Nelson

SCIENCE

Grade 4
SAMPLE
MATERIAL
INSIDE

About Nelson Science

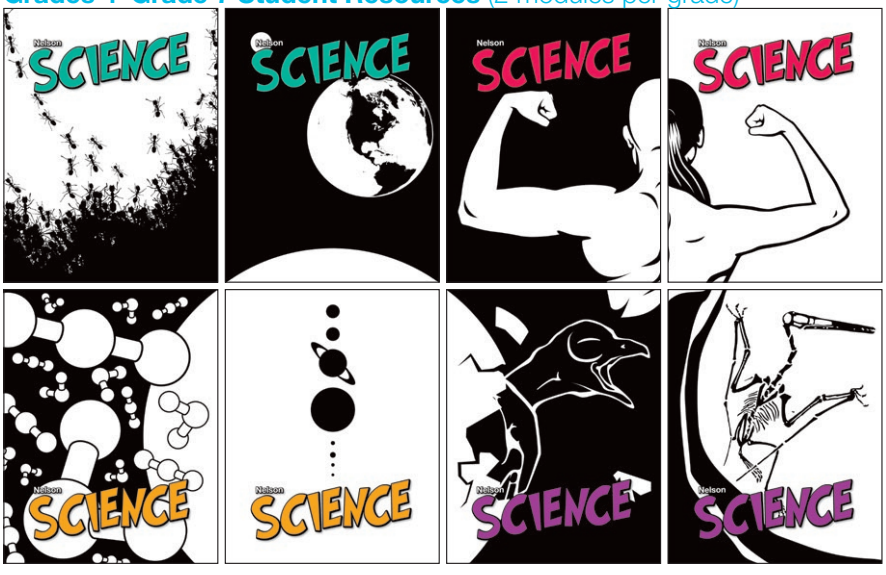
Developed by an experienced team of BC educators, *Nelson Science* is a comprehensive series built from the ground up to fully align with the new BC Science curriculum. Student resources feature activities designed to unleash students' innate curiosity. Infused with First Peoples knowledge and perspectives, and grounded in student-driven scientific inquiry, these resources open inquiry pathways that allow students to deepen their understanding of Big Ideas, develop Core and Curricular Competencies, and build place-based and content knowledge.

Key Features

- Focused on the doing of science—explorations and investigations are designed to develop the skills, processes, and habits of mind of scientific inquiry
- First Peoples scientific knowledge and perspectives are woven into activities through authentic contexts designed to support learning from First Peoples
- Design-focused activities allow students and teachers to cover all *Learning Standards* from the Applied Design, Skills, and Technologies (ADST) curriculum
- A suite of custom-developed, modifiable assessment tools, provide support for formative assessment of core and curricular competencies, as well as content knowledge

Kindergarten–Grade 3 Teacher's Resources

Grades 4–Grade 7 Student Resources (2 modules per grade)



Nelson SCIENCE

Resource Component Overview

For Students

Kindergarten–Grade 3

Activity Cards

- 9 double-sided, laminated Activity Cards featuring a unique activity on each side (total of 18 activities) to address all 4 strands: Biology, Chemistry, Physics, Earth/Space Science
- 8 copies of each Activity Card (total of 72 cards)
- Packaged in a durable cardboard box

Grades 4–7

Student Resource

- Flexible modular format—2 print modules per grade
- Each module contains 2 strands:
  - Biology and Chemistry
  - Physics and Earth/Space Science
- Online access to the Science Skills Toolkit

Online Student Centre (sold separately)*

- Each Online Student Centre provides:
  - 1 eBook containing 2 strands (includes audio read-aloud for struggling readers)
  - Science Skills Toolkit to support curricular competencies

***Contact your Sales Representative for more information.**

For Teachers

Kindergarten–Grade 3

Teacher's Resource
(includes Online Teaching Centre)

- Print Teacher's Resource with facilitation strategies and assessment support

Teacher Cards

- 5 double-sided, laminated cards to support place-based activities

Online Teaching Centre
(included with Teacher's Resource)

- Teacher's Resource eBook
- Image bank containing art and photos from the Activity Cards in JPG format
- Science Skills Toolkit with teaching notes to support curricular competencies
- Modifiable Blackline Masters (includes assessment tools)
- Interactive Whiteboard lessons for all 4 strands
- Videos with teaching notes
- Cross-curricular Connections with teaching notes
- Literature Connections with teaching notes
- Weblinks
- RSS feeds

Grades 4–7

Teacher's Resource
(includes Online Teaching Centre)

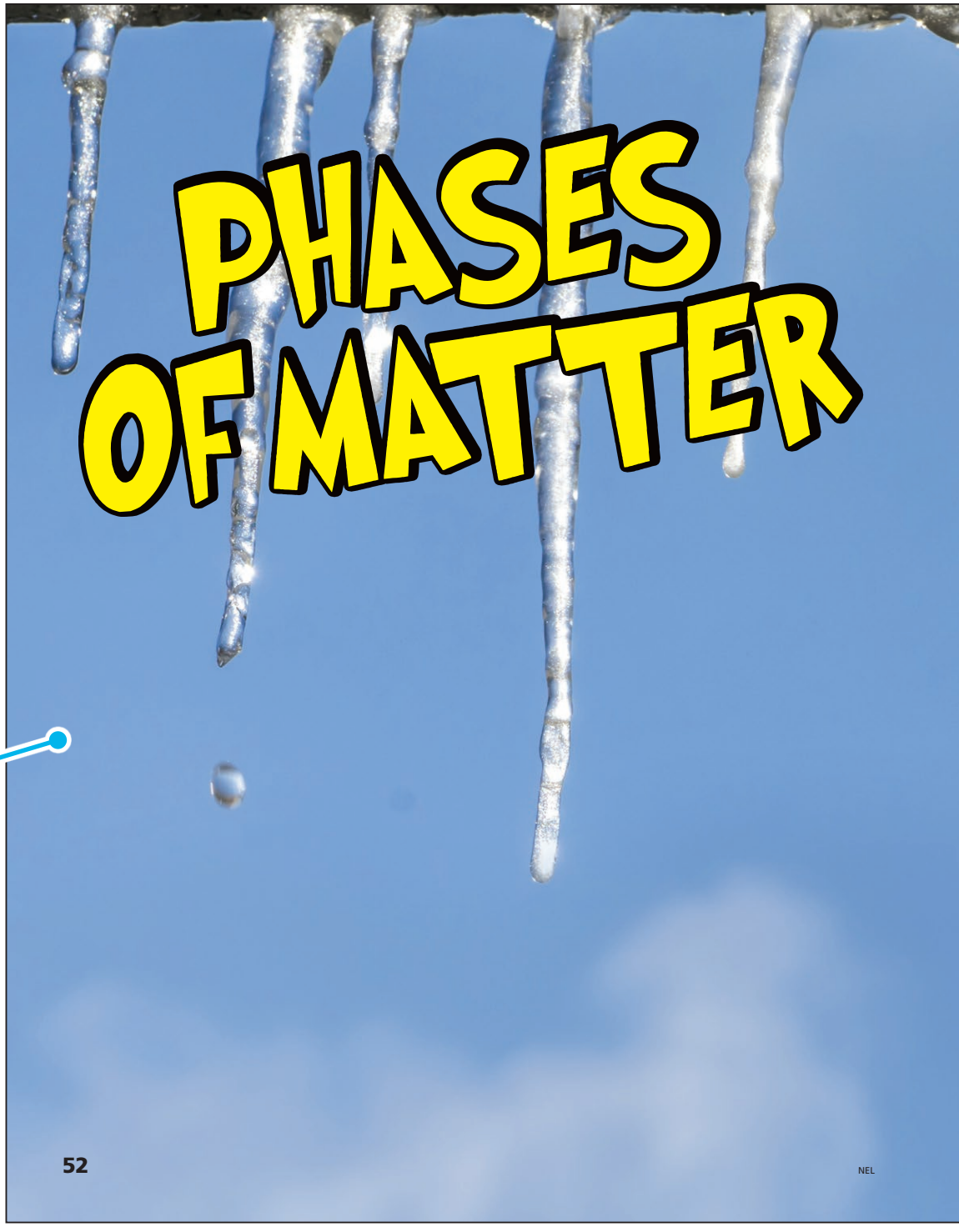
- Flexible modular format—2 print Teacher's Resource modules per grade
- Each module contains 2 strands:
  - Biology and Chemistry
  - Physics and Earth/Space Science

Online Teaching Centre
(included with Teacher's Resource)

- Teacher's Resource eBook containing 2 strands
- Image bank containing art and photos from the Student Resource in JPG format
- Science Skills Toolkit with teaching notes to support curricular competencies
- Modifiable Blackline Masters (includes assessment tools)
- Animations with teaching notes
- Videos with teaching notes
- Literature Connections with teaching notes
- Weblinks
- RSS feeds

Student Resource

Unit Opening Provocation



The opening image is visually engaging and is connected to the unit content or the curricular provocation.

Play with Goo!

You will be making a substance that is different from most of the substances you know.

Make Goo. Add a cup of water to a container. Slowly add twice as much cornstarch. Mix until it is thick.

Play with your Goo. Stir it with your hand. Punch it. Pour it. Cut it with scissors as you pour it. Roll it into a long shape. Explore!

The opening activity is always a curricular provocation. The high-interest activity is intended to engage students and elicit their naturalistic questions about the conceptual content of the unit.

Student Resource

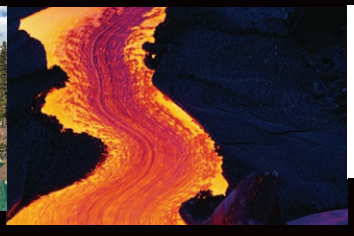
Explore!

Explore!, located after the unit opening provocation, provides a visual overview of the key topics in a unit. It replaces traditional tables of contents and supports more nonlinear, curiosity-driven approaches to the exploration of the science concepts in a unit.

EXPLORE!

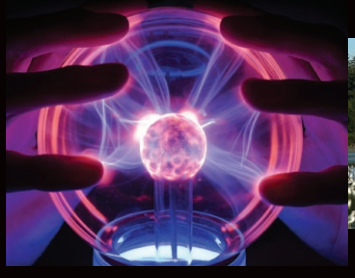
Get ready! You are about to discover that matter has mass, takes up space, and can change phase.

MATTER p. 56



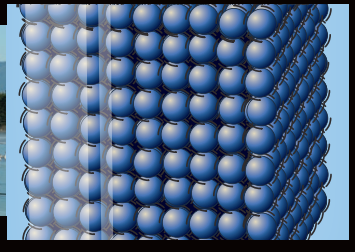
SOLIDS, LIQUIDS, AND GASES p. 58

HOW CAN WE DESCRIBE THE PHASES OF MATTER? p. 62



PLASMA p. 64

MATTER IS MADE OF PARTICLES p. 68



HOW CAN WE MODEL MATTER? p. 70

THE EFFECT OF TEMPERATURE ON PARTICLE MOVEMENT p. 72

VAPORIZATION AND CONDENSATION p. 76

WHERE DOES THE WATER COME FROM? p. 80

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Student Resource

Exploration

Explorations present conceptual content. They often include one or more hands-on *Try This!* activities.

Questions throughout the narrative help students make connections, check their understanding, or extend their thinking.

Try This! activities are structured activities that provide students with opportunities to develop science skills and conceptual understandings by doing science.

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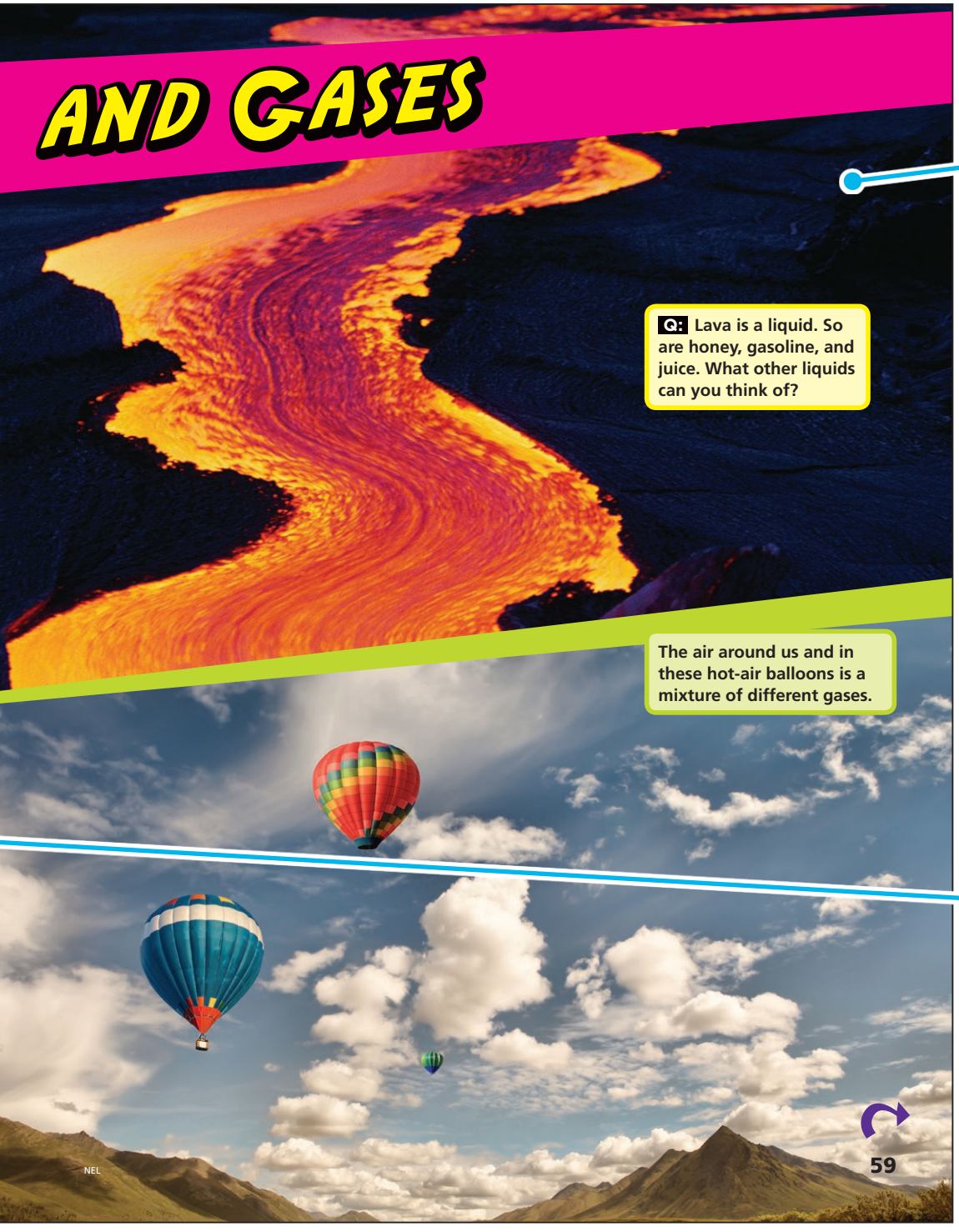


High-impact images directly relate to key concepts and provide some of the content of the lesson. These images offer opportunities for differentiated instruction and show rather than tell students about the concepts.

Place-based activities provide opportunities to do science outside the classroom and are identified with a tree icon.

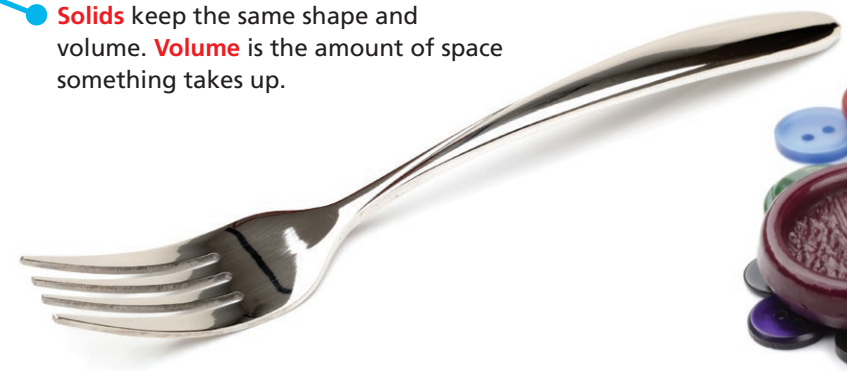
Student Resource

Exploration (continued)

Small narrative passages, often featuring local contexts, are written in student-friendly language and provide essential knowledge through engaging real-world contexts.

Essential science terms are bolded and defined in context at first point-of-use. They are also defined in the Glossary at the end of the Student Resource.

Solids keep the same shape and volume. **Volume** is the amount of space something takes up.



Liquids take the shape of their container, but they keep the same volume.

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Gases take the shape and volume of their container. Unlike solids and liquids, gases can be compressed into smaller containers.

One helium tank can hold enough helium gas to blow up hundreds of balloons!

Captions are informative and can include questions and/or activity suggestions that serve as entry points into the science content and springboards for inquiry.

Student Resource

Conduct an Inquiry!

Conduct an Inquiry! sections are full scientific inquiries. Students set their own specific question and decide how they will plan and conduct their investigation.

Conduct an Inquiry! uses the headings for scientific inquiry from the BC curriculum and prompts students through the inquiry stages.

Conduct an Inquiry!

How Can We ... the Phases

Question and Predict

You are going to test various samples to find out if they are solids, liquids, or gases.

Decide on questions to test your samples. Record them in a table like this one:

Sample	Can you pour it?	_____?	_____?	_____?	Phase

Plan and Conduct

You will need:

- sealable bag
- samples to test
- containers with different sizes and shapes

Plan how to conduct your inquiry. Carry out your procedure. Record your results in your table.

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Describe of Matter?

Process and Analyze

Classify each of your samples as a solid, liquid, or gas. Record your findings in your table.

Evaluate

How are liquids and gases similar? How are they different?

Apply and Innovate

If you wanted to make chocolates in different shapes, in what phase would you work with the chocolate?

What new questions do you have about phases of matter?

Communicate

Share your results with the class.

The *Scientific Inquiry Toolkit*, available online, supports the development of the procedural knowledge of scientific inquiry.

Student Resource

Design and Make!

There is one *Design and Make!* activity in each unit that supports implementation of the ADST curriculum and allows students to develop their design thinking in relation to science topics. These open-ended design activities invite students to come up with their own design ideas and choose one to act on.

Design and Make!

How Can We

Design and make a model to help your class understand the three phases of matter.

Understand the Context

Find out what your classmates already know about the phases of matter. Ask questions:

- What is difficult to understand about phases of matter?
- Is there something you do not understand about particles and phases?

Define

What are the most important facts about the phases of matter that you need to include in your model?

Ideate

Come up with as many ideas as you can. Be creative. Write them all down—even the crazy ones! Add to your classmates' ideas.

Look at your ideas. Which ones will work best?

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NEL

Model Matter?

Prototype

Make a plan. What materials will you use? Work safely.

Create the first version of your model. This is your prototype.

As you work, you might change your tools, materials, or steps. Record any changes.

Test

Demonstrate your prototype. Ask:

- Which parts help your classmates understand phases of matter?
- Which parts confuse them?
- Do they have any suggestions?

Make changes to improve your prototype.

Repeat this process until you are satisfied.

Make

Create the final version of your model. Include all the changes from your testing.

Share

- Describe your design process.
- Did your model help your classmates understand the phases of matter?
- How is your model different from the real phases of matter?

Design and Make! activities in the Student Resource use the headings for the design process from the BC Applied Design, Skills, and Technologies (ADST) curriculum and prompt students through the design stages.

The *Design Toolkit*, available online, provides additional support for the skills and processes of design.

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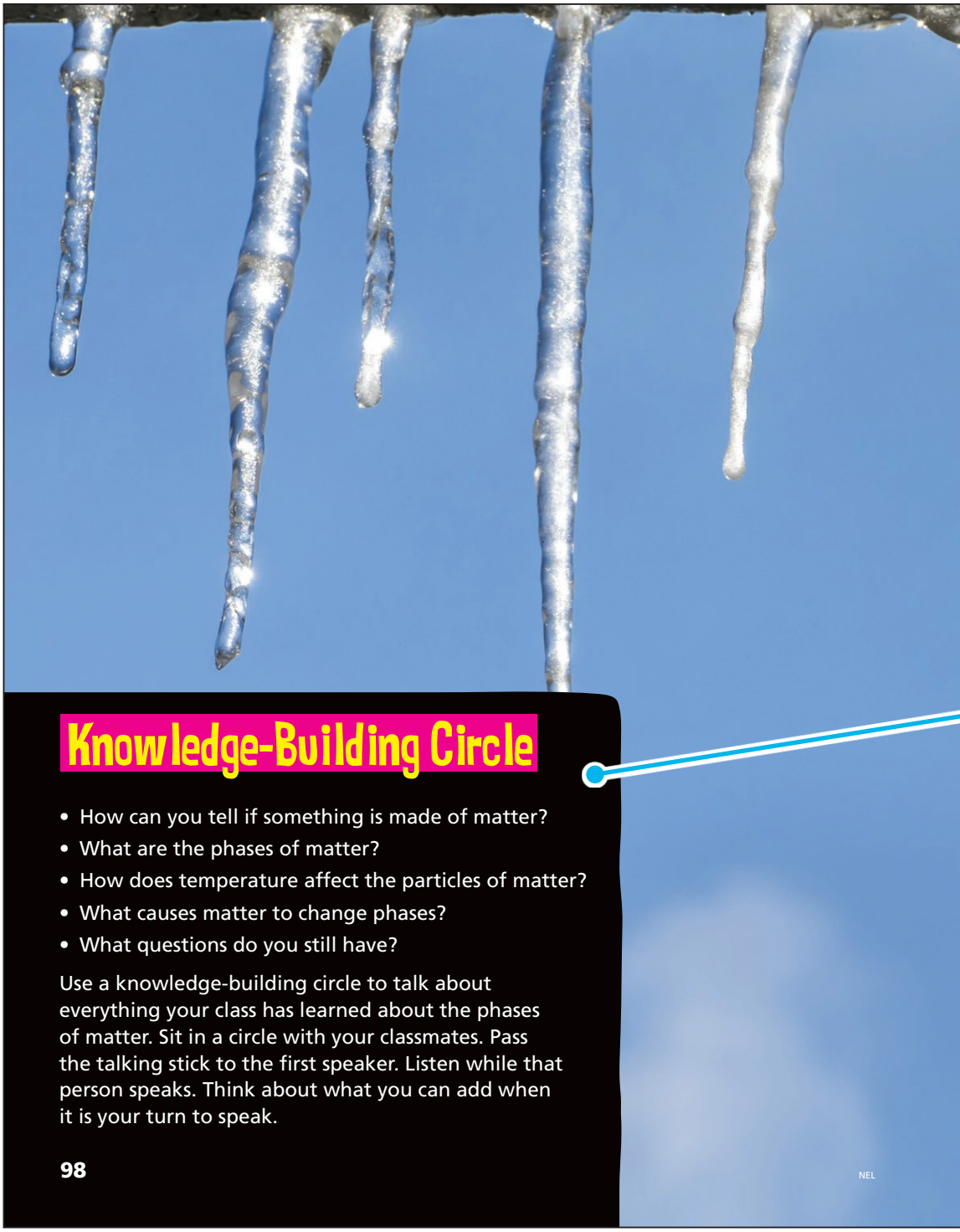
Student Resource

Unit Closing Activity



Knowledge-Building Circle

- How can you tell if something is made of matter?
- What are the phases of matter?
- How does temperature affect the particles of matter?
- What causes matter to change phases?
- What questions do you still have?

Use a knowledge-building circle to talk about everything your class has learned about the phases of matter. Sit in a circle with your classmates. Pass the talking stick to the first speaker. Listen while that person speaks. Think about what you can add when it is your turn to speak.

The closing activity in each unit is one of three types:
Knowledge-Building Circle: Students come together in a circle to pose questions and revisit, refine, and consolidate their ideas. The circle promotes a non-hierarchical approach, encourages attentive listening, and models effective First Peoples traditions of oral sharing.
Applications and Innovations: Students work individually or in small groups as part of a whole-class jigsaw activity to identify real-world applications and innovations, locally and globally, which are based on what they learned in the unit, and present the results in a manner of their choosing.
Take Action!: Students apply what they learned to come up with a personal or collaborative project to support the well-being of self, family, the community, or the land. The activity encourages deeper understanding and promotes learning from First Peoples.

Teacher's Resource

Inquiring into...

Developing the Big Idea and Unifying Concepts identifies and explains the big idea and one or two unifying concepts that are addressed in the unit.

Multi-Year Classrooms highlights areas of potential combined instruction based on the content and big idea of the unit.

Using This Provocation supports the opening activity in the Student Resource.

Inquiring into Phases of Matter

You Will Need

to make the Goo:
- cornstarch
- room-temperature water (2:1 ratio of cornstarch to water)
- bowl
- measuring cup
- spoon

per group:
- shallow container similar to a baking pan
- spoon
- scissors
- newspapers (if working indoors)

Online Teaching Centre Resources

Family Letter
Documenting Learning: Play with Goo!
Weblinks

In this unit, students will use the skills, processes, and habits of mind of scientific inquiry to explore phases of matter and the effect of temperature on particle movement. If this is the first unit of the school year, you may wish to distribute **Family Letter**.

Developing the Big Idea and Unifying Concepts

The Big Idea for this unit is **Matter has mass, takes up space, and can change phase**. As students investigate different phases of matter, they develop an understanding of what matter is and how it behaves, and how its behaviour relates to temperature and to the particles of matter.

The unifying concepts for this unit are **matter and energy** and **change**. Students have previously learned about matter in the context of the properties of familiar materials (K and 1), physical and chemical ways of changing materials (2), and atoms as the building blocks of matter (3), and about energy in the context of the needs of living things and thermal energy (3). In this unit, students will focus mostly on the properties of matter but will deal with energy as they learn about the effect of temperature on particle movement. Students have previously explored the unifying concept of change in the context of seasonal changes (K), physical and chemical changes, and life cycles (2), and changes to the local environment caused by erosion and deposition (3). In this unit, students explore phase changes.

The photograph in the background of the unit opener shows melting icicles.

Multi-Year Classrooms

The content in this unit builds on the Grade 3 Big Idea that all matter is made of particles and, to a lesser extent, on the Grade 3 Big Idea that thermal energy can be transferred. In Grade 3, students learn about atoms, the basic building blocks of matter. Now they will learn how the organization of these particles determines the phase of matter, and how particles behave when heated and cooled. In Grade 5, they will build on their understanding of solids, liquids, and gases as they learn about solutions and solubility.

Using This Provocation

The goal of Play with Goo! is to engage students in a fun, hands-on activity that allows them to **demonstrate curiosity about the natural world** as they **observe** a non-Newtonion fluid, and encourages them in a naturalistic way to **identify questions that can be investigated scientifically**. Sustained curiosity is one of the **habits of mind** associated with science.

Goals

This section provides teachers with a general overview of the unit. This section also notes any scientific descriptions and explanations that have recently been improved as new evidence became available.

STUDENT RESOURCE PAGES 52–55

Learning from First Peoples links authentic First Peoples perspectives and scientific knowledge about the natural world to the skills and concepts in a given activity.

Learning from First Peoples: Traditional ways of learning often occur through direct observation and experience of the natural world and other people. Giving students the opportunity to form their own conclusions through hands-on exploration and observation, without providing a "correct" answer, is consistent with First Peoples ways of knowing.

Science Background

Goo (a cornstarch and water mixture) is a non-Newtonian fluid—a fluid that does not follow the model of how fluids flow that was developed by Isaac Newton. Ketchup is another example of a non-Newtonion fluid.

Goo's strange behaviour is due to the strand-like shape of cornstarch particles. Cornstarch does not dissolve in water. If you put pressure on the Goo mixture, such as by punching it, the long particles become tangled, causing the mixture to become hard like a solid. However, if you move the mixture slowly, the cornstarch particles slip past each other without becoming tangled, and the mixture has the properties of a liquid.

Quicksand behaves much the same way: if you move quickly to escape, the mixture hardens and you become stuck. You are more likely to escape if you move through it slowly or try to distribute your mass by lying down.

Observing and Supporting Learning

- Give students plenty of time to explore the Goo, and let them be messy. Consider doing the activity outside to avoid cleanup. Goo is non-toxic and biodegradable. Indoors, consider placing newspapers on student desks and avoiding carpeted areas, although Goo is easily vacuumed out of carpets after it has completely dried.
- As students work on the Provocation activity, consider documenting evidence of learning using **Documenting Learning: Play with Goo!**
- Consider taking photos to document the curiosity and wonder you see as students play with Goo.
- Listen for questions, or statements that can be turned into questions. Record and use these for further student-driven inquiry opportunities throughout the unit.

Assessment Tool

Teacher's Resource

Exploration

Curricular and Core Competencies identifies the curricular competencies (scientific skills and processes and habits of mind) that students will be using to build their science knowledge and any core competencies that they will have significant opportunities to develop.

The *Focus Question* identifies a key question that is derived from the learning standards for content knowledge.

Big Ideas and Unifying Concepts identifies how the doing and knowing of science can roll up toward the big idea and goals of the science curriculum.

Solids, Liquids, and Gases

You Will Need

per student or group:
- clipboard, pencil
- camera or video camera (optional)

Online Teaching Centre Resources

Which Phases Can We Find in the Local Environment?
Place-Based Reflection
Field Guide Entry
Three-Column Chart
Documenting Learning: Solids, Liquids, and Gases
Documenting Social Responsibility: Facets
Documenting Social Responsibility: Profiles
Self-Assessment: Social Responsibility: Facets
Self-Assessment: Social Responsibility: Prompts
Scientific Inquiry Toolkit (consider ethical responsibilities, observe, classify, reflect on place)

Using This Exploration

Curricular and Core Competencies: As students **experience and interpret the local environment** during an outdoor "phase hunt," they have opportunities to **consider ethical responsibilities when deciding how to conduct** the activity. Students will also be developing the core competency of **Social Responsibility** (**facet: contributing to community and caring for the environment**). They **make observations about living and non-living things in the local environment**, and **sort and classify data using a provided table**. Students are asked to **express and reflect on their personal or shared experiences of place** by identifying how their knowledge of the local area helped them do this activity.

Focus Question: What are the properties of solids, liquids, and gases?

Big Idea and Unifying Concepts: This Exploration helps students construct their concept of **matter and energy** by introducing them to the properties of three phases of matter.

Learning from First Peoples: The Try This! activity is experiential and helps students to develop a sense of place. Students are asked to discuss how they can show respect for nature as they look for phases of matter outdoors to help them recognize the impact of their actions on the environment.

Science Background

Solids, liquids, and gases are the three main phases of matter, also known as "states" of matter. (Plasma is a phase of matter that will be introduced in another Exploration; other phases exist but are beyond the scope of this course.)

Solids have fixed shape and volume and are not compressible. Some solids, such as sponges and bread, contain air pockets, which make them readily compressible, but under extreme conditions all solids are compressible. Non-compressibility can be used as a defining property under normal conditions.

Liquids have variable shape and fixed volume and are not compressible. The particles in a liquid generally have less energy than those in a gas; as a result, the particles in a liquid are close enough together that molecular forces prevent compression.

Gases have variable shape and variable volume and are readily compressible. For example, a helium tank contains enough gas to inflate many balloons, which would have a total volume that far exceeds that of the tank. The helium gas inside the tank in the photograph in the Student Resource is compressed into a volume of a few litres but would expand to occupy several hundred litres if released.

(continued)

STUDENT RESOURCE PAGES 58–61

Note that the Goo produced in the opening activity is not an example of a different phase; instead, it shows what can happen when you mix two phases together. Most of the solids, liquids, and gases that we encounter on a regular basis are not pure substances. Rather, they are mixtures. Lava, for example, contains a variety of substances, including molten or liquid rock, suspended solids, and gases.

Possible Misconceptions

Students may still believe that air is not made of matter because we can't see it. Remind them that matter takes up space and has mass, and that the Try This! activity showed that air takes up space.

Students may have more items on their solids list in the Try This! activity, but that does not mean that most matter on Earth is in a solid phase. Two-thirds of Earth's surface (and their own bodies) is water.

Note that it is a common misconception that clouds are a gas—they are actually made up of ice crystals and/or droplets of liquid water. Clarify for students that air, including the air in the hot-air balloons shown on Student Resource page 59, is made up of gases, but not the clouds.

Science Background provides a detailed overview of the science concepts covered in a given activity and, where applicable, addresses possible misconceptions.

Learning from the Land

The Try This! is a **place-based** activity that uses the land to teach students about phases of matter. The activity adds to their existing knowledge and sense of place.

Learning from the Land provides teaching strategies and prompts when place-based learning opportunities arise.

Observing and Supporting Learning

- Invite students to read the text and answer the questions on Student Resource pages 58 and 59.
- Consider using **Documenting Learning: Solids, Liquids, and Gases** to document your observations of student learning as students respond to the images and text and do the hands-on activity.

Goals

Assessment Tool

SAMPLE RESPONSES

Q: Stone and metal are solids. What other solids are in this picture?

R: Cement, grass, glass, and plastic are also solids.

Q: Lava is a liquid. So are honey, gasoline, and juice. What other liquids can you think of?

R: Milk and tea are liquids. Lakes and rivers and oceans contain liquid water. Rain is a liquid. Our bodies produce liquids such as sweat, saliva, and urine.

Teacher's Resource

Exploration

Try This! provides facilitation strategies for these hands-on activities in the Student Resource, including notes about materials, safety precautions, and sample responses.

Blackline Master

Blackline Master

Goals

- Have students complete the Try This! activity. Consider printing **Which Phases Can We Find in the Local Environment?**, which is a copy of the procedure. You may wish to distribute clipboards and copies of **Three-Column Chart** for recording examples.
- Having students consider respect for nature in this activity supports the **habits of mind** associated with science as well as their development as **scientifically literate citizens**.

TRY THIS! Which Phases Can We Find in the Local Environment?

Purpose

This activity provides an opportunity for **place-based learning.** Students will demonstrate their current understanding of solids, liquids, and gases.

A Note about Safety

- Familiarize yourself with any poisonous plants or animals in your area, and remind students to be cautious about touching plants and animals.
- Be aware of student allergies.

Notes

- Consider having students discuss the question in Step 1 in the classroom before going outside.
- Have students add their charts to their science logs or portfolios to document their learning.
- If students are developing field guides to their local place, have them add their charts and some reflections on their experience of the land in their outdoor activity today.

Sample Responses

Student examples will vary depending on the season, weather, and place. Students may list examples they can see directly and ones that they know are there (e.g., water inside plants and animals, gasoline inside vehicles).

1. I can show respect for nature by putting things back where I found them and by not stepping on things that might get hurt by my feet.
3. I think that people, trees, and animals all have liquid inside them even though they look solid, and cars have gasoline inside them.
5. I knew where there was a small stream, so that helped me find a liquid.

Formative Assessment

Collecting Information	Using Information
As students take a moment to quietly connect with nature, observe the extent to which they seem to be able to do this in a mindful manner.	If some students are having difficulty taking a moment to connect with nature, consider prompting them as follows: *Start your minute of silence by taking a deep breath. Stand still and pay attention to how you feel inside your body. Take another deep breath. Look around and notice your surroundings.*
As students work outdoors, observe the extent to which they show respect for nature.	Provide students with descriptive feedback on the extent to which they are considering their ethical responsibilities as they work in nature; for example, *I see you are trying not to step on those plants.*
Observe for whether students are finding examples of all three phases of matter.	If students are having difficulty finding examples of liquids or gases, provide support by suggesting that they think of places where there might be liquids and gases that they cannot see.

Formative Assessment

Collecting Information	Using Information
Look at students' lists to see if they were able to sort and classify their examples of solids, liquids, and gases accurately.	If students have some errors on their lists, have them examine the material on Student Resource pages 60 and 61 on the properties of each of the phases and then revisit and correct their charts.
As students work outside, and later when they answer the last question, listen for evidence that they were using place-based knowledge and interpreting the local environment to find phases.	Provide students using place-based knowledge with descriptive feedback; for example, *I can tell you know something about the local environment. I heard you using what you know about this place to find examples of phases.*

Formative Assessment supports teachers with assessment strategies for observing students, adjusting instruction, and providing descriptive feedback.

- If you plan to observe with a core competency focus, consider using **Documenting Learning: Social Responsibility: Profiles** (or **Facets**).
- Some students may wish to document this activity as an example of their **Social Responsibility** competency in Science, and complete a self-assessment using **Self-Assessment: Social Responsibility: Facets** (or **Prompts**).
- After the Try This! activity, consider having students complete **Place-Based Reflection** or **Field Guide Entry**.
- Students will likely have longer lists of solids and liquids, and this can lead to the misconception that more of the matter on Earth is solid than liquid. Ask, *What do you think is the most common phase of matter on Earth? What about the oceans? Let's look at a map of the world to compare land and water*.
- Consider having students collaborate on a class chart of examples of different phases of matter that they saw outside. Encourage students to consider whether each example keeps its shape and volume and whether it can be compressed. Model the use of this terminology when discussing phases with students.
- Invite students to discuss how they experience the phases of matter in their own bodies. For example:
  - gases: breathing air, burping, passing gas
  - liquids: blood, drinking water, passing water
  - solids: bones, solid waste

  Ask questions such as the following: *Why is it important for our bodies to be made partly of solids?* (bones/structure) *Why do you think we have so much liquid in our bodies?* (liquids flow; nutrients dissolve in liquids and can be transported more easily)

Social Responsibility

Assessment Tool

Blackline Master

Identifying Inquiry Opportunities

- Listen for and record students' questions and areas of interest along the walk. In particular, listen for observations that students could turn into testable questions. Students may have questions relating to changes of phase, or determining the phase of substances that don't fit neatly into one of the three phases. Consider having students plan and conduct inquiries to answer these questions at appropriate times within the unit.

Identifying Inquiry Opportunities scaffolds concrete suggestions for additional or alternative scientific inquiries based on students' own questions.

Teacher's Resource

Conduct an Inquiry!

You Will Need is a list of materials teachers will need for any activities in the Exploration. *Online Teaching Centre Resources* is a list of resources in the Online Teaching Centre that can be used to support the Exploration, such as Blackline Masters, Assessment Tools, and the Science Skills Toolkit.

Conduct an Inquiry!
How Can We Describe the Phases of Matter?

You Will Need

per student or group:
- rocks, bolts, buttons, coins, small pebbles, marbles
- honey, oil, corn syrup, water
- sealable bags
- cups or containers of various sizes and shapes
- measuring cups (optional)
- basketball (optional)

Online Teaching Centre Resources

How Can We Describe the Phases of Matter? Recording Table
Scientific Inquiry Process
Scientific Inquiry Report
Documenting Learning: How Can We Describe the Phases of Matter?
Scientific Inquiry Scale
Scientific Inquiry Self-Assessment Scale
Documenting Critical Thinking: Facets
Documenting Critical Thinking: Profiles
Self-Assessment: Critical Thinking: Facets
Self-Assessment: Critical Thinking: Prompts
Scientific Inquiry Toolkit (identify testable questions, plan procedures, conduct procedures, observe, record, classify, identify applications, communicate)

Using This Inquiry

Curricular and Core Competencies: Students will collect their own evidence about the properties of different phases of matter as they **identify questions** they can use to determine whether something is a solid, a liquid, or a gas. They will **suggest ways to plan and conduct an inquiry, collect simple data**, and **sort and classify data using a provided table**. This will help students develop **an understanding and appreciation of evidence**. They are asked to **transfer and apply their learning** to think about how they would make chocolates, and **communicate their findings**. Students will develop **Critical Thinking (facet: question and investigate)** throughout this inquiry.

Big Idea and Unifying Concepts: This inquiry further develops the Big Idea: **Matter has mass, takes up space, and can change phase**. Through their own experimentation, they begin to recognize that solids have fixed shape and volume; liquids have variable shape but fixed volume; and gases have variable shape and volume. (Although the phases also differ in terms of compressibility, students will probably not be able to test this property.)

Science Background

Students at this grade level have not yet been exposed to the concept of volume (the amount of space something takes up) in Mathematics, so a definition is provided in the Student Resource.

Possible Misconceptions

Students may think that liquids change volume when they are poured into a different container—for example, from a small glass into a large glass. Encourage students to use different-sized measuring cups to pour liquid from one to another, checking the volume after each pouring.

Observing and Supporting Learning

Goals

- This inquiry is an opportunity for students to develop **procedural knowledge** in Science as they develop questions and plan procedures for a scientific inquiry. Students will also develop their **understanding and appreciation of the nature of science as an evidence-based way of knowing the natural world**.

Blackline Master

- If necessary, display **Scientific Inquiry Process** and discuss the inquiry process as a class.

Assessment Tool

- Consider using **Documenting Learning: How Can We Describe the Phases of Matter?** to document your observations of students' scientific inquiry skills and processes.
- Give each small group samples that include one or more solids (stick with examples of solids that are non-compressible, such as buttons, rocks, washers, or bolts); one or more liquids, each in a sealable bag; and a bag filled with air.

STUDENT RESOURCE PAGES 62–63

Blackline Master

- Hand out **How Can We Describe the Phases of Matter? Recording Table** for students to complete during the activity. Students can record their observations in words or sketches, or by taking photos or making a video.
- Students may suggest questions such as these: *Can you change its shape? Can you change its volume?* In Process and Analyze, they may identify properties that can be used to identify the phases, such as can be poured, keeps the same volume, keeps its shape, and compressibility.
- For Evaluate, students may identify properties such as the following: solids keep their shape and volume; liquids keep their volume but not their shape; the shape and volume of a gas depends on the shape and volume of its container.
- For Apply and Innovate, students may identify that they would need to melt the chocolate to change its shape.
- Some students may wish to document this inquiry as an example of their **Critical Thinking** competency in Science and complete a self-assessment.
- Observe students as they work and highlight relevant sections of the **Scientific Inquiry Scale**. Have students highlight applicable "I can" statements on the **Scientific Inquiry Self-Assessment Scale**. If some students have difficulty self-assessing accurately, conference with them individually.

Sample	Can you pour it?	Does it change shape?	Does it change volume?	Phase
fork	no	no	no	solid
honey	yes	yes	no	liquid
bag of gas	yes	yes	maybe, I can't tell for sure	gas

Assessment Tool

Custom-developed, modifiable assessment tools support formative assessment of core and curricular competencies, as well as content knowledge.

Formative Assessment

Collecting Information	Using Information
Listen for whether students are identifying questions that will distinguish the properties of the three phases, and procedures that will answer their questions.	If students are having difficulty, provide additional instruction by having students brainstorm questions and procedures using the images and text on pages 56 and 57.
As students collect, sort, and classify data, ask questions to clarify and extend their understanding and appreciation of evidence; for example, *Did your procedures allow you to collect evidence to answer all your questions? If not, what else could you do?*	If students are unable to come up with procedures to answer some of their questions, provide additional instruction by giving them procedures that will provide evidence; for example, students are unlikely to have come up with a procedure to show that a gas is compressible. Give students a well-inflated basketball. They will probably not be able to compress the ball with their hands, but sitting on it shows some change in shape without an apparent loss of air.
As students attempt to transfer and apply their learning to making chocolates, ask questions to clarify and extend their thinking; for example, *Why did you say you have to melt the chocolate? What property does liquid chocolate have that sold chocolate does not?*	If students are having difficulty transferring and applying their learning to this example, consider adjusting instruction by providing concrete materials—a plain chocolate bar, a heat source such as hot water, and a mould—and challenge students to make a chocolate in the shape of the mould.

Identifying Inquiry Opportunities

- Listen for questions that students have as they test the different samples. If they have questions about other materials, provide them with these materials and encourage them to test and classify them based on their properties.

Teacher's Resource

Design and Make!

Design and Make!
How Can We Model Matter?

You Will Need

per student or group:
- "particles" such as dry rice, dry beans, marbles, beads, popcorn, and/or frozen peas
- Petri dishes and/or plates
- glue or other adhesive
- other materials identified by students

Online Teaching Centre Resources

Design Process
Design and Make! Share Stage
Design Log
Documenting Learning: How Can We Model Matter?
Design Scale
Design Self-Assessment Scale
Scientific Inquiry Scale
Scientific Inquiry Self-Assessment Scale
Documenting Communication: Facets
Documenting Communication: Profiles
Self-Assessment: Communication: Facets
Self-Assessment: Communication: Prompts
Documenting Creative Thinking: Facets
Documenting Creative Thinking: Profiles
Self-Assessment: Creative Thinking: Facets
Self-Assessment: Creative Thinking: Prompts
Documenting Critical Thinking: Facets
Documenting Critical Thinking: Profiles
Self-Assessment: Critical Thinking: Facets
Self-Assessment: Critical Thinking: Prompts
Design Toolkit

Blackline Master

Assessment Tool

Using This Design and Make!

Curricular and Core Competencies: This activity uses the curricular competencies of all stages of Applied Design in the Applied Design, Skills, and Technologies curriculum as well as the four curricular competencies under the Apply and Innovate section of the Science curriculum.

As students design and make their model, they will be developing the core competencies of **Communication (facets: connect and engage with others to share and develop ideas; collaborate to plan, carry out, and review constructions and activities;** and **explain, recount, and reflect), Creative Thinking (all facets)**, and **Critical Thinking (facet: develop and design)**.

Big Idea and Unifying Concepts: As students consider how to portray each phase of matter using a model, they further develop their own understanding of the aspect of the Big Idea that deals with phases of matter, as well as the unifying concept of **matter and energy**.

This Design and Make! also supports the Big Ideas that **designs can be improved with prototyping and testing; skills are developed through practise, effort, and action;** and **the choice of technology and tools depends on the task.**

Science Background

It will be impossible for students to construct models of the three phases of matter to scale. If students use spheres of 1 cm in diameter to represent gas particles, they would have to space these spheres 10 m apart in order for their model to be to scale.

Observing and Supporting Learning

- If necessary, start with a class discussion on the design process, using the Blackline Master **Design Process**.
- Consider using **Documenting Learning: How Can We Model Matter?** to document your observations of students' design processes as they design and make their models.
- Provide students with a variety of materials to choose from to represent the particles of matter, and with flat containers such as Petri dishes or plates to contain the particles. Encourage students to view the available materials before they begin to ideate. They may request additional materials.
- In the Define stage, students may determine that their classmates don't understand the difference between how solid particles and liquid particles are arranged, so their model needs to show how the particles of a solid and liquid are arranged and how they move.
- In the Ideate stage, students may come up with an idea such as the following: *I suggested that we freeze peas together with water to represent solid particles, let*

lots of frozen peas roll around on a plate to represent liquid particles, and put one frozen pea on each of many different plates and let them roll around to represent gas particles.

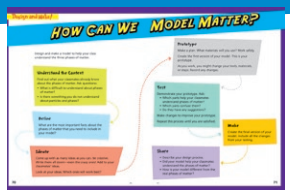
- In the Prototype stage, if students use the freezing technique, they may realize that they need to glue the peas together because the model falls apart as it melts. The Test phase may reveal that glue doesn't work well on wet peas. Explain that failure is to be expected and revising is part of the process that all designers use to create successful products.
- Have students present their final models to the whole class. While this may be time consuming, it will reinforce the arrangement and behaviour of particles in three phases of matter as well as the design process.
- In the Share stage, students may identify that their models are different from the real phases of matter because the particles were bigger, and glue was needed to hold them together. You may wish to have students complete **Design and Make! Share Stage** at this point.
- Ask students to consider whether they want to use this design activity as an example of their **Communication, Creative Thinking,** or **Critical Thinking** competencies in Science and complete a self-assessment. Students may make different choices depending on what they see as their strengths in the activity.
- Observe students as they work, and highlight relevant statements in all sections of the **Design Scale**, and in the Apply and Innovate section of the **Scientific Inquiry Scale**.
- Have students highlight applicable "I can" statements on the **Design Self-Assessment Scale**, and in the Apply and Innovate section of the **Scientific Inquiry Self-Assessment Scale**. Share your assessment of their work in the form of descriptive feedback, and then provide an opportunity to revise their self-assessment if they wish.

Formative Assessment	
Collecting Information	**Using Information**
Observe students as they work through the stages of the design process.	If students are having difficulty with any of the steps, provide additional instruction based on the Tips for Teachers in the Design Toolkit. Consider distributing and/or reviewing **Design Process**.

Identifying Design Opportunities

- Give students time to pursue any new design issues they have identified.
- Students could use their models, and consider whether they need to revise them or add to them, as they learn about the effect of temperature on particle movement and phase changes.

STUDENT RESOURCE PAGES 70–71



Cross-Curricular Considerations

In Grade 4 Mathematics, students work with 2D and 3D models.

Blackline Master

Communication
Creative Thinking
Critical Thinking

Assessment Tool

Blackline Master

Colour-coded icons, shown at point-of-use, act as identifiers for coverage of curricular goals, and core and curricular competencies.

Identifying Design Activities provides concrete suggestions for additional or alternative design activities

Teacher's Resource

Unit Closing Activity

Knowledge-Building Circle

You Will Need

per class (optional):
- talking stick
- video camera

Using This Closing Activity

Curricular and Core Competencies: As students participate in a knowledge-building circle to examine and improve ideas, identify any misconceptions or confusion, and elevate the understanding of the group as a whole, they will be developing their **Communication** competency (**facets: connect and engage with others** and **explain/recount and reflect**).

Big Idea and Unifying Concepts: Students have an opportunity to demonstrate their understanding of the Big Idea: **Matter has mass, takes up space, and can change phase**, and of the unifying concepts of **matter and energy** and **change**.

Learning from First Peoples: Knowledge-building circles are based on sharing, relationships, and memories. Consider connecting with local First Peoples to find out how knowledge-building circles are similar to and different from cultural talking circles, and what the protocols are for talking circles.

Observing and Supporting Learning suggests possible teaching strategies for engaging students in this activity.

Observing and Supporting Learning

- Students come together in a circle to pose questions, and to revisit, refine, and consolidate their ideas about phases of matter. The activity serves to identify shared problems and gaps in understanding and to advance the understanding beyond the level of the most knowledgeable individual.
- Teachers may wish to use a talking stick or other strategy to help students take turns speaking.
- A knowledge-building circle is intended to be a non-hierarchical way of sharing and building group knowledge, so it should not be led by the teacher. Consider reinforcing this by participating in the knowledge-building circle on an equal footing with students rather than simply watching and listening. For example, you could share something you learned about matter that you did not know before, or a question you still have.
- Similarly, if you actively assess student learning during the knowledge-building circle, you will be setting yourself outside the circle. Consider video-recording the knowledge-buildng circle so that both you and students can use excerpts as evidence of learning later to communicate learning to parents in parent–teacher interviews or student-led conferences.

STUDENT RESOURCE PAGES 98-99

- Consider using a talking stick to encourage good listening. The person holding the stick speaks and everyone else listens attentively. If someone else wants to speak, the stick is passed to that person. If necessary, pass the talking stick around the circle to encourage each person to speak. Students can say "pass" when the talking stick comes to them. When students become more comfortable with this protocol, they can just raise their hands for the stick.
- The typical structure of a knowledge-building circle is as follows:

  1. Everyone sits in a circle at the same level, including the teacher.
  2. Students participate in active listening—they give the person talking (holding the talking stick) their full attention.
  3. Students raise their hand once another student has finished speaking.
  4. The student who finishes speaking passes the talking stick to someone with a raised hand.
- If necessary, take a few minutes before starting to practise the kind of dialogue that takes place during a knowledge-building circle. Possible stems for students to use include the following:
  - I would like to add to what you said …
  - I agree with …
  - Something that I have tried is …
  - I have a matching idea … or I have a tag idea …
  - I have a different idea …
  - I need to understand …
  - Another idea I had …
- The first time the class participates in a knowledge-building circle, record these stems in a prominent place for students to refer to.

Identifying Inquiry Opportunities

Consider providing time for students to plan and conduct inquiries to answer questions that remained at the end of the knowledge-building circle.

Notes

Notes

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