the apple. The high air content also makes apples float.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
2 days before	• Purchase an apple.
Day of	• Display cut apple for class.

APPARATUS	MATERIALS
• knife	• apple

Suggested Timing

5 min to demonstrate; 60 min for observations

Safety Precautions

- Do not allow students to handle the knife.
- Remind students not to eat anything in the science classroom.

Activity Planning Notes

As you cut the apple, ask students what they think will happen. After observing the browned apple, slice the remaining half to show that the inside has not browned. Have students explain their predictions.

Accommodations

- Have students complete a POE chart to help organize their thoughts. You may wish to hand out **BLM 1–1 Predict, Explain, Observe, Explain** for this purpose.

Activity Wrap-up

- Discuss the observations as a class. Ensure that all students understand the relationship between rate of browning and surface area.
- Have students predict the rate of browning if the apple is uncut, diced, or shredded.

What's Going On? Activity (page 59)

Increase Surface Area

Purpose

- Students investigate the effect of surface area on dissolving.

Science Background

Reactions occur only on the surface of a substance, or the point at which the two substances contact. Thus, increasing surface area will speed up a reaction.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
2 days before	• Buy sugar cubes. • Gather materials. • Photocopy **BLM 3–3 Factors Affecting Rate of Change** (optional).
Day of	• Distribute materials.

APPARATUS	MATERIALS
• 2 – 50 mL beakers • felt-tip marker • mortar and pestle (optional) • stopwatch (optional)	• 2 sugar cubes • 50 mL water

Suggested Timing

30 min

Safety Precautions

- Remind students not to eat or drink anything (including sugar) in the science classroom.
- Have students use a brush and a dust pan to collect any pieces of broken glass. Point out the broken glass container.

Activity Planning Notes

Consider using plastic beakers to avoid the possible hazard of broken glass.

Model for students how to colour two sugar cubes. Then crush one and ask the class which cube will dissolve faster. Have a student read the directions aloud. Indicate the 25 mL mark on the beaker so students can see how much water to add. Answer any questions before allowing student pairs to carry out the procedure.

Qualitative observations will suffice, but you may wish to hand out stopwatches for students to measure the rate of dissolving.

Accommodations

- Prepare an overhead that shows a diagram of the set-up for students to use.
- Stress the check boxes as a strategy to help students stay on track.
- Demonstrate how to crush one of the coloured sugar cubes with a pencil. You may wish to provide mortar and pestle or a plastic bag and rolling pin for this purpose.

What's Going On? Activity Answers (page 59)

1. • The inside of the sugar cube stayed white because we only coloured the outside with a marker.
• crushed; There was more surface area contact between the solvent and solute.

2. The greater the surface contact, the faster the rate of dissolving.

Activity Wrap-up

- Have students complete and then discuss questions 1 and 2.
- Have students stir the beaker containing the crushed sugar cube. Ask why the sugar dissolves and lead students toward the understanding that stirring is another way to increase surface area. If you have not already done so, hand out **BLM 3–3 Factors Affecting Rate of Change** and have students read the information for stirring and fill in an example.

Test It! Activity (page 60)

Big or Small: Faster or Slower?

Purpose

- Students design an investigation to test the effect of surface area on the rate of a chemical reaction.

Science Background

Refer to the Science Background for the What's Going On? activity on page 71 of the teacher resource.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
2 days before	• Buy effervescent antacid tablets. • Collect materials and apparatus. • Photocopy **Master 3 Centimetre Grid**, **BLM 3–3 Factors Affecting Rate of Change**, **BLM 3–4 Making a Bar Graph**, **BLM 3–5 Making a Bar Graph in Microsoft® Excel** (optional), and any assessment masters you plan to use.
Day of	• Review with students how to use the apparatus. • Set out materials.

APPARATUS	MATERIALS
• 3 – 100 mL beakers • stopwatch • plastic bag or mortar and pestle	• water • 3 identical effervescent antacid tablets

Suggested Timing

60–75 min

Safety Precautions

- Have students clean up their work area and thoroughly wash their hands at the end of the investigation.
- Have students use a brush and a dust pan to collect any pieces of broken glass. Point out the broken glass container.

Activity Planning Notes

You may wish to divide this activity between two classes, the first for planning and the second for carrying out the procedure.

Not all antacids will effervesce. For best results, select a brand containing sodium bicarbonate and an acid such as ASA (e.g., Alka-Seltzer®). Use plastic beakers to avoid the possible hazard of broken glass.

Begin the activity by illustrating the reaction between an effervescent antacid tablet and a glass of water. Ask the students if this is a physical or chemical change. Students should realize that a chemical reaction is occurring and that fizzing is the visual clue that a gas is being produced. You may wish to display **OHT A–8 Identifying Physical Changes and Chemical Changes** as a reminder. Ask the students how they could measure this reaction and lead them toward the idea of timing the fizzing.

As a class, read the directions and make sure everyone understands what to do. Consider using **OHT A–10** and **OHT A–11 Test It! Big or Small: Faster or Slower?** to coach students through the activity.

Demonstrate the proper use of the apparatus before students begin.

Survey answers to questions 1 and 2 to ensure that students are making reasonable predictions and can correctly identify variables. Review their procedures for safety and sound design. Students should vary the surface area of the tablet while keeping all other variables constant.

When you hand out materials, direct students to add water to the powder, not the other way around as the powder will float, delaying the reaction.

Accommodations

- Students may crush the tablets inside a plastic bag instead of using the mortar and pestle. Alternatively, provide pre-crushed tablets.
- Some students may have difficulty putting their steps in logical order. Have them write out the steps on one side of a piece of paper and then cut out the steps. They can rearrange the steps until they are in logical order, and then glue the steps in place in their student resource.
- Have students who have difficulty writing discuss their experimental procedure orally or draw a diagram.

Test It! Activity Answers (pages 60–61)

1. Accept either combination of: larger, slower; or smaller, faster.
2. **a)** surface area

   b) temperature, amount, time
3. **a)** Sample answer: crush the tablets

   b) Sample answer: rate of fizzing

   c) Sample answer:

   I will start the stopwatch when I add the tablets. I will stop the stopwatch when the fizzing stops.
4. Answers will vary. Students should include a description of the surface area of the tablets during each repetition, when to start and stop the stopwatch, and how many times to repeat the test with a changed variable.
5. Answers will vary. The sample answer in the table is for 18°C and 50 mL of water.

Trial	Surface Area	Time to React (s)
1	whole	80
2	quartered	67
3	powdered	32

6. The greater the surface area, the faster the rate of change.
7. Answers will vary. Look for evidence that students have evaluated their experimental design and identified at least one area for improvement.

Activity Wrap-up

- Have students make a bar graph of their observations. Provide them with **Master 3 Centimetre Grid** and **BLM 3–4 Making a Bar Graph**, if needed. Alternatively, allow students to use a graphing calculator or spreadsheet program to create a graph. **BLM 3–5 Making a Bar Graph in Microsoft® Excel** provides coaching for this.
- Have students complete and then discuss their results in a class discussion. Consider having students use **Assessment Master 3 Lab Report Checklist** to assess the quality of their reports.
- Consider handing out copies of **Assessment Master 11 Fair Test Checklist** for students to assess their experimental design.
- Have students write a summary statement in their Science Log about the relationship between surface area and rate of reaction.
- If you have not already done so, hand out **BLM 3–3 Factors Affecting Rate of Change** and have students read the section on surface area and fill in an example.

Try This! Activity (page 61)

Purpose

- Students plan a procedure that demonstrates the difference in flammability between solids in a pile and suspended in air.

Science Background

Dust explosions are a hazard in grain elevators and silos, coal mines, and saw mills. Lightning, static electricity, or a flame can ignite the haze of particles suspended in the air, usually with explosive results. Conversely, the same substances in a pile are much less flammable. A solution of air and dust particles is highly flammable because of the large amount of surface area exposed to the oxidizer (air). The rate of reaction is directly proportional to surface area.

No materials are required for this thought experiment.

Suggested Timing

30 min

Safety Precautions

- Do not allow students to carry out the procedures they design.

Activity Planning Notes

Consider having students work with a partner or a small group to design a demonstration.

You may wish to carry out a student design, show a video of the reaction, or perform the demonstration described in the Alternative Activities at the end of this section. See the Technology Links on the next page for video suggestions.

Accommodations

- Pair ESL and LD Learners with students who have stronger language skills.
- Have students who have difficulty writing discuss their experimental procedure orally or draw a diagram.

Activity Wrap-up

- As a class, share news reports, videos, or pictures of grain or coal dust explosions to help make real-world connections. These reactions occur fairly often and are deadly and dramatic so news reports are easy to find in an Internet search.

Ongoing Assessment

- Use question 6 on page 61 to assess students' understanding of the connection between surface area and rate of reaction.
- Use **Assessment Master 2 Co-operative Group Work Rubric** to assess students' group work during the activities.
- Use **Assessment Master 12 Fair Test Rubric** to assess students' experimental designs in the Test It! and Try This! activities.
- Use **Assessment Master 4 Lab Report Rubric** to assess students' reports of the Test It! activity.

Alternative Activities

- Demonstrate that steel tongs will not burn, but that steel wool does. Ask students how surface area might be involved.
- Compare the cooling rate of ice cubes with different surface areas. Specifically, compare square cubes from home with restaurant cubes, which are usually scooped and have a larger surface area. Ask which kind cools a drink faster? Relate the rate to the amount of surface area in contact with the drink.
- Investigate the role of surface area in the chemical reaction that inflates a vehicle's air bag. The sodium azide in air bags is shaped into pellets so engineers can determine the precise surface area needed to produce the desired rate of change. In just milliseconds, this chemical produces 60 L of nitrogen gas, which inflates the life-saving bag.
- Demonstrate the impressive and messy reaction of a Mentos® mint in a small sample of Diet Coke®. Repeat using a penny or candy. All of these items make the drink fizz, but the rough surface of the mint provides the large surface area that stimulates the release of bubbles.

- Compare the flammable nature of a pile with a dust cloud by carrying out a demonstration using wheat flour or lycopodium powder. First, show that a pile of flour will not catch on fire. Then use a bellows to blow the pile from the desk over a flame from a lighter or candle. The powder will light and produce an orange flame. Be sure to follow your department's safety procedures and place a shield between students and the demonstration.

Technology Links

- For examples of dust explosions, go to **www.mcgrawhill.ca/books/Se10** and follow the links to Dust Explosions.
- For a video of a dust experiment, go to **www.mcgrawhill.ca/books/Se10** and follow the links to Flammable Solids.

3.3 Concentration and Rate of Change (page 62)

SUGGESTED TIMING	MATERIALS	BLACKLINE MASTERS
45 min	• peat (optional) • tannic acid (optional)	BLM 3–3 Factors Affecting Rate of Change OHT A–7 Making and Diluting a Solution OHT A–12 and OHT A–13 Test It! Concentrated or Dilute: Faster or Slower? Assessment Master 7 Safety Checklist Assessment Master 8 Safety Rubric Assessment Master 11 Fair Test Checklist

Specific Expectations

CIM1.03 – distinguish between chemical reactions and physical processes, using appropriate scientific terminology
CIM1.04 – identify the factors that alter the rate of physical processes and chemical reactions
CIM2.01 – select and use appropriate lab equipment and apply WHMIS safety procedures for the handling, storage, disposal, and recycling of laboratory materials
CIM2.02 – conduct experiments to investigate how materials can interact chemically
CIM2.04 – conduct experiments to determine the factors affecting rates of chemical reactions and physical processes
CIM2.05 – communicate the results of investigations using a variety of oral, written, and graphic formats
SIM2.01 – formulate testable questions on science-related claims and conduct investigations based on the concept of a fair test
SIM2.03 – interpret research data, including analysis for accuracy and bias as appropriate, using a range of strategies for reading for information
SIM2.04 – organize and communicate information collected from lab investigations and information research using graphic organizers

Science Background

Canada is one of the biggest producers of peat. Peat bogs are quite acidic (low pH); not many bacteria can live in a bog. Peat moss is used as a fertilizer, burned for heat, and used in some expensive skin creams (Lindow moss in particular).

Tannin, found naturally in many trees including oak and walnut, reacts with proteins in animal hide to form substances that do not rot easily and is used to preserve leather.

Activity Planning Notes

Remind students of what they learned about concentration in Chapter 2. They should recall the difference between concentrated and dilute solutions and that more concentrated substances react faster.

After students have completed the Test It! activity, read the Science and Literacy Link on page 64 as a class. Help students relate to the facts in the article by explaining that the workers were mining peat from a bog. You might explain what a bog is and identify a nearby bog, or point out the Wainfleet Bog on a map. This bog is located in Port Colbourn near Lake Erie. Note: Lindow Man was found in England.

You might show some samples of tanned leather, peat moss, and tannic acid and explain the uses of peat and tannin (tannic acid).

Peat moss is full of stagnant water. In stagnant water, dissolved oxygen is not replaced once it is used up or bubbles out. Explain that moving water not only circulates fresh water containing oxygen, but the agitation actually helps more oxygen dissolve in the water.

Have students read about concentration and record an example using **BLM 3–3 Factors Affecting Rate of Change**. You may continue to refer to this blackline master throughout the chapter.

Consider using the following blackline master:
- **BLM 3–3 Factors Affecting Rate of Change**

Accommodations

- Prompt students to highlight the connections between concentration and rate of rotting in the article on page 64.
- Pair ESL and LD Learners with students who have stronger language skills.

Technology Links

- For additional information about peat go to **www.mcgrawhill.ca/books/SE10** and follow the links to Peat.
- For information about leather tanning, go to **www.mcgrawhill.ca/books/SE10** and follow the links to The Tanning Process.

Reading Icon Answer (page 64)

1. Students should underline: low concentration of oxygen; high concentration of tannic acid.

Check Your Understanding Answers (page 64)

2. **a)** low; not enough oxygen for bacteria to live so body doesn't rot
   b) high; Lindow Man was tanned like leather

Test It! Activity (page 62)

Concentrated or Dilute: Faster or Slower?

Purpose

- Students test the effect of concentration on the rate of reaction between hydrochloric acid and magnesium ribbon.

Science Background

Hydrochloric acid reacts with magnesium to produce hydrogen gas and magnesium chloride. Although it looks like the metal dissolves, the gas bubbles are evidence of a chemical reaction.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
2 weeks before	• Verify availability of magnesium ribbon and hydrochloric acid in desired concentrations. • Review the school's procedures for cleaning up acid spills.
1 to 2 days before	• Prepare three concentrations of hydrochloric acid. Label the corresponding beakers Solution 1, 2, or 3. • Cut magnesium ribbon into 0.5 cm lengths. • Photocopy any assessment masters you plan to use.
Day of	• Set out materials.

APPARATUS	MATERIALS
• stopwatch	• Solution 1: 20 mL dilute hydrochloric acid (0.1 Mol/L or 5%) • Solution 2: 20 mL medium-concentration hydrochloric acid (0.2 Mol/L or 10%) • Solution 3: 20 mL concentrated hydrochloric acid (0.5 Mol/L or 20%) • 3 pieces of magnesium ribbon

Suggested Timing

60 min

Safety Precautions

- Check that students are wearing safety goggles at all times.
- Ensure that the eye wash station is in good condition.
- Have students wash skin or clothing immediately and thoroughly if acid spills on them.
- Clean up spills with sodium carbonate or sodium bicarbonate immediately after they happen. This is as effective as water and less messy.
- Remind students to clean up their work area and wash their hands well with soap and water at the end of the investigation.
- Have students use a brush and a dust pan to collect any broken glass beakers. Point out the broken glass container.

Activity Planning Notes

Because of the dangers involved in diluting acids, it is highly recommended to purchase acids at the desired concentrations. If you must dilute the acid, never pour water into a concentrated acid. This will generate a tremendous amount of heat and the reaction can cause a dangerous splash. If you must dilute a concentrated acid with water, pour the acid slowly and gently into the water. Concentrations under 1 Mol/L are recommended.

You may wish to conduct this activity as a teacher demonstration due to the dangers associated with strong acids.

Introduce the lab by reviewing the concept of concentration and displaying three beakers with varying concentrations of orange drink. Ask students to identify the least and most concentrated solutions. Consider using **OHT A–7 Making and Diluting a Solution** and making a connection with what students learned during Find Out: Making and Diluting a Solution in Chapter 2. Ask a volunteer to summarize what they remember.

Set out the three concentrations of hydrochloric acid: dilute, medium, and concentrated. Explain that since the acid is colourless, appearance will not help identify the level of concentration. This might be compared to sugar-water or salt-water concentrations. Make sure the beakers of hydrochloric acid are correctly labelled as 1, 2, or 3.

Use an analogy to help students conceptualize how concentration affects the rate of reaction. For example, in a crowded bus with a high concentration of people, people bump into each other more often. The rate of collision increases as concentration increases. Other examples include the concentration of swimmers in a pool, skaters on a rink, or passengers on public transit during rush hour. Have students imagine a muddy sports team getting on a train and mud being spread every time a player bumps someone or something. (This mimics a reaction.) The more muddy people there are (higher concentration), the faster the mud will spread (rate of reaction).

Read the introduction and review the safety precautions. Consider having students complete **Assessment Master 7 Safety Checklist** to emphasize the importance of following safety practices in the lab.

As a class, read the What to Do section on page 63 and make sure everyone understands what to do. Consider using **OHT A–12** and **OHT A–13 Test It! Concentrated or Dilute: Faster or Slower?** to coach students through this activity.

Accommodations

- Encourage students to use diagrams to illustrate the differences between dilute (show least solute particles), medium concentration, and concentrated solutions (show most solute particles).
- Stress the check boxes as a strategy to help students stay on track.
- Some students may have difficulty processing the steps and need some coaching. Pair such students with someone who has stronger skills. The weaker students could do the timing while partners record. Alternatively, have students do each step in the investigation at the same time .
- Pair students with dexterity problems with those without such difficulties.
- Provide digital stopwatches.

Test It! Answers (pages 62–63)

1. How does concentration affect the rate of reaction?

2. Yes. The more concentrated solution will react faster.

3. **a)** concentration

b) Any three of:

- surface area or amount of magnesium ribbon
- temperature of reactants
- amount of solution
- type of acid

7. The time for reactions will vary. Students should circle the relative rate of change:
Solution 1: Low; Slow

Solution 2: Medium; Medium

Solution 3: High; Fast

8. Answers will vary. Sample answer:

- The higher the concentration of hydrochloric acid, the faster it reacts with magnesium ribbon.

Activity Wrap-up

- Have students complete and then discuss questions 7 and 8 on page 63. Consider having students compare their observations with those of their peers. Have students write a conclusion in their Science Log.
- As a class, discuss what happened in this reaction and ask students to identify the reactants and products.
- If you have not already done so, refer students to **BLM 3–3 Factors Affecting Rate of Change** and have them read the information about concentration and write an example.
- Consider having students assess the experimental design using **Assessment Master 11 Fair Test Checklist**.

Ongoing Assessment

- Use question 8 on page 63 and question 2 on page 64 to assess students' understanding of the role that concentration plays in the rate of change.
- Consider using **Assessment Master 8 Safety Rubric** to assess students' safety practices during the Test It! activity.

Alternative Activities

- Demonstrate the effect of different concentrations of oxygen on the rate of burning. You might compare the burning rate of a wooden splint in room air versus pure oxygen.
- Have students form crystals by making rock candy. Stir 400 g of sugar into 250 mL of boiling water and heat to 165°C. Wet a craft stick and roll it in sugar, then suspend it in the cooling sugar-water so that it doesn't touch the bottom of the container. Set this aside to cool and watch the crystals grow over a few days.
- Compare the evaporation rate of different concentrations of alcohol and water in watch glasses.
- Have students compare the cleaning effectiveness of dilute versus concentrated soapy dish water on a greasy dish.

3.4 Temperature and Rate of Change (page 65)

SUGGESTED TIMING	MATERIALS	BLACKLINE MASTERS
30 min 40–60 min for Test It!	• beakers (plastic, if available) • samples of hot, cold, and room temperature water • thermometer	Master 1 Narrative Lab Report Master 3 Centimetre Grid Paper BLM 3–3 Factors Affecting Rate of Change BLM 3–6 Temperature OHT A–14 to OHT A–16 Test It! Hot or Cold: Faster or Slower? Assessment Master 4 Lab Report Rubric Assessment Master 10 Using Tools and Equipment Rubric Assessment Master 17 Narrative Lab Report Checklist

Specific Expectations

CIM1.03 – distinguish between chemical reactions and physical processes, using appropriate scientific terminology
CIM1.04 – identify the factors that alter the rate of physical processes and chemical reactions
CIM2.01 – select and use appropriate lab equipment and apply WHMIS safety procedures for the handling, storage, disposal, and recycling of laboratory materials
CIM2.02 – conduct experiments to investigate how materials can interact chemically
CIM2.03 – conduct experiments to investigate how materials can interact physically
CIM2.04 – conduct experiments to determine the factors affecting rates of chemical reactions and physical processes
CIM2.05 – communicate the results of investigations using a variety of oral, written, and graphic formats
SIM2.04 – organize and communicate information collected from lab investigations and information research using graphic organizers

Key Terms Teaching Strategies

Have students complete some or all of the following activities to help them learn and remember the key terms:

- Write definitions for these terms in their Science Log. You may wish to have students keep a glossary at the back of their Science Log.
- Create a mind map that shows the relationship between the terms and gives examples of each.

Help students remember the key terms by posting them on a science word wall.

Activity Planning Notes

As a class, read the information on page 65. Have students brainstorm everyday examples of hot and cold. As a class, quantify the temperature of as many examples as possible. Have students label these examples using **BLM 3–6 Temperature**.

Accommodations

- Provide digital thermometers for students who find graduated thermometers difficult to read.

Review how to use a thermometer by having students read the temperature of several samples of water.

Have students complete and then discuss questions 3 to 5 on page 65, before beginning the investigation.

Consider using the following blackline master:
- **BLM 3–6 Temperature**

Check Your Understanding Answers (page 65)

3. how hot or cold something is

4. with a thermometer

5. degrees Celsius

Test It! Activity (page 66)

Hot or Cold: Faster or Slower?

Purpose

- Students examine the effect of temperature on the rate of reaction.

Science Background

As temperature increases, so does the movement of particles in that substance. Increased movement results in increased collisions and more opportunities for particles to react with each other. The energy increase associated with the faster moving (hotter) particles provides more energy to break chemical bonds and form new ones.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
2 days before	• Buy effervescent antacid tablets. • Collect materials. • Set out a large beaker of water so that it will reach room temperature. • Photocopy **BLM 3–7 Making a Line Graaph**, **BLM 3–8 Making a Line Graph in Microsoft® Excel** (optional), **Assessment Master 4 Lab Report Rubric**, **Assessment Master 10 Using Tools and Equipment Rubric**, and any other blackline masters you intend to use.
Day of	• Set out materials. • Heat water if not providing students with hot plates.

APPARATUS	MATERIALS
• 3 – 100 mL beakers • hot plate • thermometer • stopwatch • ruler • tongs (optional)	• 120 mL water • handful of ice • 2 identical effervescent antacid tablets

Suggested Timing

40–60 min

Safety Precautions

- Have students use a brush and a dust pan to collect any broken glass. Remind them to put the pieces in the broken glass container.
- Remind students not to touch the hot plate's heating element.
- Caution students to unplug the hot plate by pulling on the plug, not the cord.
- Remind students not to eat or drink anything in the science classroom.
- Demonstrate how to use tongs or an oven mitt to handle the hot beaker.
- Have students clean up their work area and thoroughly wash their hands at the end of this activity.

Activity Planning Notes

Consider providing students with hot water and ice water to save time and eliminate risks related to using a hot plate. You can dispense hot water from a kettle, the spout of a coffee urn, or possibly from a tap. When possible, use plastic beakers to avoid the possible hazard of broken glass.

Use identical antacid tablets. Effervescing tablets allow students to time the fizzing reaction. Alternatively, students may time the rate of dissolving (physical change).

Read the directions together as a class and make sure that students understand what to do. Consider using **OHT A–14** to **OHT A–16 Test It! Hot or Cold: Faster or Slower?** to coach students through this activity.

Review the safety precautions and demonstrate the proper use of a thermometer and hot plate. Tell students not to let the water boil—50°C to 70°C is hot enough and will reduce the chance of burns.

Have students label the beakers as follows: A, Room temperature; B, Ice; and C, Hot.

Review graphing skills to prepare students for question 8 on page 68. You may wish to have students use **BLM 3–7 Making a Line Graph** to do question 7. Review how to extrapolate from a graph for question 9. You may wish to provide an exemplar for students.

Accommodations

- Provide digital thermometers for students who find graduated thermometers difficult to read.
- Qualitative or relative temperatures may be used instead of measuring temperatures.
- Stress the check boxes as a strategy to help students stay on track.
- Some students may have difficulty processing the steps and need some coaching. Pair such students with someone who has stronger skills.
- Provide students who need more space to record their graph with **Master 3 Centimetre Grid Paper**.
- Students with motor difficulties may need to use B**LM 3–8 Making a Line Graph in Microsoft® Excel**. They may not be able to answer question 9 using this line graph.

Test it! Answers (pages 66–68)

1. a) hot

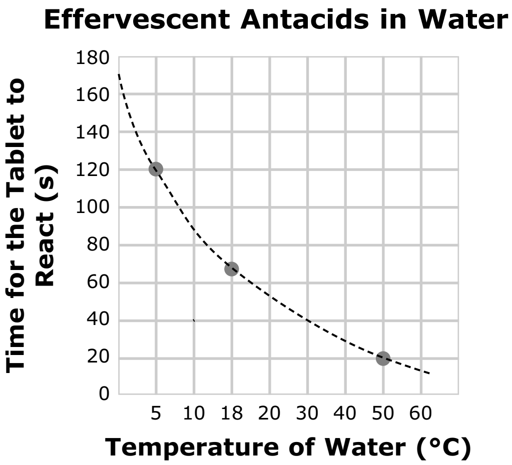
b) cold

2. a) speed of reaction between antacid tablet and water

b) Look for three of the following variables:

- surface area of antacid tablet
- temperature of antacid tablet
- amount of antacid tablet
- type of antacid tablet
- amount of water

8. Check that students have correctly titled the graph, labelled the axes, provided a reasonable scale, and plotted each data point.



9. Answers will vary. See graph in question 8 for sample answer.

a) Sample answer: 55 s

b) Sample answer: 35 s

c) Sample answer: 15 s

Activity Wrap-up

- Have students compare their observations with those of their peers.
- Have students complete the last column of the observation chart on page 68.
- As a class, write a conclusion based on the observations. For example, higher temperatures speed up the rate of change.
- Refer students to **BLM 3–3 Factors Affecting Rate of Change** and have them read about temperature and fill in an example.
- Have students review **Assessment Master 17 Narrative Lab Report Checklist** and then write a narrative lab report using **Master 1 Narrative Lab Report**.

Ongoing Assessment

- Use **Assessment Master 10 Using Tools and Equipment Rubric** to assess students' use of the thermometer during the Test It! activity.
- Use **Assessment Master 4 Lab Report Rubric** to assess students' lab reports for the Test It! activity.

Alternative Activities

- Observe two chemical glow sticks. Put one in hot water (maximum 60°C) and the other in ice water. Observe that the heated glow stick is much brighter and burns out faster. Inexpensive dollar store sticks will burn out fastest. Ask students how they can use this knowledge to make a glow stick last longer. You may wish to assign the timing of these reactions as homework.
- Time the reaction of baking soda with vinegar at various temperatures.
- Time the rate of dissolving of drink crystals in water at various temperatures.

3.5 Catalysts and Inhibitors: Controlling the Rate of Change (page 69)

SUGGESTED TIMING	MATERIALS	BLACKLINE MASTERS
25–30 min 15 min for Try This!	• several products made using a catalyst (e.g., Teflon®, synthetic leather, plastic) • several enzyme-containing products (e.g., laundry detergent, bread, beer) • several inhibitor-containing products (with preservatives) • catalytic converter or cross-section photo of catalytic converter • model of lungs	BLM 3–3 Factors Affecting Rate of Change BLM 3–9 Compare Catalysts and Inhibitors OHT A–4 Periodic Table OHT A–17 Compare Catalysts and Inhibitors

Specific Expectations

CIM1.03 – distinguish between chemical reactions and physical processes, using appropriate scientific terminology
CIM1.04 – identify the factors that alter the rate of physical processes and chemical reactions
CIM2.02 – conduct experiments to investigate how materials can interact chemically
CIM2.04 – conduct experiments to determine the factors affecting rates of chemical reactions and physical processes
CIM2.05 – communicate the results of investigations using a variety of oral, written, and graphic formats
CIM3.01 – research the interactions of materials that are used in daily life
SIM2.03 – interpret research data, including analysis for accuracy and bias as appropriate, using a range of strategies for reading for information
SIM2.04 – organize and communicate information collected from lab investigations and information research using graphic organizers

Key Terms Teaching Strategies

Have students complete some or all of the following activities to help them learn and remember the key terms:
- Write definitions for these terms in their Science Log.
- Create a mind map of examples of catalysts and inhibitors.
- Have students complete the double bubble organizer using **BLM 3–9 Compare Catalysts and Inhibitors**.

Help students remember the key terms by posting them on a science word wall.

Reading Icon Answers (page 71)

1. Opinions will vary. Sample answers:

a) Before reading: yes; After reading, yes

b) Before reading: no; After reading, no

Activity Planning Notes

Show students some examples of products (e.g., Teflon®, synthetic leather, plastic) made using a catalyst to speed up production. Explain that without a catalyst, it would take a very long time or very high temperatures to produce plastics. In food production, catalysts are used to hydrogenate oils, which turn liquid oils into solids at room temperature. This makes products like shortening easier to handle. The catalyst speeds up the process and, therefore, saves money.

In addition to industrial uses, catalysts and inhibitors are used at home. For example, enzymes in laundry detergents break down stains and enzymes in yeast make bread rise.

Platinum is the catalyst used to make carbon monoxide detectors work. In medicine, a catalyst added to a swab speeds up the growth of samples.

As a class, read the information on page 69. The cereal box highlights the preservative BHT (butylated hydroxytoluene). Make a link to what students learned about oxidation in Chapter 2. Explain that antioxidants like BHT prevent oxidation and this slows the spoiling of fats and oils in products such as foods, drugs, and cosmetics.

Distribute **BLM 3–9 Compare Catalysts and Inhibitors** to help students complete the organizer in question 2.

Read the top of page 70 as a class before doing the demonstration.

Have students answer the Before You Read part of question 1 on page 71, before you ask a volunteer to read the Science and Literacy Link aloud. Help students understand how carbon monoxide blocks the uptake of oxygen by drawing a simple lock and key diagram on the chalkboard. The oxygen, carbon monoxide, and red blood cell each look like a different puzzle piece. Either the oxygen *or* carbon monoxide will fit onto the red blood cell, but only one at a time. Therefore, if the carbon monoxide is attached to the red blood cell, no oxygen can be picked up.

Help students understand how a catalytic converter works by showing an actual or photo of a catalytic converter. Point out the honeycomb structure inside. Using **OHT A–4 Periodic Table**, have students locate the elements platinum, palladium, and rhodium.

Tie these examples back to what students have learned about the role of surface area. Both catalytic converters and lungs are divided into tiny pockets (alveoli in lungs) that maximize the surface area on which reactions can take place.

Consider using the following blackline master and overhead transparencies:
- **BLM 3–9 Compare Catalysts and Inhibitors**
- **OHT A–4 Periodic Table**
- **OHT A–17 Compare Catalysts and Inhibitors**

Accommodations
- Show a picture of lung structure and red blood cells picking up oxygen to help students understand carbon monoxide.
- ESL and LD Learners could be paired with students who have stronger language skills.

Check Your Understanding Answers (page 69)

1. **a)** and b)
   - speed up chemical changes
   - make processes possible at body temperature that would require very high temperatures without enzymes

2. Sample answer:

   Catalyst Differences: speeds up a reaction, makes a reaction possible, reduces temperature required for a reaction

   Similarities: affects rate of a reaction, does not usually get used up during a reaction

   Inhibitor Differences: slows down or stops a reaction

Try This! Activity (page 69

Purpose

- Students observe amylase turning starch into sugar.

Science Background

Digestion begins in the mouth, where teeth break up food and catalysts (enzymes) in saliva begin chemical changes. Enzymes such as amylase convert the starches into sugar before the starches reach bacteria in the colon that would feed on it and cause bloating and gas. Besides amylase, saliva contains the catalysts lipase and lysozyme. Lipase begins breaking down fats, while lysozyme helps kill bacteria.

Each catalyst is associated with a specific reaction. A catalyst will not catalyse just any reaction.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
1 day before	• Book a room where eating food is permitted. • Check that no students are allergic to the ingredients in crackers. • Buy plain crackers.
Day of	• Double check for allergies.

APPARATUS	MATERIALS
	• plain crackers (2 per student)

Suggested Timing

15 min; 2 min if assigned as homework

Safety Precautions

- Caution students to avoid choking when chewing crackers.
- Check with students about food allergies. If students have allergies to wheat starch, consider using other starchy foods such as rice cakes.
- Have students clean up the area and wash their hands at the end of the activity.

Activity Planning Notes

In advance, book a room where eating food is permitted (e.g., cafeteria). You might have water on hand for students who need a drink afterward. Alternatively, since students cannot eat in the science lab, assign this activity as homework.

Read the directions as a class to make sure everyone understands what to do.

Accommodations

- Students with allergies to wheat starch could be given an alternative starchy food such as crackers made from rice or corn, or a slice of raw potato.

Activity Wrap-up

- Survey students' observations.
- Ask students to use what they know about surface area and rates of change to explain why teeth breaking up food might help digestion.

- Remind students of the Try This! activity in which they observed apple slices. Explain that oxidative browning is also a result of enzyme action. Refer to the Science Background notes on page 70 of this teacher resource.
- If you have not already done so, refer students to **BLM 3–3 Factors Affecting Rate of Change** and have students read about catalysts and fill in an example.

Teacher Demonstration (page 70)

A Catalyst in a Chemical Change

Purpose

- Students observe that a catalyst speeds up a specific reaction without being consumed.

Science Background

Rochelle salt is the common name for potassium sodium tartrate.

Hydrogen peroxide oxidizes Rochelle salt to produce carbon dioxide gas bubbles, methanoate ions, and water. This reaction is very slow, even when heated. Ions in the cobalt chloride significantly speed up the reaction.

The cobalt chloride makes the mixture pink at first but then it turns green as the hydrogen peroxide oxidizes the cobalt chloride. The cobalt chloride then oxidizes the Rochelle salt, turning the mixture pink again.

The dramatic change in the rate of fizzing highlights how much the catalyst speeds up the reaction. The colour change and the change back to the original colour highlights that the catalyst is not consumed at the end of the reaction.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
2 weeks before	• Obtain materials.
1 day before	• Prepare solutions if they are not available in the required concentrations.
	• Photocopy **BLM 3–10 Teacher Demonstration: A Catalyst in a Chemical Change**.
Day of	• Preheat the Rochelle salt and hydrogen peroxide solutions to 65°C.

APPARATUS	MATERIALS
• 2 – 600 mL beakers • overflow tray • thermometer • hot plate • beaker tongs	• 600 mL 0.3 Mol/L Rochelle salt solution • 200 mL 6% hydrogen peroxide solution • 30 mL 0.3 Mol/L cobalt chloride solution

Suggested Timing

15 min

Safety Precautions

- Keep students at least 2 m from this demonstration.
- Wear safety glasses as you demonstrate this reaction.
- Do not shake the hydrogen peroxide bottle and be cautious of gas being released when the bottle is opened.
- Use beaker tongs to handle the hot beakers.
- If glass beakers break, use a brush and a dust pan to collect the pieces. Put them in the broken glass container.

Activity Planning Notes

In advance, prepare the solutions as follows:

- Dissolve 50.8 g of solid Rochelle salt in 600 mL of water to get a 0.3 Mol/L solution.
- Dilute 40 mL of 30% hydrogen peroxide in 160 mL of water to get a 6% solution. Alternatively, buy a 6% solution at the drug store. If prepared in advance, ensure it is sealed to prevent its decomposition into water and oxygen. Refrigeration will slow down the decomposition rate.
- Dissolve 2 g of solid cobalt chloride in 30 mL of water to get a 0.3 Mol/L solution.

Preheat the Rochelle salt and hydrogen peroxide solution about 10 minutes before class starts.

Distribute **BLM 3–10 Teacher Demonstration: A Catalyst** in a Chemical Change. As you proceed through the demonstration, provide time for students to record their observations on the blackline master. After they complete the blackline master, have them answer the questions in the student resource.

Begin the demonstration by displaying the three solutions and explaining the role of each in the reaction. You might display samples of solid Rochelle salt and cobalt chloride to help students understand what is in the solutions. Label the beakers A and B and place them in the overflow tray. Then have students answer questions 1 to 8 on the blackline master before you add the catalyst to the beaker. Have students record their observations after each step.

Pour 300 mL of Rochelle salt solution and 100 mL of 6% hydrogen peroxide solution into each beaker.

Pour about half the cobalt chloride solution into beaker B. Keep the beakers plainly visible for comparison purposes.

Direct students to page 70 in the student resource and read question 7 aloud. Have students make predictions and explanations before sharing them with the class. Pour some of the catalysed solution from beaker B into beaker A. Find out if students' predictions were correct.

Accommodations

- Repeat the demonstration for students who require additional viewing. Either prepare extra solution or use less solution in the first reaction.
- Place the beakers on an overhead projector so all students can see the reactions.
- Pair visually impaired students with a partner who can explain what happens at each step.
- Pair students who have difficulty writing with someone who can help record their answers.

Teacher Demonstration Activity Answers (page 70)

Sample answers are provided.

1. There is a colour change and bubbles/gas are produced.
2. pink
3. **a)** The colour changes from pink to green and back to pink. Bubbles form faster.
   b) pink
4. The rate of change in beaker B is faster than in beaker A.
5. **a)** Yes
   b) It changed colour.
6. **a)** No
   b) It was still there to catalyse a second change.
7. **a)** The mixture in beaker A will react faster.
   b) The catalyst in beaker B will speed up the reaction.

Activity Wrap-up

- After students complete the blackline master, have them complete and then discuss the questions on page 70 in the student resource.
- As a class, write a conclusion about the role of a catalyst in a reaction.
- If you have not already done so, refer students to **BLM 3–3 Factors Affecting Rate of Change** and have them read about catalysts and fill in an example.

Alternative Activities

- Add equal volumes of hydrogen peroxide to each of three test tubes. To test tube 1, add manganese dioxide, an inorganic catalyst that will catalyse the breakdown of hydrogen peroxide into water and oxygen. To test tube 2, add a piece of liver. To test tube 3, add a piece of raw potato. The catalase enzyme present in liver and potato will break down hydrogen peroxide. Add a quantifiable element by having students time the reactions.
- Demonstrate the reaction between potassium permanganate and oxalic acid. Display two beakers of acidified oxalate solution. Add dilute potassium permanganate solution to both beakers, which turns the solutions purple. To one beaker, add a few crystals of manganese (II) sulfate to catalyse the reaction, which turns the solution colourless again in about 1 minute. The non-catalysed solution will turn colourless over 5 minutes. Students may notice that the change speeds up over time. This reaction is an autocatalyst, which feeds itself, so it speeds up.

Ongoing Assessment

- Use question 2 on page 69 as a formative assessment of how well students understand catalysts and inhibitors.
- Use student work on page 70 to assess their understanding of catalysts.

Technology Links

- For information about the catalyst in a hair curler, go to **www.mcgrawhill.ca/books/Se10** and follow the links to Catalyst.
- For a directory of online experiments, go to **www.mcgrawhill.ca/books/Se10** and follow the links to Experiments.
- For an interactive applet about how the lungs work, go to **www.mcgrawhill.ca/books/Se10** and follow the links to Learn How Your Lungs Work.
- For pictures and a video about the autocatalyst reaction of permanganate and oxalic acid, go to **www.mcgrawhill.ca/books/Se10** and follow the links to Autocatalysis.

Chapter 3 Review (page 72)

SUGGESTED TIMING

75 min to complete and take up the review, and then assign the Practice Test

BLACKLINE MASTERS

Master 5 Certificate
Master 6 List of Skills
BLM 3–11 Chapter 3 Practice Test
BLM 3–12 Chapter 3 Test
BLM 3–13 BLM Answers

Using the Chapter Review

Depending on your class, students should be able to work through the review at their own pace. In order to have success with the Chapter Review, some students may need to do it in chunks, by completing several questions and then taking them up before continuing. This process will prevent students from completing many questions incorrectly.

To provide additional reinforcement of key terms, have students complete a mind map relating as many terms as possible. Or, if they have not already done so, have students complete **BLM 3–3 Factors Affecting Rate of Change**. Once the review is completed and taken up, assign **BLM 3–11 Chapter 3 Practice Test** for students to answer individually. They may wish to use their completed review to help them.

Review Guide

Question	Section(s)	Refer to
1	3.4	Temperature and Rate of Change (page 65)
2	3.2	Surface Area and Rate of Change (page 58)
3	3.5	Catalysts and Inhibitors: Controlling the Rate of Change (page 69)
4	3.1	How Fast Is It, and How Can You Tell? (page 57)
5	3.5	Catalysts and Inhibitors: Controlling the Rate of Change (page 69)
6	3.5	Catalysts and Inhibitors: Controlling the Rate of Change (page 69)
7	**a)** 3.4 **b)** 3.3 **c)** 3.2	**a)** Temperature and Rate of Change (page 65) **b)** Test It! Concentrated or Dilute: Faster or Slower? (page 62) **c)** Surface Area and Rate of Change (page 58)
8	3.3	Test It! Concentrated or Dilute: Faster or Slower? (page 62)
9	3.5	Catalysts and Inhibitors: Controlling the Rate of Change (page 69)

Accommodations

- Allow students to make a chapter summary page of the key ideas/skills from the chapter. The back of the student resource provides space to do this. Alternatively, you might develop a chapter summary as an entire class.
- If students have difficulty with a particular review question, use the Review Guide to identify the section they need to review.
- **BLM 3–11 Chapter 3 Practice Test** can be customized to produce extra reinforcement questions.

Summative Assessment

- Have students complete **BLM 3–12 Chapter 3 Test** to assess individual skills.
- You may wish to develop **Master 5 Certificate** to show students what they have learned during this chapter. Cut and paste the related skills from **Master 6 List of Skills**.

10	**a)** 3.4 **b)** 3.3 **c)** 3.2 **d)** 3.5	**a)** Temperature and Rate of Change (page 65) **b)** Test It! Concentrated or Dilute: Faster or Slower? (page 62) **c)** Surface Area and Rate of Change (page 58) **d)** Catalysts and Inhibitors: Controlling the Rate of Change (page 69)
11	3.2–3.4	Surface Area and Rate of Change (page 58) Concentration and Rate of Change (page 62) Temperature and Rate of Change (page 65)
12	3.2–3.4	Surface Area and Rate of Change (page 58) Temperature and Rate of Change (page 65) Catalysts and Inhibitors: Controlling the Rate of Change (page 69)

Chapter 3 Review Answers (pages 72–73)

1. **b)** temperature
2. **d)** surface area
3. **g)** enzyme
4. **a)** rate of change
5. **e)** catalyst
6. **f)** inhibitor
7. **a)** food rotting in your backpack; backpack
   b) bleaching hair with concentrated bleach; it contains more bleach
   c) burning coal dust; it has more surface area
8. **b)** concentration of water present
9. **d)** they stop life reactions from happening
10. **a)** increase the temperature
    b) increase the concentration
    c) make the pieces smaller to expose more surface area
    d) add a catalyst
11. Look for designs that make reasonable suggestions for changing one variable and controlling other variables. Sample answer for temperature variable:
    - Find two identical sugar cubes. Place one sugar cube in hot water and the other in cold water at the same time. Stir both at a constant speed. Time how long it takes each cube to dissolve.
12. **a)** to **c)** Any three of the following:
    - increase surface area by chopping up carrots
    - increase temperature by steaming (not boiling) or broiling (not baking)
    - add a catalyst that speeds softening, such as MSG
    - increase exposed surface area by stirring while heating