Activity Preparation for Chapter 3

Activity/Investigation	Advance Preparation	Time Required	Other Considerations
Find Out: Is It a Mixture or a Pure Substance? (page 58) (TR page 70)	• 1 or 2 days before – Prepare a class set of labelled plastic transparent containers of each substance.	• 30–45 min	
Find Out: Separate a Three-Part Mixture (page 62) (TR page 75)	• 1 day before – Prepare the three-part mixtures of iron filings, salt, and sand. Mix them together thoroughly so it looks like there are only two solids in the jar. The sand will make the salt look dirty. – If you choose to use them, photocopy any assessment masters.	• 45–60 min	• You may want to demonstrate how to fold the filter paper. • Don't use sugar instead of salt. Since sugar has a lower melting point, it is harder to get the water to evaporate without burning the sugar.
Find Out: Testing for Elements and Compounds (page 68) (TR page 80)	• 1 day before – Obtain required equipment and materials. – If you choose to use them, photocopy any assessment masters.	• 45–60 min	• Demonstrate the correct method of holding the mouth of the test tube away from anyone's face as you do the pop and glowing splint tests.
Test It: Compare the Melting Points and Boiling Points of Water and Salt Water (page 71) (TR page 85)	• 1 day before – If you choose to use them, photocopy **Master 1 Centimetre Grid Paper**, **Master 2 Safety Precaution Symbols**, B**LM 1–1 Using a Hot Plate**, **BLM 3–4 Suggested Procedure for Test It!**, and any assessment masters. • Day of – After planning with students, gather the materials for the next lab period. Or, gather the materials in advance and give students planning hints by showing them the equipment.	• 90–105 min (30–45 min for group planning; overnight to make ice cubes and salt ice cubes; 60 min to run the investigation)	• Provide students that have trouble devising their own procedures **BLM 3–4 Suggested Procedure for Test It**!

Materials Needed for Chapter 3

Activity/Investigation	Apparatus	Materials	Blackline Masters
Find Out: Is It a Mixture or a Pure Substance? (page 58) (TR page 70)	• transparent plastic containers • magnifying glass	• chalk • graphite • iron filings • salt • sugar • water • salt and pepper • sugar water • plastic fork • foam cup	
Find Out: Separate a Three-Part Mixture (page 62) (TR page 75)	• magnet • test tube • rubber stopper • test tube rack • support stand • filter paper • funnel • ring clamp • evaporating dish • Bunsen burner or hot plate • waxed pencil • paper	• plastic wrap • iron filings • salt • water	**Recommended** Assessment Master 2 Co-operative Group Work Rubric Assessment Master 12 Using Tools and Equipment Rubric **Optional** Assessment Master 1 Co-operative Group Work Checklist Assessment Master 11 Using Tools and Equipment Checklist
Find Out: Testing for Elements and Compounds (page 68) (TR page 80)	• 3 test tubes • tweezers or tongs • test tube rack • stoppers • 3 wooden splints • matches • scoop	• hydrochloric acid (dilute) • zinc • vinegar • baking soda • hydrogen peroxide (3%) • manganese dioxide	**Recommended** Assessment Master 10 Safety Rubric Assessment Master 12 Using Tools and Equipment Rubric **Optional** Assessment Master 9 Safety Checklist Assessment Master 11 Using Tools and Equipment Checklist
Test It: Compare the Melting Points and Boiling Points of Water and Salt Water (page 71) (TR page 85)	**Note:** This list may vary according to student lab designs. • ice cube trays • beakers • hot plates • thermometers	• salt • water	**Recommended** OHT A–12—A–14 Test It! Compare the Melting Points and Boiling Points of Water and Salt Water Assessment Master 13 Fair Test Checklist Assessment Master 14 Fair Test Rubric **Optional** BLM 1–1 Using a Hot Plate BLM 3–4 Suggested Procedure for Test It! Assessment Master 10 Safety Rubric Assessment Master 12 Using Tools and Equipment Rubric

CHAPTER 3 Classifying Matter

(page 54)

SUGGESTED TIMING

30–45 min

BLACKLINE MASTERS

OHT 5 How Would You Organize This?
Assessment Master 1 Co-operative Group Work Checklist
Assessment Master 2 Co-operative Group Work Rubric

Overall Expectations

CPMV.01 – explain the characteristics and classification of common materials, using appropriate scientific terminology
CPMV.02 – investigate the physical and chemical properties of common materials through laboratory activities
CPMV.03 – analyze how the use of various materials is based on their physical and chemical properties
SILV.01 – illustrate how science is a part of daily life
SILV.02 – use appropriate scientific skills, tools, and safety procedures to investigate problems
SILV.03 – examine the connections between science and activities in daily life

Key Terms Teaching Strategies

Have students complete some or all of the following activities to help them learn and remember the two 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.
- Talk about how these words might be important in the chapter to come.
- Discuss categories and classifications that they may have personal experience with.

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

Activity Planning Notes

Read the information on page 54 together as a class. Have students brainstorm categories they might use to classify the items in the garage. Record their ideas on the chalkboard.

Choose four of the categories. Have students record the categories in question 1. For each category, have students write two items from the garage. After discussing the answers, have them complete the Try This! activity.

Consider using the following overhead transparency:

- **OHT 5 How Would You Organize This?**

Making Connections Answer (page 54)

1. Answers will vary. Possible choices for sorting items include the following:
- sporting equipment: hockey stick, baseball glove, soccer ball
- garden equipment: hose, trowel, seeds
- craft items: wreath, dried flowers, ribbons
- construction or repair equipment: hammer, sawhorses, paint, ladder, saw, paintbrush

Try This! Activity (page 54)

Have students work in small groups of two or three. Give each group a piece of chart paper, some sticky notes, and a marker. After students empty their pockets, tell them to follow these steps.

- Decide on two categories to classify the objects found in their pockets, pencil case, or backpack. Record these categories on chart paper.
- Divide each category into two subgroups. For example, two categories might be Things to Write With and Money, and the subgroups could be Pens and Pencils, and Loonies and Quarters.
- Put the name of each item on a sticky note. Put the sticky notes on the chart paper in the correct category.
- Present their chart to the class.

Consider having students work in groups of four, with each student contributing two or three objects. Or, expand the activity by having students classify the items in their own group, then joining with another group to see how the increase in the number of objects changes the classification scheme.

Consider using **Assessment Master 1 Co-operative Group Work Checklist** and **Assessment Master 2 Co-operative Group Work Rubric** to help assess how well students worked together.

3.1 Types of Matter (page 55)

SUGGESTED TIMING	MATERIALS	BLACKLINE MASTERS
30–45 min 30–45 min for Find Out	• 2 opaque bags • marbles, pasta, paper clips, candies • salt water solution • bottle of salad dressing that has two visible layers	BLM 3–1 Making and Testing Concrete OHT A–10 Classifying Matter OHT A–11 Comparing a Mechanical Mixture and a Solution

Specific Expectations

CPM1.03 – explain the characteristics of pure substances and mixtures, using appropriate scientific terminology
CPM1.04 – describe the physical properties of common materials, using appropriate scientific terminology
CPM2.01 – plan and conduct investigations on the physical and chemical properties of substances, using lab equipment and materials safely and accurately
CPM2.03 – organize and record the observations of the investigations, using appropriate formats
SIL2.03 – conduct investigations safely, using appropriate lab equipment
SIL2.04 – observe and record data, using a variety of formats, including the use of SI units, where appropriate

Key Terms Teaching Strategies

Have students complete some or all of the following activities to help them learn and remember the two 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.
- Write a paragraph that contains the four key terms.

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

Reading Icon Answer (page 55)

2. Wording will vary but should include some of the following ideas.
- Matter: everything you can see or feel (e.g., air, water) Note: Heat and light are not matter.
- Mixtures: made of two or more different types of particles (e.g., sand, gravel)
- Pure Substances: made of only one type of particle (e.g., copper metal, helium gas, distilled water)
- Solutions: you can see only one part (e.g., salt water)
- Mechanical Mixtures: you can see two or more parts (e.g., pulpy orange juice)
- Elements: have only one kind of atom (e.g., carbon)
- Compounds: combine two or more different elements (e.g., water)

Reading Icon Answers (page 59)

1. Students should highlight the following items: clock, school, toothpaste, fluoride, baking soda, peroxide, shower, soap, water, ears, breakfast, cereal, milk, blueberries, iron, jeans, T-shirt, socks, bleach, sunscreen, cars, gasoline, air, carbon monoxide, sulfur dioxide, acid rain, water, bus.

2. Mixture — clock, school, toothpaste, shower, soap, ears, breakfast, cereal, milk, blueberries, jeans, T-shirt, socks, bleach, sunscreen, cars, gasoline, air, bus

Pure Substance — fluoride, baking soda, peroxide, water, carbon monoxide, sulfur dioxide, acid rain, iron

Activity Planning Notes

Begin by referring to the classification chart on page 55. Explain that by the end of the chapter, students will be able to complete the entire chart.

On page 56, discuss as a class the idea of a mixture and a pure substance using the idea of the same particles versus different particles. Begin with a demonstration. Prepare two bags of particles. You can use marbles, paper clips, pasta, or candies. Bag 1 should have all the same particles (e.g., marbles). Bag 2 should have a mixture of different particles (e.g., marbles, candies). Make sure you have enough in each bag for all students to take a small handful.

Have each student reach into Bag 1, grab a handful of particles, and place them on their desk. Then have each student reach in and grab a handful of particles from Bag 2 and place them on their desk. Relate each of these handfuls respectively to a pure substance, which has just one type of particle, and a mixture, which has different types of particles. As well, have students compare their handfuls with those of the other students in the class. Help them see that every pure substance has the same particles but a mixture has different particles.

Go back to the flowchart on page 55 and have students fill in the Mixtures and Pure Substances boxes.

Using the demonstration activity again as your focus, look only at mixtures. Show students examples of mixtures they are familiar with such as salt water and a bottle of salad dressing.

Have students complete and discuss the questions on pages 56 and 57. Then ask them to complete the Solutions and Mechanical Mixtures boxes on page 55. They will fill in the last two boxes after working through section 3.3.

Read the Science and Literacy Link on page 59 as a class. Have students complete and then discuss the questions.

Consider using the following overhead transparencies:
- **OHT A–10 Classifying Matter**
- **OHT A–11 Comparing a Mechanical Mixture and a Solution**

Accommodations

- Provide a buddy for students who are weaker at copying notes.
- Allow time for all students to copy the required information.

Making Connections Answer (page 56)

1. A mixture. You can see different parts (e.g., chips, dough).

Check Your Understanding Answers (page 57)

2. Salt in a box. Look for the following ideas.
   • The label lists only one ingredient.
   • You can see only one type of crystal.
3. Answers may vary. Ingredients include: egg slices, cheese, carrot sticks, lettuce, and tomato. Wording may vary. Look for the idea that you can see different parts of the salad.
4. Answers may vary. For example:
   Mechanical Mixture Difference: You can see at least two parts.
   Similarity: There is more than one kind of particle.
   Solution Difference: You can see only one part.

Making Connections Answer (page 57)

5. Answers may vary, but should indicate that mouthwash is a solution. You can see only one part, but there many different chemicals listed on the bottle.

Making Connections Answer (page 59)

3. Accept any reasonable list. For example: toothpaste, eggs, toast, water, juice, sink, bed sheets, shoes, clothes, air, carpet, other humans, pets.

Find Out Activity (page 58)

Is It a Mixture or a Pure Substance?

Purpose

- Students become familiar with classifying chemicals.

Science Background

All matter can be sorted into different categories based on the properties it has.

A pure substance has a fixed composition with a unique set of properties (e.g., melting and boiling points) that do not change. A mixture has a varied composition. Each component within a mixture retains its properties, though this may not be obvious at first glance.

Mixtures can be separated by physical means because the properties of the individual components do not change. For example, salt water can be separated into salt and water since water has a lower boiling point than salt. Both the salt and the water have retained their own boiling points. If you boil salt water, you will boil off the water well before the salt is affected.

In order for a new substance to be formed with new physical properties, a chemical reaction has to take place. Note that students are not required to understand chemical reactions. This is the difference between a compound (pure substance) and a mixture (students will learn this in the next chapter). A compound is the result of a chemical reaction that combines different pure substances. A compound cannot be separated unless another chemical reaction takes place.

A mixture contains substances that have not reacted to form a new compound. These substances can be separated by physical means. For example, even though salt disappears from sight when it dissolves in water, the salt is breaking into smaller pieces. The properties of the salt have not changed. It is this difference in properties that allows for the separation.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
1 or 2 days before	• Prepare a class set of labelled plastic transparent containers of each substance.

APPARATUS	MATERIALS
• transparent plastic containers • magnifying glass	• chalk • graphite • iron filings • salt • sugar • water • salt and pepper • sugar water • plastic fork • foam cup

Suggested Timing

30–45 min

Safety Precautions

- Have students clean up the work area and wash their hands at the end of the activity.

Activity Planning Notes

As a class, read the instructions. Introduce the activity by choosing a sample and modeling what to do. Use the following script to help students make observations. You might consider making the script into a flowchart that students can use to complete the activity.

- Look at the sample and ask: "Is there more than one substance?"
  - If you can see more than one substance, it is a mixture.
- If you can see only *one* substance, read the label and ask: "Is there more than one ingredient on the label?"
  - If the label lists more than one substance, it is a mixture.
  - If it lists only one substance, it is a pure substance.

Have students record their observations of the substance on page 58 before telling them to examine the rest of the samples. Direct students to use the flowchart on page 55 to help them. Encourage students to explain and rationalize the answers they record. As you circulate, you may want to ask students to justify their choices.

Tell students it might be hard to determine if some substances are mixtures or pure substances without more information. They will learn further sorting techniques later on in the chapter.

Accommodations

- Encourage students to map their thoughts using a flowchart or concept map.

What Did You Find Out? Answers (page 58)

5. Student responses may include but are not limited to salt, sugar, water. Explanations will vary. For example:
- There is only one visible substance and only one name on the label.

6. Student responses may include but are not limited to chalk, graphite, iron filings, plastic fork, foam cup. Explanations will vary. For example:
- It was hard to see more than one substance even though there were several ingredients listed on the label.

Activity Wrap-up

- Have students complete and then discuss questions 5 and 6. Help students come to understand that some mixtures are more difficult to classify when it is not clear what is in the sample.
- You might connect this activity to science by discussing dichotomous keys in biology. Explain that biologists may use flowcharts to classify animals according to answers to yes/no questions. Use a sample dichotomous key from a biology text or from the Internet to show students how it works.
- Consider discussing the merits and disadvantages of using flowcharts to sort things in chemistry, biology, and real life.

Ongoing Assessment

- Have students do Check Your Understanding question 4 on page 57 as a formative assessment of how well they understand mechanical mixtures and solutions.
- You might prepare a different set of substances and have students redo the activity on page 58, and then assess how well students differentiate between mixtures and pure substances.

Technology Links

- For some sample dichotomous keys for biology, go to **www.mcgrawhill.ca/books/Se9** and follow the links to Dichotomous Keys.

Alternative Activities

- Show one of the following videos:
  – *Atoms*, Bill Nye, The Science Guy (Magic Lantern Communication Ltd.). Bill Nye explains how atoms combine to form molecules.
  – *Physical and Chemical Changes: Four Weddings and a Friendship* (23 min), available from http://media.hwcdsb.edu.on.ca/htbin/wwform/226/wwk770. In an animated presentation, atoms look for partners and employment. Xenon and Krypton set up as a marriage counsellor and an employment officer who conduct a series of marriages (e.g., H to O, Na to Cl) and find jobs for various elements, compounds, and mixtures.
  – *Molecules in Solids, Molecules in Liquids*, and *Atoms* from the "Eureka!" series, available from TVOntario Sales and Licensing department. Many school boards may already have these videos available for teachers to borrow.
- Have students do an alternative activity about mixtures using **BLM 3–1 Making and Testing Concrete**, which provides detailed procedure notes. Students may enjoy this hands-on lab and will find out how different proportions in a mixture change its properties. In industry, people often have to find the correct proportions for a mixture in order to maximize its usefulness. Cement is readily available from hardware stores. Once the bag has been opened, store it in a garbage bag or two in order to prevent too much moisture from entering the cement. Moisture makes the resulting concrete weaker.
  Be very careful with the amount of water that the students add. Too much or not enough water will make the concrete unworkable.
  Students can use a metre stick to make sure they drop each block from exactly the right height in the drop zone each time.
  The best mixture should be 1 cement : 2 sand : 3 stones by volume.
- Use some or all of the activities in the following Chemistry *ActiveFolders*: Matter.

3.2 Separating Mixtures (page 60)

SUGGESTED TIMING

45–60 min
45–60 min in the computer lab for Try This!
45–60 min for Find Out

MATERIALS

- 2 opaque bags
- marbles, pasta, paper clips, candies
- magnet and iron filings
- plastic wrap
- filtration set-up (funnel, filter paper, ring stand, clamp for funnel, beaker under funnel)
- hot plate
- evaporating dish
- distillation apparatus (optional)

BLACKLINE MASTERS

BLM 3–2 Water Purification
BLM 3–3 Separation by Paper Chromatography
OHT A–11 Comparing a Mechanical Mixture and a Solution
Assessment Master 1 Co-operative Group Work Checklist
Assessment Master 2 Co-operative Group Work Rubric
Assessment Master 11 Using Tools and Equipment Checklist
Assessment Master 12 Using Tools and Equipment Rubric

Specific Expectations

CPM1.03 – explain the characteristics of pure substances and mixtures, using appropriate scientific terminology
CPM1.04 – describe the physical properties of common materials, using appropriate scientific terminology
CPM2.01 – plan and conduct investigations on the physical and chemical properties of substances, using lab equipment and materials safely and accurately
CPM2.03 – organize and record the observations of the investigations, using appropriate formats
SIL2.03 – conduct investigations safely, using appropriate lab equipment
SIL2.04 – observe and record data, using a variety of formats, including the use of SI units, where appropriate
SIL2.05 – assess data to make inferences and conclusions and to answer questions and refine procedures

Key Terms Teaching Strategies

Have students 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.

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

Activity Planning Notes

Begin this section by using the same demonstration materials in Section 3.1. Have students take one handful out of the mixture bag. Allow them to separate the different particles into their respective categories. They should be able to make a pile of two or three different items (e.g., marbles, paper clips, dry pasta). Explain that the mixture has been separated into its component parts. The important fact about mixtures is that they have several different pure substances mixed together but each of the substance's particles remains intact. The particles can be separated out based on their different properties. The separation that students completed was based on different shapes of particles.

Demonstrate each of the separation techniques listed in the student resource on page 60: magnetism, filtering, and solubility. Describe the properties that substances must have in order to use each method of separation.

Have students complete and then discuss the Check Your Understanding and Making Connections questions on page 61.

Mention that distillation is a process that separates two liquids or separates solids from a liquid. If you have access to a distillation apparatus, consider demonstrating the process. Alternatively, you could use photographs and explain the process. Students need to know this word to answer a question later on.

Students may make more sense of the Try This! activity on page 61 if they do the Find Out Activity first.

You may wish to demonstrate or have students try chromatography, an important forensic method for mixtures at crime scenes. **BLM 3–3 Separation by Paper Chromatogra**phy provides support for this activity.

Accommodations

- If students work in pairs, consider choosing partners that are more likely to stay on task.

Consider using the following blackline master and overhead transparency:

- **BLM 3–3 Separation by Paper Chromatography**
- **OHT A–11 Comparing a Mechanical Mixture and a Solution**

Check Your Understanding Answers (page 61)

1. Filtering is used to separate a solid that is mixed with a liquid.

2. No. Look for the idea that dissolved solids stay with the liquid. Filtering can be used only to remove an undissolved solid.

Making Connections Answers (page 61)

3. a) Filtering; The sawdust will not pass through the filter but the water will.

b) Distillation or boiling or evaporation; Salt and water is a solution. Solutions can be separated by boiling away the water.

c) Magnetism; A magnet will easily remove the iron filings.

d) Picking apart by hand; Marshmallow and banana pieces are large and easy to pick apart.

e) Distillation or boiling; Gasoline boils at a different (lower) temperature than water.

4. Look for the following order.

1. Add water to the mixture. The sugar will dissolve. The sand will not dissolve.
2. Filter the sand out of the mixture using a funnel and filter paper.
3. Heat the sugar and water mixture to evaporate the water.

Try This! Activity (page 61)

Purifying City Drinking Water

Purifying drinking water is a practical example of separating mixtures. The properties of the different contaminants in water are used to separate them out to make drinking water safer. Help students gain awareness of the importance of clean drinking water by doing this activity.

Have students follow the suggested links or search for a water treatment plant close to the school. Consider distributing **BLM 3–2 Water Purification** and having students answer the questions about water treatment plants. Note that there will be many difficult vocabulary words on most web pages about water purification processes. You may wish to go over some of the new words with students before they enter the computer lab.

If your school Internet connection tends to be slow, or if you would like to use this activity as homework, consider going on-line, printing some of the pages, and making overhead transparencies or photocopies to discuss with students. This strategy will help control the number of new words you need to define and explain.

Technology Links

- For additional information and pictures showing how water is purified in urban water control plants, go to **www.mcgrawhill.ca/books/Se9** and follow the links to More About Purifying City Drinking Water.

Find Out Activity (page 62)

Separate a Three-Part Mixture

Purpose

- Students practise separating a mixture using various separation techniques.

Science Background

A mixture that contains several parts can be separated using the differences in their physical properties. For example, some solids may be soluble in water while others are not. The difference in solubility can be used to separate the two solids without destroying either solid. First, add water to the mixture. The soluble solid dissolves and the insoluble solid remains. Next, filter the mixture. The soluble solid goes through the filter paper while the insoluble solid stays on the filter paper. Then, slowly evaporate the water. The dissolved solid reappears.

There are only three elements that are magnetic: iron, cobalt, and nickel. A mixture containing any of these substances can be separated using the property of magnetism.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
1 day before	• Prepare the three-part mixtures of iron filings, salt, and sand. Mix them together thoroughly so it looks like there are only two solids in the jar. The sand will make the salt look dirty. • If you choose to use them, photocopy any assessment masters.

APPARATUS	MATERIALS
• magnet • test tube • rubber stopper • test tube rack • support stand • filter paper • funnel • ring clamp • evaporating dish • Bunsen burner or hot plate • waxed pencil • paper	• plastic wrap • iron filings • salt • water

Suggested Timing

- 45–60 min

Safety Precautions

- Due to safety issues, you should demonstrate evaporating the residue in the evaporating dish.
- Have students clean up the work area and wash their hands at the end of the activity.

Activity Planning Notes

In advance, wrap magnets in plastic wrap to make cleaning up each magnet easier at the end of the activity.

Read the information as a class and make sure everyone understands what to do. Students can work through the activity as it is outlined and answer questions as they proceed.

Accommodations

- It may be helpful for some students if you demonstrate the separation before they perform the lab.
- You might decide to do the whole lab as a demonstration if you anticipate behaviour difficulties.

What to Do Answers (pages 62–63)

1. three

2. iron filings

3. magnetism

7. No. Some of the solid dissolved.

11. a) It has large, glassy crystals.

11. b) sand. Explanations will vary; For example, it looks like sand.

12. There is a clear liquid in the evaporating dish. It might be water or a solution.

13. There are crystals in the dish.

What Did You Learn? Answers (page 63)

14. a) magnetism; removed the iron filings

b) filtering; removed the undissolved solid

c) evaporation; separated the dissolved solid from the water

Activity Wrap-up

- Make connections with separating mixtures in cooking (e.g., separating the pulp from orange juice; boiling down a liquid when making sauce).
- Consider having students complete **Assessment Master 1 Co-operative Group Work Checklist** to help assess how well they worked together. Have students discuss how to improve group work.
- Consider having students use **Assessment Master 11 Using Tools and Equipment Checklist** to help assess how well they used tools and equipment.

Alternative Activities

- You might redo this lab using a different mixture (e.g., salt, sand, sawdust). Instead of separating by magnetism, students can use density to separate the sawdust from the sand once the water has been added. The sawdust will float and the sand will sink.
- Paper chromatography is a separation process that is used in forensics and research laboratories. Inks move at different rates through solvents, depending on their polarity and molar mass. This movement is easily traced using filter or chromatography paper. Have students use **BLM 3–3 Separation by Paper Chromatography** to support them in doing this activity.
  You might demonstrate chromatography. Set it up at the beginning of class and check it periodically throughout class. Students will be amazed to see the ink crawl up the paper. If you use fine enough filter paper, you may be able to show the result on the overhead projector. Alternatively, use permanent markers. If you choose this option, you must use methanol, ethanol, acetone, ammonium hydroxide, or hydrochloric acid as a solvent instead of water.
  Plant materials lend themselves well to chromatography. Crush a leaf such as from a geranium, and use a toothpick to spot the coloured juice onto the paper. The more concentrated you can make the spot, the better the results will be. A dilute or spread-out spot will not show the results as clearly.
  Consider using chromatography for a forensic mystery that students investigate. Create a mystery strip for each group to analyze. Once they have completed the known strips, give students an unknown sample that you have prepared from ink that was left at the scene of a crime. By comparing chromatograms, students should be able to identify the ink present, and thus identify the pen that wrote the mystery letter. Then the owner of the pen can be apprehended.

Ongoing Assessment

- Use **Assessment Master 2 Co-operative Group Work Rubric** to assess how well students worked together during the Find Out Activity.
- Use **Assessment Master 12 Using Tools and Equipment Rubric** to assess student use of tools and equipment during the Find Out Activity.

3.3 Pure Substances (page 64)

SUGGESTED TIMING

20–25 min for demonstration
45–60 min for text and teaching
45–60 min for Find Out

MATERIALS

- electrolysis apparatus
- electricity source
- water
- 2 test tubes
- 2 wooden splints
- matches

BLACKLINE MASTERS

OHT 6 The Periodic Table
Assessment Master 9 Safety Checklist
Assessment Master 10 Safety Rubric
Assessment Master 11 Using Tools and Equipment Checklist
Assessment Master 12 Using Tools and Equipment Rubric

Specific Expectations

CPM1.03 – explain the characteristics of pure substances and mixtures, using appropriate scientific terminology
CPM1.05 – describe the chemical properties of common materials, using appropriate scientific terminology
CPM2.01 – plan and conduct investigations on the physical and chemical properties of substances, using lab equipment and materials safely and accurately
CPM2.02 – use appropriate laboratory safety and disposal procedures while conducting investigations
CPM2.03 – organize and record the observations of the investigations, using appropriate formats
SIL2.03 – conduct investigations safely, using appropriate lab equipment
SIL2.04 – observe and record data, using a variety of formats, including the use of SI units, where appropriate
SIL2.05 – assess data to make inferences and conclusions and to answer questions and refine procedures
SIL3.02 – evaluate the investigation of the topic they selected and suggest possible refinements

Key Terms Teaching Strategies

Have students complete some or all of the following activities to help them learn and remember the two 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.
- Write a paragraph that contains the nine key terms.

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

Activity Planning Notes

Set up the electrolysis apparatus as shown on page 64. Apply electricity and invite students to watch bubbles form. The electricity splits the water into the bubbles of oxygen gas and hydrogen gas.

When you have at least 10 mL to 20 mL of gas in each side of the apparatus, hold a test tube above one of the burettes and open the stopcock to collect the gas in the test tube. As long as the water level in the centre tube is above the level of the top of the burette, there will be enough pressure to push the gas out of the burette. Do the splint test immediately on the first tube before collecting and testing the second tube. Hold your thumb over the mouth of the test tube while waiting for a

student to light the splint, or cork the tube to light the splint yourself.
- To test for oxygen, light a splint and blow it out. Put it into the mouth of the tube with oxygen and it will relight.
- To test for hydrogen, light a splint and put it in the test tube with hydrogen. You will hear a loud pop as the hydrogen gas recombines with oxygen in the air to make water.

Have students complete and then discuss questions 1 and 2 on page 64.

After reading and discussing page 65, have students return to the flowchart on page 55 and fill in the Elements and Compounds boxes.

Students at this level often have trouble seeing the periodic table as relevant. Consider introducing the topic by gathering samples of some elements if your school has materials available. You might bring yellow sulfur, metals, and graphite.

Consider using **OHT 6 The Periodic Table** to help students make sense of this organizational tool for chemicals. Try to focus on the concrete aspects of how it helps to organize real things. You might use an analogy such as a dresser with drawers, each of which contains a different element. Focus on teaching the periodic table as a living, breathing, concrete, tangible tool. Discussing the elegance of the theoretical knowledge in the table is neither appropriate nor interesting to these students.

Read the information on pages 66 and 67 together as a class and assign the follow-up questions. You might do the Try This! activity on page 66 together as a class.

Consider using the following overhead transparency:
- **OHT 6 The Periodic Table**

Check Your Understanding Answers (page 64)

1. Bubbles form at the electrodes in the water.

2. a) The splint relights.

b) The splint makes a loud popping sound.

Check Your Understanding Answer (page 65)

3. Yes.
- Sodium chloride is a white crystal that is edible.
- Sodium is a silvery metal that explodes in water.
- Chlorine is a poisonous, greenish gas.

Making Connections Answer (page 66)

1. Answers will vary. Accept any reasonable explanation. For example:
- It is important for scientists who share data with other scientists around the world to use a standard set of symbols that everyone understands.

Try This! Answer (page 66)

- He, Ne, Ar, Kr, Xe, Rn, F, Cl, Br, I, P, N, and H are gases.
- Hg and Br are liquids.
- The rest are solid.

Making Connections Answers (page 67)

2. Answers are in italics.
An *element* is a pure substance that cannot be broken down into simpler substances.
A *compound* is a substance made up of two or more different elements.
Elements in a compound do not keep their own *properties* when they bond.

3. a) hydrogen; H
oxygen; O
chlorine; Cl
sodium; Na
copper; Cu
silver; Ag

b) Answers may include but are not limited to the following:
- metal — silver, gold, lead, tungsten, molybdenum
- non-metal — chlorine, carbon, krypton
- metalloid — silicon, boron, arsenic

Find Out Activity (page 68)

Testing for Elements and Compounds

Purpose

- Students do and observe chemical reactions and test their products.

Science Background

Elements consist of tiny particles called atoms. Atoms of the same element can combine with one another to form molecules, but they are not compounds. Atoms of different elements can also combine with one another to form molecules, and these combinations are compounds. Hydrogen and oxygen are elements which exist as molecules in nature. Carbon dioxide is a compound. All three are clear and colourless gases that can't be distinguished through observations, and therefore require chemical tests to prove their identity.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
1 day before	• Gather required equipment and materials • If you choose to use them, photocopy any assessment masters.

APPARATUS	MATERIALS
• 3 test tubes • tweezers or tongs • test tube rack • stoppers • 3 wooden splints • matches • scoop	• hydrochloric acid (dilute) • zinc • vinegar • baking soda • hydrogen peroxide (3%) • manganese dioxide

Suggested Timing

45–60 min

Safety Precautions

- Have students tie back long hair and roll up any long sleeves.
- Remind students never to point the mouth of a test tube at anyone's face or body, including their own. Consider referring students to page 20 to review science lab safety. Discuss the consequences of failing to respect safety rules.
- Have students clean up the work area and wash their hands at the end of the activity.

Activity Planning Notes

As a class, read the instructions. Refer students to page 64 to help them record the tests for oxygen and hydrogen in questions 1 and 2 on page 68.

Emphasize proper procedure as you perform the teacher demonstration outlined in the student resource. Make sure students know the difference between a glowing and burning splint. Have students record their observations for Test tube 1 in the chart on page 69.

Have students complete the student activity in pairs. Read the instructions as a class and make sure everyone understands what to do. Students should use the chart to record their observations and predict the identity of the gases.

Accommodations

- Remind students about what happened in the introductory demonstration in which water was separated into oxygen and hydrogen. Help them make the connection that the same tests were used as in the Find Out Activity, and that the same gases are produced in both demonstrations.

Find Out Activity Answers (page 68)

1. Glowing splint test for oxygen: Light a splint and blow it out. Place the glowing splint into a sample of oxygen gas. The splint relights.
2. Pop test for hydrogen: Put a burning splint into a sample of hydrogen gas. The splint makes a loud popping sound.

What Did You Observe? Answers (page 69)

15.

	Glowing Splint Test	Burning Splint Test	Identity of Gas
Test tube 1		splint makes pop sound	hydrogen
Test tube 2	splint goes out	splint goes out	carbon dioxide
Test tube 3	splint relights; flame on the lit splint burns brighter		oxygen

What Did You Learn? Answers (page 69)

16. Encourage students to be constructively self-critical instead of criticizing their peers. Try to create an atmosphere in the classroom where students can feel free to admit mistakes and develop their own skills as well as, perhaps, helping others to develop theirs.
17. carbon dioxide. Carbon dioxide puts out the flame in the glowing splint and burning splint tests.

Activity Wrap-up

- Have students complete and then discuss the What Did You Learn? questions.
- Consider having students use **Assessment Master 9 Safety Checklist** to help assess how well they practise safety in the lab.

Ongoing Assessment

- After students have watched the teacher demonstration on page 64 and discussed the information on page 65, have them answer the Check Your Understanding question on page 65. Use this as a formative assessment to see what students do and do not understand. Identify students who have problems with this concept. Ask the question again after these students have completed the Find Out activity on page 68. Check that their understanding of what elements and compounds are has increased.
- Consider using **Assessment Master 10 Safety Rubric and Assessment Master 12 Using Tools** and **Assessment Master 12 Using Tools and Equipment Rubric** to assess students' performance during the activity.

Technology Links

- For more discussion about atoms, ions, elements, and molecules and an activity involving the periodic table, go to **www.mcgrawhill.ca/books/Se9** and follow the links to Periodic Table Song.
- For more information on atoms, ions, elements, molecules, and states of matter, go to **www.mcgrawhill.ca/books/Se9** and follow the links to Chemistry in Depth.

Alternative Activities

- The student activity on page 69 identifies carbon dioxide by its lack of positive reaction, but other gases may have the same reaction. Consider demonstrating the limewater test, which is a more specific and positive test for carbon dioxide. Prepare a solution of limewater, and make sure the calcium hydroxide is completely dissolved so that it is clear and colourless. Add more water if needed.
  Have students blow into the solution with a straw. They should notice that the water turns cloudy. The cloudy substance is calcium carbonate.
- If your students seem to grasp the abstract concepts of chemistry and enjoyed the Find Out Activity, consider exploring the Technology Link, which takes them to a site where they learn the difference between atoms, ions, elements, and molecules, and explore what kinds of changes occur in matter. They will find out about the structures and properties of the four states of matter, including plasma.
- Use some or all of the activities in the following Chemisty *ActiveFolders*: Elements, Compounds, and Mixtures, and The Periodic Table of Elements.

3.4 Properties of Pure Substances and Mixtures (page 70)

SUGGESTED TIMING

30 min for demonstration
90–105 min for Test It! (30–45 min for group planning; overnight to make ice cubes and salt ice cubes; 60 min to run the investigation)

MATERIALS

- antifreeze
- water
- antifreeze tester

BLACKLINE MASTERS

Master 1 Centimetre Grid Paper
Master 2 Safety Precaution Symbols
BLM 1–1 Using a Hot Plate
BLM 3–4 Suggested Procedure for Test It!
BLM 3–5 Chapter 3 Word Puzzle
OHT A–12 to OHT A–14 Test It! Compare the Melting Points and Boiling Points of Water and Salt Water
Assessment Master 10 Safety Rubric
Assessment Master 12 Using Tools and Equipment Rubric
Assessment Master 13 Fair Test Checklist
Assessment Master 14 Fair Test Rubric

Specific Expectations

CPM1.03 – explain the characteristics of pure substances and mixtures, using appropriate scientific terminology
CPM1.04 – describe the physical properties of common materials, using appropriate scientific terminology
CPM2.02 – use appropriate laboratory safety and disposal procedures while conducting investigations
SIL1.01 – describe how the procedures, skills, and tools employed in different areas of science are also evident in daily life
SIL1.02 – explain the importance of a "fair test" for troubleshooting and testing everyday science problems
SIL2.01 – formulate questions about problems or issues that can be scientifically tested
SIL2.02 – plan, conduct, and refine simple investigations to answer student-generated questions
SIL2.03 – conduct investigations safely, using appropriate lab equipment
SIL2.04 – observe and record data, using a variety of formats, including the use of SI units, where appropriate
SIL2.05 – assess data to make inferences and conclusions and to answer questions and refine procedures
SIL2.06 – communicate plans, observations, and results using a variety of oral, written, and graphic representations, and including the use of SI units, where appropriate

Science Background

Pure substances usually have a sharp melting point, which means they melt completely over a narrow temperature range.

Reading Icon Answer (page 70)

1. Look for the idea that pure substances may work differently than mixtures do.

Activity Planning Notes

Read page 70 together as a class. Explain that even though some mixtures look like pure substances, mixtures and pure substances work differently. Provide some practical examples.

- Using a frozen substance that is not pure water as an ice cube in a drink could poison the drink.
- Mixing the wrong amounts of antifreeze and water could cause problems in a car engine if the temperature drops too low during the winter.

If you can, borrow an antifreeze tester (density gauge) from the automotive department in your school. Use two different solutions of water and antifreeze and demonstrate how the gauge works to provide information mechanics need to tell how much antifreeze is mixed with water in the radiator. Throughout the demonstration, make sure students stay away from the antifreeze.

Have students use underlining to help them process the information to answer the Check Your Understanding and Making Connections questions.

Have students complete the Test It! investigation to compare the properties of water and salt water. While they wait to take temperature readings in the lab, have students work on **BLM 3–5 Chapter 3 Word Puzzle**.

Consider using the following blackline master:

- **BLM 3–5 Chapter 3 Word Puzzle**

Check Your Understanding Answer (page 70)

2. Accept two of: melting point, density, boiling point.

Making Connections Answer (page 70)

3. Antifreeze guaranteed to –20ºC has more water. Adding water produces a mixture with a higher freezing point.

Test It! Activity (page 71)

Compare the Melting Points and Boiling Points of Water and Salt Water

Purpose

- Students design a lab to compare the melting points and boiling points of water and salt water.

Science Background

The point of this investigation is to help students understand that mixtures boil and freeze at different temperatures than the pure substances that make them up. Adding salt to the salt-water mixture affects the melting point and boiling point of the salt-water mixture. The melting points and boiling points of water and salt do not change.

For every 58 g of salt added to 1 L of water at sea level, the boiling point of the mixture will increase by 1ºC and the freezing/melting point will decrease by 2ºC. The boiling point decreases by 1ºC for every 10 m above sea level.

Note that altitude and barometric pressure affect these values. If your classroom is far above sea level, the boiling point will be lower. The freezing point is not affected as dramatically by elevation as is the boiling point.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO
1 day before	• If you choose to use them, photocopy **Master 1 Centimetre Grid Paper**, **Master 2 Safety Precaution Symbols**, **BLM 1–1 Using a Hot Plate**, **BLM 3–4 Suggested Procedure for Test It!**, and any assessment masters.
Day of	• After planning with students, gather the materials for the next lab period. Or, gather the materials in advance and give students planning hints by showing them the equipment.

APPARATUS	MATERIALS
• ice cube trays • beakers • hot plates • thermometers	• salt • water

Note: This list may vary according to student lab designs.

Suggested Timing

- 90–105 min (30–45 min for group planning; overnight to make ice cubes and salt ice cubes; 60 min to run the investigation)

Safety Precautions 

- Space students around the room to set up their investigations so they don't bump into each other.
- Caution students to be careful with thermometers. Do not hesitate to make overexcited students sit out the investigation if their behaviour seems likely to cause equipment breakage or injury to others.
- Review the safe use of a hot plate. Consider having students review **BLM 1–1 Using a Hot Plate**.
- Avoid putting a very cold beaker directly on a hot surface. Begin by placing it on a cool or barely warm burner.
- Caution students to be careful around steam. Steam can cause serious burns to the skin.
- Have students clean up the work area and wash their hands at the end of the activity.

Activity Planning Notes

Students may have worked through the procedure for this lab in the Try This! on page 41 in Chapter 2. If they did, remind them of their experiences.

Work closely with your students to develop this lab. You might suggest making ice cubes to your class. This may help them determine an appropriate method for completing this investigation. **OHT A–12** to **OHT A–14 Test It! Compare the Melting Points and Boiling Points of Water and Salt Water** will assist you in talking through the investigation plans with students.

You may wish to have students use **Master 2 Safety Precaution Symbols**, and glue the symbols they need into their student resource.

Explain that the temperature of an ice-water mixture does not change until all of the ice has turned to water. Many students will not be aware of this.

Offer students **Assessment Master 13 Fair Test Checklist** to help check whether they are developing a fair test.

Accommodations

- Have students work in pairs or groups.
- Consider having each group prepare one salt-water solution (i.e. 0 g salt, 20 g salt, 40 g salt, 60 g salt) for making ice cubes for the class. This will speed up the process and reduce the chance of error.
- Provide students who have difficulty developing a procedure with **BLM 3–4 Suggested Procedure for Test It!**
- Students who find the grid on page 73 too small may wish to use **Master 1 Centimetre Grid Paper** and glue their graphs onto one of the blank pages at the back of the student resource.

Activity Wrap-up

- Have students complete and then discuss the answers to questions 11 to 13.
- Consider using the following questions in a wrap-up discussion:
  – How does the amount of salt added affect the melting point of salt water?
  – How does the amount of salt added affect the boiling point of water?

Test It! Answers (pages 71–73)

1. Answers may vary. Accept any reasonable question. For example:
- How does the boiling point of water and salt water compare?
- How does the melting point of water and salt water compare?

2. Accept all reasonable answers. For example:
- The salt water will have a higher boiling point than water.
- The salt water will have a lower melting point than water.

3. saltiness of the water

4. Answers will vary. For example:
- Wear thermal mitts when handling things that are hot.
- Do not stir the mixture with the thermometer.
- Keep the lab counter neat and uncluttered to avoid knocking things over.

5. Equipment may vary depending on the lab design. Look for items such as: ice cube trays, beakers, hot plate, thermometer, stirring rod, measuring scoop, support stand, thermometer clamp, scale.

6. The picture should show the set up for equipment. For example:
- A support stand and a thermometer clamp holds a thermometer in a beaker containing a mixture. The beaker is being heated on a hot plate.

7. Accept any reasonable plan to make a fair test. For example:
Melting Point
- I will use the same number of ice cubes in each beaker.

- I will position the thermometer so that it is in the middle of the beaker and doesn't touch the sides.
- I will check the temperature ever two minutes, and record the temperature of the ice when the thermometer stops decreasing.
- I will record the temperature of the mixture in each beaker.

Boiling Point

- One at a time, I will heat each beaker until the contents reach the boiling point.
- I will position the thermometer so that it is in the middle of the beaker and doesn't touch the sides.
- I will check the temperature every two minutes, and record the temperature when it stops increasing.

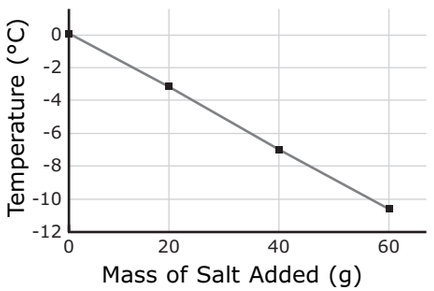
9. Recording methods might vary. Look for a chart that allows students to record melting points and boiling points for water and different concentrations of salt water. Some students might record the time it takes for the contents in each beaker to boil. Although time is not important in this activity, it is a good lab procedure for students to follow.

Here is a data table with sample results.

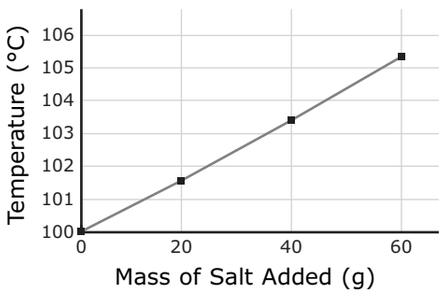
	Melting Point (°C) of Salt Ice	Boiling Point (°C) of Water
Beaker		
A: no salt	0ºC	100ºC
B: 20 g salt	–3.5ºC	101.7ºC
C: 40 g salt	–6.9ºC	103.4ºC
D: 60 g salt	–10.3ºC	105.2ºC

10. There should be a steady change between the two variables in both graphs. For example:

Melting Point of 200 mL of Salt Ice



Boiling Point of 200 mL of Salt Water



11. The melting point decreases.

12. The boiling point increases.

13. Answers will vary. For example:

- Melt ice on sidewalks by salting them.
- Cook food faster by adding salt to cooking water.

Ongoing Assessment

- Check students' answers to the Making Connections question on page 70 to assess their understanding of properties of mixtures.
- Consider using **Assessment Master 10 Safety Rubric** to assess students' safety practices and **Assessment Master 12 Using Tools and Equipment Rubric** to assess student use of tools and equipment during the investigation.
- Use **Assessment Master 14 Fair Test Rubric** to assess student ability to design a fair test. Be sure to give both positive feedback as well as areas for improvement.

Technology Links

- For more information on substances used to melt ice and snow, go to **www.mcgrawhill.ca/books/Se9** and follow the links to Ice Melters.

Chapter 3 Review (page 74)

SUGGESTED TIMING

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

BLACKLINE MASTERS

Master 3 Certificate
Master 4 List of Skills
BLM 3–5 Chapter 3 Word Puzzle
BLM 3–6 Chapter 3 Practice Test
BLM 3–7 Chapter 3 Test

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 3–6 Chapter 3 Practice Test** can be customized to produce extra reinforcement questions.

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 **BLM 3–5 Chapter 3 Word Puzzle** at some point in the chapter. Once the review is completed and taken up, assign the **BLM 3–6 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	3.1	Categories of Matter (page 56)
2	3.3	Elements (page 65)
3	3.1	Categories of Matter (page 56)
4	3.1	Categories of Matter (page 56)
5	3.3	Compounds (page 65)
6	3.1	Categories of Matter (page 56)
7 a)	3.4	Properties of Pure Substances and Mixtures (page 70)
7 b), c), d)	3.1	Categories of Matter (page 56)
8	3.2	Find Out Activity Separate a Three-Part Mixture (page 62)
9	3.1	Find Out Activity Is It a Mixture or a Pure Substance? (page 58)
10	3.2	Find Out Activity Separate a Three-Part Mixture (page 62)
11	3.2	Find Out Activity Separate a Three-Part Mixture (page 63)

Chapter 3 Review Answers (pages 74–75)

1. c) mixtures

2. b) element

3. e) pure substance

4. f) solution

5. a) compound

6. d) mechanical mixture

7. a) Both mixture and pure substance are acceptable, depending on how students interpret the question. Students should give the correct reason for their choice.
mixture; Water is added to antifreeze when it is put in a car.
pure substance; Antifreeze lists only one ingredient on the container.

b) mixture; You can see more than one part in raisin bread.

c) pure substance; All other substances are removed from the water during distilling.

d) pure substance; Sugar is a compound.

8. c) use water to dissolve the salt and then use filtration

9. a) solution; Only one part was seen but the substances were then separated by evaporation.

b) mechanical mixture; There were two solids in the mixture. One solid dissolved in water; the other solid stayed at the bottom of the beaker.

10. a) pick apart by hand

b) evaporation or filtering

c) evaporation

11. He could add water to the mixture. The sugar will dissolve in the water. He could filter the gold dust out of the mixture using a funnel and filter paper. When the filter paper dries, the gold dust will remain on the paper.

Summative Assessment

- Have students complete **BLM 3–7 Chapter 3 Test** to assess individual skills.
- You may wish to develop **Master 3 Certificate** to show students what they have learned during this chapter. Cut and paste the related skills from **Master 4 List of Skills**.