hands-on science
An Inquiry Approach

Properties of Energy for Grades K–2

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Jennifer Lawson

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**Hands-On Science: An Inquiry Approach**
*Properties of Energy for Grades K–2*

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Introduction to Hands-On Science

About Hands-On Science

Hands-On Science helps develop students’ scientific literacy through active inquiry, problem solving, and decision making. With each activity in Hands-On Science, students are encouraged to explore, investigate, and ask questions as a means of heightening their own curiosity about the world around them. Students solve problems through firsthand experiences and by observing and examining objects within their environment. In order for young students to develop scientific literacy, concrete experience is of utmost importance—in fact, it is essential.

Format of Hands-On Science

The redesigned Science Curriculum for British Columbia (<https://curriculum.gov.bc.ca/>) is based on a “Know-Do-Understand” model. The three elements—Content (Know), Curricular Competencies (Do), and Big Ideas (Understand) all work together to support deeper learning. Hands-On Science promotes this model through its inquiry-based, student-centred approach. As such, it is structured around the following elements.

The Big Ideas are broad concepts introduced in kindergarten and expanded upon in subsequent grades, fostering a deep understanding of science. The Big Ideas form the basis of the Hands-On Science modules to address important concepts in biology, chemistry, physics, and earth/space science.

The Core Competencies are embedded throughout the curriculum and throughout Hands-On Science. These competencies enable students to engage in deeper lifelong learning.

Core Competencies

<table>
<thead>
<tr>
<th>Thinking</th>
<th>knowledge, skills, and processes that enable students to explore problems, weigh alternatives, and arrive at solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>problem solving and making effective decisions, and applying them to real-world contexts</td>
</tr>
<tr>
<td>Communication</td>
<td>effectively reading, writing, speaking, listening, viewing, and representing</td>
</tr>
<tr>
<td></td>
<td>using a variety of information sources and digital tools</td>
</tr>
<tr>
<td>Personal and Social</td>
<td>relates to a student’s identity as an individual and as a member of a group or community</td>
</tr>
<tr>
<td></td>
<td>contributing to the care of themselves, others, and the larger community</td>
</tr>
</tbody>
</table>

The Learning Standards are made up of Curricular Competencies and Content. Curricular Competencies are skills, strategies, and processes students develop as they explore science through hands-on activities. Curricular Competencies are addressed further on page 33.

The Content of the Science Curriculum for British Columbia and Hands-On Science is concept-based and relates directly to the Big Ideas. The Content relies on cross-cutting concepts developed throughout the grade levels, including:

- cause and effect
- change
- cycles
- evolution
- form and function
- interactions
- matter and energy
- order
- patterns
- systems
**The Multi-Age Approach**

*Hands-On Science* is designed with a multi-age approach to meet the needs of students in kindergarten to grade two (K–2). Each module explores the Big Ideas, Core Competencies, and Learning Standards for K–2. This approach provides teachers and students with flexible, personalized learning opportunities.

**Inquiry and Science**

Throughout *Hands-On Science*, as students explore science concepts, they are encouraged to ask questions to guide their own learning. The inquiry model is based on five components:

1. formulating questions
2. gathering and organizing information, evidence, or data
3. interpreting and analyzing information, evidence, or data
4. evaluating information, evidence, or data, and drawing conclusions
5. communicating findings

Using this model, teachers facilitate the learning, and students drive the process through inquiry. As such, the approach focuses on students’ self-reflections as they ask questions, discover answers, and communicate their understanding. An inquiry approach begins with structured inquiry, moves to guided inquiry and, finally, results in open inquiry.

Inquiry takes time to foster and requires scaffolding from a structured approach to more open inquiry as students gain skills and experience.

In *Hands-On Science*, the focus of most activities is on guided inquiry, as teachers pose the main question for the lesson, based on the Learning Standards. Students are involved in generating further inquiry questions to personalize learning, but will continue to benefit from guidance and support from the teacher.

Open inquiry activities are only successful if students are motivated by intrinsic interests and if they are equipped with the skills to conduct their own research study. (Banchi and Bell, 2008)

**The Goals of Science Education in British Columbia**

Science plays a fundamental role in the lives of Canadians. The Science Curriculum for British Columbia (<https://curriculum.gov.bc.ca/> states:

Science provides opportunities for us to better understand our natural world. Through science, we ask questions and seek answers to grow our collective scientific knowledge. We continually revise and refine our knowledge as we acquire new evidence. While maintaining our respect for evidence, we are aware that our scientific knowledge is provisional and is influenced by our culture, values, and ethics. Linking traditional and contemporary First Peoples understandings and current scientific knowledge enables us to make meaningful connections to our everyday lives and the world beyond.

The Science curriculum takes a place-based approach to science learning. Students will develop place-based knowledge about the area in which they live, learning about and building on First Peoples knowledge and other traditional knowledge of the area. This provides a basis for an intuitive relationship with and respect for the natural world; connections to their ecosystem
and community; and a sense of relatedness that
courages lifelong harmony with nature.

The Science Curriculum for British Columbia identifies five goals that form the foundation of science education. In keeping with this focus on scientific literacy, these goals are the bases for the lessons in *Hands-On Science*. The Science Curriculum for British Columbia contributes to students’ development as educated citizens through the achievement of the following goals. Students are expected to develop:

1. an understanding and appreciation of the nature of science as an evidence-based way of knowing the natural world that yields descriptions and explanations that are continually being improved within the context of our cultural values and ethics
2. place-based knowledge of the natural world and experience in the local area in which they live by accessing and building on existing understandings, including those of First Peoples
3. a solid foundation of conceptual and procedural knowledge in science that they can use to interpret the natural world and apply to new problems, issues, and events; to further learning; and to their lives
4. the habits of mind associated with science—a sustained curiosity; an appreciation for questions; an openness to new ideas and consideration of alternatives; an appreciation of evidence; an awareness of assumptions and a questioning of given information; a healthy, informed skepticism; a seeking of patterns, connections, and understanding; and a consideration of social, ethical, and environmental implications
5. a lifelong interest in science and the attitudes that will make them scientifically literate citizens who bring a scientific perspective, as appropriate, to social, moral, and ethical decisions and actions in their own lives, culture, and the environment

**Hands-On Science Principles**

- Effective science education involves hands-on inquiry, problem solving, and decision making.
- The development of Big Ideas, Core Competencies, Curricular Competencies, and Content form the foundation of science education.
- Children have a natural curiosity about science and the world around them. This curiosity must be maintained, fostered, and enhanced through active learning.
- Science activities must be meaningful, worthwhile, and related to real-life experiences.
- The teacher’s role is to facilitate activities and encourage critical thinking and reflection. Children learn best by doing, rather than by just listening. Instead of simply telling, the teacher, therefore, should focus on formulating and asking questions, setting the conditions for students to ask their own questions, and helping students to make sense of the events and phenomena they have experienced.
- Science should be taught in conjunction with other school subjects. Themes and topics of study should integrate ideas and skills from several core areas whenever possible.
- Science education should encompass, and draw on, a wide range of educational resources, including literature, nonfiction research material, audio-visual resources, and technology, as well as people and places in the local community.
- Science education should be infused with knowledge and worldviews of Indigenous peoples, as well as other diverse multicultural perspectives.
- Science education should emphasize personalized learning. Personalized learning also focuses on enhancing student engagement and providing them with choices to explore and investigate ideas. Personalized learning also encompasses place-based learning, where learning focuses on the local environment.

- Science education is inclusive in nature. Learning opportunities should meet the diverse needs of all students through differentiated instruction and individualized learning experiences.

- Self-assessment is an integral part of science education. Students should be involved in reflecting on their work and setting new goals based on their reflections which, in turn, enables them to take control of their learning.

- Teacher assessment of student learning in science should be designed to focus on performance and understanding, and should be conducted through meaningful assessment techniques implemented throughout each module.

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**Cultural Connections**

To acknowledge and celebrate the cultural diversity represented in Canadian classrooms, it is important to infuse cultural connections into classroom learning experiences. It is essential for teachers to be aware of the cultural makeup of their class and to celebrate these diverse cultures by making connections to curricular outcomes. In the same way, it is important to explore other cultures represented in the community and beyond, to encourage intercultural understanding and harmony. For example, teachers in British Columbia should make connections to the local cultural communities to highlight their contributions to the province. Throughout *Hands-On Science*, suggestions are made for connecting science topics to cultural explorations and activities.
Indigenous Perspectives and Knowledge

Indigenous peoples are central to the Canadian context, and it is important to infuse Indigenous knowledge into the learning experiences of all students. The intentional integration of Indigenous knowledge in *Hands-On Science* helps to address the Calls to Action of the Truth and Reconciliation Commission of Canada, particularly the call to "integrate Indigenous knowledge and teaching methods into classrooms" (Action 62) and "build student capacity for intercultural understanding, empathy and mutual respect" (Action 63).

Indigenous peoples have depended on the land since time immemorial. The environment shapes the way of life: geography, vegetation, climate, and natural resources of the land determine the methods used to survive. Because they observe the land and its inhabitants, the environment teaches Indigenous peoples to survive. The land continues to shape Indigenous peoples' way of life today because of their ongoing, deep connection with the land. Cultural practices, stories, languages, and knowledge originate from the land.

The traditional territories of the First Peoples cover the entirety of what is now British Columbia. The worldviews of Indigenous peoples and their approaches and contributions to science are now being acknowledged and incorporated into science education. It is also important to recognize the diversity of Indigenous peoples in British Columbia and to focus on both the traditions and contemporary lives of the Indigenous communities in your area. Contact personnel in your school district—Indigenous consultants and/or those responsible for Indigenous education—to find out what resources (e.g., people, books, videos) are available. Many such resources are also featured in *Hands-On Science*.

**NOTE:** When implementing place-based learning, many opportunities abound to consider Indigenous perspectives and knowledge. Outdoor learning provides an excellent opportunity to identify the importance of place. For example, use a map of the local area to have students identify where the location is in relation to the school. This will help students develop a stronger image of their community and surrounding area.

It is also important to identify on whose traditional territory the school is located, the traditional territory of the location for the place-based learning, as well as the traditional names for both locations. The following map, “First Nations in British Columbia,” from Indigenous Services Canada can be used for this purpose: <https://www.aadnc-aandc.gc.ca/DAM/DAM-INTER-BC/STAGING/texte-texte/fnmp_1100100021018_eng.pdf>.

Incorporate land acknowledgment once students have learned on whose territory the school and place-based learning location are located. The following example can be used for guidance:

- We would like to acknowledge that we are gathered today on the traditional, ancestral, and unceded territory of the _______ people.

When incorporating Indigenous perspectives, it is important to value Traditional Ecological Knowledge (TEK):

Traditional Ecological Knowledge, or TEK, is the most popular term to denote the vast local knowledge First Peoples have about the natural world found in their traditional environment. TEK is, above all, local knowledge based in people’s relationship to place. It is also holistic, not subject to the segmentation of contemporary science. Knowledge about a specific plant may include understanding its life cycle, its spiritual connections, its relationship to the seasons and with other plants and animals in its ecosystem, as well as its uses and its stories. (*Science First Peoples Teacher Resource Guide*)

Indigenous peoples developed technologies and survived on this land for millennia because of their knowledge of the land. Indigenous peoples
used observation and experimentation to refine technologies, such as building canoes and longhouses and discovering food-preservation techniques. As such, TEK serves as an invaluable resource for students and teachers of science.

Indigenous peoples do not view their knowledges as “science” but, rather, from a more holistic perspective, as is reflected in this quote from Dr. Jolly, Cherokee, and President of the Science Museum of Minnesota:

> When I weave a basket, I talk about the different dyes and how you make them and how the Oklahoma clay that we put on our baskets doesn’t permeate the cell walls, it deposits on the outside. It makes a very nice dye but if you cut through the reed you’ll see white still on the inside of the reed, whereas if I make a walnut dye and if I use as my mordent, alum and I use as my acid cider, that walnut dye will permeate the cell walls. You cut through the reed and it’s brown through and through. Now what I’ve just described is the difference between osmosis and dialysis. That Western science calls those scientific terms is really wonderful, but it’s not scientific terms if you are a basket weaver. Our culture incorporates so much of what people would call scientific knowledge and ways of thinking so naturally that we haven’t parsed it out and put it in a book and said this is our science knowledge versus our weaver’s knowledge. When I weave a basket I also tell the stories of the spirituality and not just the ways of which I dyed it. A basket weaver is as much a scientist, as an artist, and a spiritual teacher. We’d never think that you’d separate out just the science part, but you can’t weave a basket without knowing the science. (Science First Peoples Teacher Resource Guide)

Throughout *Hands-On Science*, there are many opportunities to incorporate culturally appropriate teaching methodologies from an Indigenous worldview. First Peoples Pedagogy indicates that making connections to the local community is central to learning (Science First Peoples Teacher Resource Guide). As one example, Elders and Knowledge Keepers offer a wealth of knowledge that can be shared with students. Consider inviting a local Elder or Knowledge Keeper as a guest into the classroom in connection with specific topics being studied (as identified within the given lessons throughout the module). An Elder or Knowledge Keeper can guide a nature walk, share stories and experiences, share traditional technologies, and help students understand Indigenous peoples’ perspectives of the natural world. Elders and Knowledge Keepers will provide guidance for learners and opportunities to build bridges between the school and the community.

Here are a few suggestions about working with Elders and Knowledge Keepers:

- Elders and Knowledge Keepers have a deep spirituality that influences every aspect of their lives and teachings. They are recognized because they have earned the respect of their community through wisdom, harmony, and balance in their actions and teachings. (see “Aboriginal Elder Definition” at <https://www.ictinc.ca/blog/aboriginal-elder-definition>).
- Some Indigenous keepers of knowledge are more comfortable being called “Knowledge Keepers” than “Elders.” Be sensitive to their preference. In many communities, there are also “Junior Elders” who may also be invited to share their knowledge with students and school staff.
- Elders and Knowledge Keepers may wish to speak about what seems appropriate to them, instead of being directed to talk about something specific. It is important to respect this choice and not be directive about what an Elder or Knowledge Keeper will talk about during their visit.
- It is important to properly acknowledge any visiting Elders or Knowledge Keepers and
their knowledge, as they have traditionally been and are recognized within Indigenous communities as highly esteemed individuals. There are certain protocols that should be followed when inviting an Elder or Knowledge Keeper to support student learning in the classroom or on the land. The Science First Peoples Teacher Resource Guide offers guidelines and considerations for this.

It is especially important to connect with Indigenous communities, Elders, and Knowledge Keepers in your local area, and to study local issues related to Indigenous peoples in British Columbia. Consider contacting Indigenous education consultants within your local school district or with the British Columbia Ministry of Education to access referrals. The following link provides a province-wide list of Indigenous contacts: <www.bced.gov.bc.ca/apps/imcl/imclWeb/AB.do>. Also, consider contacting local Indigenous organizations for referrals to Elders and Knowledge Keepers. Such organizations may also be able to offer resources and opportunities for field trips and place-based learning.

**NOTE:** It is important for educators to understand the significant contribution that Elders, Knowledge Keepers, and Indigenous communities make when they share their traditional knowledge. In their culture of reciprocity, this understanding should extend past giving a gift or honorarium to an Elder or Knowledge Keeper for sharing sacred knowledge. As such, educators should think deeply about reciprocity and what they can do beyond inviting Indigenous guests to their classrooms. Educators can expand their own learning and become connected to Indigenous people by, for example, engaging in Indigenous community events, working with the Education Department of the local Nations, or exploring ways to continue developing the relationship between the local Nations and educators in the district.

The First Nations Education Steering Committee of British Columbia has articulated the following **First Peoples Principles of Learning:**

- Learning ultimately supports the well-being of the self, the family, the community, the land, the spirits, and the ancestors.
- Learning is holistic, reflexive, reflective, experiential, and relational (focused on connectedness, on reciprocal relationships, and a sense of place).
- Learning involves recognizing the consequences of one’s actions.
- Learning involves generational roles and responsibilities.
- Learning recognizes the role of Indigenous knowledge.
- Learning is embedded in memory, history, and story.
- Learning involves patience and time.
- Learning requires exploration of one’s identity.
- Learning involves recognizing that some knowledge is sacred and only shared with permission and/or in certain situations.

These principles generally reflect First Peoples pedagogy, and have been considered in the development of **Hands-On Science.**

The First People Principles of Learning (FPPL) is a framework for approaching learning, or a worldview on what learning is and how it happens. Teachers are encouraged to find their own meaning in them, explore them with their class, and take them up in a way that is meaningful to them. They are embedded in the new curriculum—the new curriculum was created based on these principles. Teachers can make their own connections to the FPPL through the **Hands-On Science** resource. (Melanie Nelson, February 12, 2018)
It is also important to note that the *Science First Peoples Teacher Resource Guide* recommends a 7E model for guiding experiential learning activities in science. This model suggests that the following elements are essential to the learning experience:

The 7E Model

<table>
<thead>
<tr>
<th>Environment</th>
<th>■ using the local land (place-based learning)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engage</td>
<td>■ inspiring curiosity and activating knowledge</td>
</tr>
<tr>
<td>Explore</td>
<td>■ investigating science concepts through hands-on experiences</td>
</tr>
<tr>
<td>Elders</td>
<td>■ connecting local Knowledge Keepers to learning</td>
</tr>
<tr>
<td>Explain</td>
<td>■ describing observations and sharing new knowledge</td>
</tr>
<tr>
<td>Elaborate</td>
<td>■ extending and enhancing learning</td>
</tr>
<tr>
<td>Evaluation</td>
<td>■ providing opportunities for students to demonstrate understanding and skills</td>
</tr>
</tbody>
</table>

These seven elements are strongly evident in the approach used in *Hands-On Science*, as is explained in the following sections.

For more information on First Peoples Pedagogy and First Peoples Principles of Learning, please see the *Science First Peoples Teacher Resource Guide*.

**NOTE:** Indigenous resources recommended in *Hands-On Science* are considered to be authentic resources, meaning that they reference the Indigenous community they came from, they state the individual who shared the story and gave permission for the story to be used publicly, and the person who originally shared the story is Indigenous. Stories that are works of fiction were written by an Indigenous author. For more information, please see *Authentic First Peoples Resources* at: <www.fnesc.ca/learningfirstpeoples/>.

**References**


“Learning First Peoples Classroom Resources.” First Nations Education Steering Committee. <http://www.fnesc.ca/learningfirstpeoples/> (includes *First Peoples Principles of Learning and Authentic First Peoples Resources*)


How to Use *Hands-On Science* in Your Classroom

*Hands-On Science* is organized in a format that makes it easy for teachers to plan and implement. Four modules address the selected topics of study for kindergarten to grade-two classrooms. The modules relate directly to the Big Ideas, Core Competencies, Curricular Competencies, and Content outlined in the Science Curriculum for British Columbia.

**Multi-Age Teaching and Learning**

Whether working with students in a single-grade classroom from kindergarten to grade two, or working with multi-age classes, teachers will find appropriate learning opportunities in *Hands-On Science*. The lessons meet the diverse needs of all students through the implementation of differentiated instruction and personalized learning.

The Science Curriculum for British Columbia establishes specific Big Ideas, Curricular Competencies, and Content for each grade level. *Hands-On Science* has worked within themes to infuse these Big Ideas, Curricular Competencies, and Content into multi-age modules (see the Curriculum Learning Framework at the beginning of each module). It is therefore important for teachers to work collaboratively with their colleagues across grade levels to determine how best to implement lessons. The Curriculum Learning Frameworks will also be helpful, as each one includes a grade-level focus for specific lessons. This will assist teachers in both single-grade classrooms or multi-age classrooms to identify lessons and topics appropriate to their class.

Differentiated instruction and personalized learning will also ensure the needs of all students are met during science lessons. For example, in any classroom, whether multi-age or single-grade, students will be working at varying levels of literacy. As such, some students may be communicating their learning through drawing, while others may use single words, and yet others write several sentences. The lessons in *Hands-On Science* are developed to foster growth and learning at all literacy levels.

The same situation may be evident in terms of numeracy. For example, some students may be using comparative nonstandard measurement, while other students may be capable of working with standard metric measurement units and devices. There is plenty of flexibility in *Hands-On Science* to ensure that all students’ learning needs can be met through active, student-centred learning.

**Module Overview**

Each module features an overarching question that fosters inquiry related to the Big Ideas. The module also has its own introduction, which summarizes the general concepts and goals for the module. This introduction provides background information for teachers, planning tips, and lists of vocabulary related to the module, as well as other pertinent information (e.g., how to embed Indigenous perspectives).

Also included at the beginning of each module is a Curriculum Learning Framework, which is based on the Big Ideas and Learning Standards (Curricular Competencies and Content) from the Science Curriculum for British Columbia (https://curriculum.gov.bc.ca/).

The Curriculum Learning Framework identifies the Big Ideas, Sample Guided Inquiry Questions, and Content for each grade level. As well, Content is connected to specific lessons, which are listed below each Content concept. Although specific lessons were intentionally written for grade-level content, much of this content is interconnected. As such, the overarching theme of the module provides a variety of connections to all three grade levels and, therefore, offers many springboards to learning.
Lesson Title
- provides a guided inquiry question related to the Learning Standards explored in the lesson

Information for Teachers
- presents basic scientific knowledge needed for activities

Explore
- presents whole-class and small-group activities which provide students with choice and opportunities to pose further inquiry questions while collaborating with peers
- details procedures, including higher-level questioning techniques, and suggestions for encouraging the development of concepts and skills
- identified as Explore Part One, Explore Part Two, and so on (when there is more than one in a lesson)

Expand
- provides opportunities for individual students to expand what they know, do, and understand
- empowers and encourages students to pose their own inquiry questions and conduct investigations, research, and projects individually, with support and facilitation by the teacher as needed; student success will depend on prior modelling, guided practice, and individual skills
- includes suggestions for Makerspace projects and Loose Parts exploration

Initiating Event: What Do We Observe, Think, and Wonder About Plants and Animals?

About Plants and Animals?
Observe, Think, and Wonder

Materials
- lists all materials required to conduct the main activities
- includes items for display purposes or for recording students’ ideas
- suggests visual materials (e.g., large pictures, sample charts, diagrams) to assist in presenting ideas and questions and encourage discussion
- connects to Image Bank visuals, which may be printed or projected for specific activities (see Appendix on page 177 for thumbnails and free access)

Information for Teachers
In this lesson, students will participate in place-based learning to explore plants and animals in a local natural environment. Encourage students to suggest local natural areas, and plan ahead to select a location.

NOTE: It is important to prepare for guest speakers and to ensure that students are appropriately prepared as well. Reserve behavioral expectations and discuss questions that students may wish to ask the guest. Be sure to have students thank the speaker for the visit and consider following up with written or illustrated thank you notes. It is also important to consider protocols for Elders. Please see the Science First People Teacher Resource Guide (see References, page xx) for guidelines and considerations.

Materials
- chart paper
- markers
- digital camera
- magnifying glasses
- tweezers
- sketch gloves
- recycled bags
- string
- portable whiteboard or chart paper with a sturdy backboard

Engage
Discuss the location for the place-based learning experience. Ask:
- Who has been to this place before?
- What do you think we will see there? Smell? Hear? Feel?
- What is it like there?

Explore Part One
Once the class has arrived at the place-based learning location, provide time for students to explore the area freely (under adult supervision). Provide access to materials such as digital cameras, magnifying glasses, tweezers, sketch gloves, garden tools for exploration, and recycled bags in which to collect artifacts. As students explore, pose questions with them to ponder. For example:
- What are you examining?
- Why is it interesting to you?
- What do you wonder about it?
- What do you see? Feel? Hear?

Expand
To prepare students for journaling, do a journal entry together as a class. This will require a portable whiteboard and markers, or chart paper with a sturdy backboard.

Learning Centre
- supports diverse learners, promotes differentiated instruction, and is based on multiple-intelligences research (see page 17)
- includes a task card that remains at the centre, along with any required supplies and materials; review the task card before students work at the centre, to ensure they are familiar with the content and the expectations (students are not expected to read and comprehend all content on the card, but it serves as a guide for teachers and a visual prompt for students)

Engage
- activates prior knowledge, piques students’ curiosity about related concepts, and introduces the lesson’s guided inquiry question
- models for students how to pose their own inquiry questions; teachers may choose to record the guided inquiry question (e.g., on a sentence strip) for display, so students can refer to it during activities and discussions
How to Use Hands-On Science in Your Classroom

Reproducibles
■ may be used to guide activities or record data
■ may also serve as a template for designing and constructing graphic organizers
■ included as thumbnails in the lessons
■ provided as full-sized, printable version on the Portage & Main website (see Appendix for URL and password)

Embed Part One
■ provides students with opportunities to participate in a Talking Circle (see page 16) to demonstrate their learning through consolidation and reflection
■ allows for synthesis and application of inquiry and new ideas
■ reviews main ideas of the lesson, focusing on the Big Idea, Core Competencies, and Learning Standards
■ reviews guided inquiry question so students can share their knowledge, provide examples, and ask further inquiry questions

Embed Part Two
■ embeds learning by adding to graphic organizers; having students record, describe, and illustrate new vocabulary; and adding new vocabulary to the word wall throughout the module or even all year
■ provides opportunity to reflect the cultural diversity of the classroom and the community by including new terminology in languages other than English, including Indigenous languages
■ explores Core Competencies with students to foster student self-assessment of how these skills were used throughout the lesson

Assessment
■ provides suggestions for authentic assessment
■ includes student self-assessment, formative assessment, and summative assessment (see pages 29–34)

Enhance
■ enriches and elaborates on the Big Idea, Core Competencies, and Learning Standards with optional activities
■ includes interactive activities, available through the Portage & Main Press website; check this section of each lesson for directions on accessing interactive activities
■ encourages active participation and learning through Family Connections

How Can I Sort Objects From Nature?
1. Look at each object from our nature walk.
2. Describe how it looks, feels, smells, and sounds. (Do not taste it!)
3. Sort the objects into the bins.
4. Describe your sorting rules to others.

Embed Part One: Talking Circle
Rerun the guided inquiry question: What do we observe, think, and wonder about plants and animals? Have students share their experiences and knowledge, provide examples, and ask further inquiry questions.

Embed Part Two: Talking Circle
Rerun the guided inquiry question: What do we observe, think, and wonder about plants and animals? Have students share their experiences and knowledge, provide examples, and ask further inquiry questions.

NOTE: Use the same prompts from these templates over time to see how thinking changes with different activities.

Enhance
■ Family Connection: Provide students with the following sentence starter:
   A favourite place for us to visit outside is.
   Have students take home the sentence starter to complete. Family members can help the student draw and write about this topic.

Student Self-Assessment
Have students complete the core/essential skill assessment template, on page xx, to reflect on their success working with others, as they share and compare ideas.

Assessment
■ provides suggestions for authentic assessment
■ includes student self-assessment, formative assessment, and summative assessment (see pages 29–34)
The Curricular Competencies Correlation Chart at the beginning of each module provides details on how students' Curricular Competencies are developed through scientific inquiry. The chart outlines the skills, strategies, and processes that students use in the module and identifies the specific lessons in which these Curricular Competencies are the focus. The Curricular Competencies are developed in various ways over time, and therefore are addressed in multiple lessons throughout *Hands-On Science* modules.

Each module includes a list of related resources for students (books, websites, and online videos).

Each module is organized into lessons based on the Learning Standards. The first lesson in each module provides an initiating event, using an Observe-Think-Wonder strategy. Real-life explorations, often within the local environment, provide opportunity for place-based learning, which is discussed in more detail on page 18.

The second lesson in each module explores storytelling as it relates to the inquiry topics. This lesson includes an emphasis on Indigenous stories, children's literature, and nonfiction texts, while providing opportunities for students to engage in activities that focus on literacy and creative storytelling.

The last lesson in each module provides an opportunity for personalized learning through individualized inquiry, as students explore what more they would like to know, do, and understand about the module's Big Ideas.

**Talking Circles**

Talking Circles originated with First Nations leaders as a process to encourage dialogue, respect, and the co-construction of ideas. The following process is generally used in a Talking Circle:

- the group forms a complete circle
- one person holds an object such as a stick, feather, shell, or stone
- only the person holding the stick talks, while the rest listen
- the stick is passed around in a clockwise direction
- each person talks until they are finished, being respectful of time
- the Talking Circle is complete when everyone has had a chance to speak
- a person may pass the stick without speaking, if they choose

See <www.firstnationspedagogy.ca/circtalks.html> for more information. Also consider inviting a local Elder or Knowledge Keeper to share with the class the process of a Talking Circle.
Multiple Intelligences Learning Centres

Learning centres in *Hands-On Science* focus on a different multiple intelligence to provide opportunities for students to use areas of strength and also to expose them to new ways of learning.

Teachers are encouraged to explore the topic of multiple intelligences with their students and to have students self-reflect to identify ways they learn best, and ways that are challenging for them. Guidelines for this process are included in *Teaching to Diversity* by Jennifer Katz (see References, page 21).

<table>
<thead>
<tr>
<th>Multiple Intelligence</th>
<th>These learners...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal-Linguistic</td>
<td>...think in words and enjoy reading, writing, word puzzles, and oral storytelling.</td>
</tr>
<tr>
<td>Logical-Mathematical</td>
<td>...think by reasoning and enjoy problem solving, puzzles, and working with data.</td>
</tr>
<tr>
<td>Visual-Spatial</td>
<td>...think in visual pictures and enjoy drawing and creating visual designs.</td>
</tr>
<tr>
<td>Bodily-Kinesthetic</td>
<td>...think by using their physical bodies and enjoy movement, sports, dance, and hands-on activities.</td>
</tr>
<tr>
<td>Musical-Rhythmic</td>
<td>...think in melodies and rhythms and enjoy singing, listening to music, and creating music.</td>
</tr>
<tr>
<td>Interpersonal</td>
<td>...think by talking to others about their ideas and enjoy group work, planning social events, and taking a leadership role with friends or classmates.</td>
</tr>
<tr>
<td>Intrapersonal</td>
<td>...think within themselves and enjoy quietly thinking, reflecting, and working individually.</td>
</tr>
<tr>
<td>Naturalistic</td>
<td>...learn by classifying objects and events and enjoy anything to do with nature and scientific exploration of natural phenomena.</td>
</tr>
<tr>
<td>Existential</td>
<td>...learn by probing deep philosophical questions and enjoy examining the bigger picture as to why ideas are important.</td>
</tr>
</tbody>
</table>
### Icons

To provide a clear indication of important features of *Hands-On Science*, the following icons are used throughout lessons:

| Place-Based Learning | Place-based learning focuses on the local environment and community. It is important for students to explore the local area in order to build personalized and contextual knowledge.  
  
  Place-based learning:  
  - emphasizes exploring the natural environment, replacing classroom walls with the natural land  
  - offers firsthand opportunities to observe, explore, and investigate the land, waters, organisms, and atmosphere of the local region  
  - promotes a healthy interplay between society and nature  
  - helps students envision a world where there is meaningful appreciation and respect for our natural environment—an environment that sustains all life  
  
  Many lessons in *Hands-On Science* incorporate place-based learning activities, whether it be a casual walk around the neighbourhood to examine trees or a more involved exploration of local waterways. |
|---|---|
| Applied Design, Skills, and Technologies | Throughout *Hands-On Science*, students have opportunities to use applied design, skills, and technologies to plan and construct objects. For example, in *Living Things for Grades K–2*, students design and construct models of an animal’s environment to show how the animal meets its basic needs.  
  
  Using applied design skills and technology, students seek solutions to practical problems through research and experimentation. There are specific steps:  
  1. Identify a need. Recognize practical problems and the need to solve them.  
  2. Create a plan. Seek alternate solutions to a given problem, create a plan based on a chosen solution, and record the plan through writing and labelled diagrams.  
  3. Develop a product or prototype. Construct an object that solves the given problem, and use predetermined criteria to test the product.  
  4. Communicate the results. Identify and make improvements to the product, and explain the changes. |
| Ecology and the Environment | *Hands-On Science* provides numerous opportunities for students to investigate issues related to ecology, the environment, and sustainable development. The meaning of sustainability can be clarified by asking students: “Is there enough for everyone, forever?” These topics also connect to Indigenous worldviews about respecting and caring for the Earth. |
| Technology | Digital learning, or information and communication technology (ICT), is an important component of any classroom. As such, technological supports available in schools—digital cameras, computers/tablets, interactive whiteboards (IWB), projectors, document cameras, audio-recording devices, calculators—can be used with and by students to enhance their learning experiences. |
| Classroom Safety | When there are safety concerns, teachers may decide to demonstrate an activity, while still encouraging as much student interaction as possible. The nature of science and scientific experimentation means that safety concerns do arise from time to time. |
Makerspace Centres
To foster open inquiry and promote personalized learning, each module of *Hands-On Science* suggests a Makerspace centre as part of the Expand section. A Makerspace is a creative do-it-yourself environment, where participants pose questions, share ideas, and explore hands-on projects. In the school setting, a Makerspace is usually cross-curricular and should allow for inquiry, discovery, and innovation. Sometimes, the Makerspace is housed in a common area, such as the library, which means it is a space used by the whole school community. A classroom Makerspace is usually designed as a centre where students create do-it-yourself projects, emphasizing personalized learning, while collaborating with others on cross-curricular ideas. It is important to remember learning is not directed here. Rather, simply create conditions for learning to happen.

There is no list of required equipment that defines a Makerspace; however, the centre may evolve to foster inquiry within a specific topic. Students are given the opportunity to work with a variety of age-appropriate tools, as well as with everyday, arts-and-crafts, and recycled materials. Materials to consider at Makerspace centres include:

- general supplies (e.g., graph or grid paper for planning and designing, pencils, markers, paper, cardstock, cardboard, scissors, masking tape, duct tape, glue, rulers, metre sticks, tape measures, elastic bands, string, Plasticine, modelling clay, fabric/cloth, straws, pipe cleaners, aluminum foil)
- recycled materials (e.g., various sizes of boxes, cardboard rolls, milk cartons, plastic bottles, spools, plastic lids)
- art supplies (e.g., paper, paint, markers, chalk, pastels, crayons, pencil crayons, beads, sequins, foam shapes, yarn, glass beads)
- building materials (e.g., sticks, wooden blocks, wooden dowels, toothpicks, craft sticks, balsa wood)
- age-appropriate tools (e.g., hammers, nails, screwdrivers, screws)
- natural objects (e.g., rocks, shells, feathers, seeds, wood slices, sticks)
- commercial products (e.g., LEGO, LEGO Story Starter, WeDo, MakeDo, Meccano, Plus-Plus, K’Nex, KEVA Planks, Dominoes, Wedgits)
- technology (e.g., Green Screen, iPads, coding/programming [Beebots, Code-a Pillar], apps such as Hopscotch, Tynker, Scratch Jr., Tickle)
- topic-based literature to inspire projects
- reference materials (e.g., books, videos, websites, visual images)

Work with students to develop a collaborative culture in which they tinker, invent, and improve on their creations. Ask students for ideas on how to stock the Makerspace, based on their project ideas, and then work collaboratively to acquire these supplies. The internet may also provide ideas for projects and materials.

Set up a recycling box/bin in the Makerspace centre for paper, cardboard, clean plastics, and other materials students can use for their creations. Stress to students that Makerspaces can help reuse many items destined for a landfill. Discuss which items can/should be placed in this bin.

Some things to consider when planning and developing a Makerspace centre are:

- Always address safety concerns, ensuring materials, equipment, and tools are safe for student use. Include safety gloves and goggles, as appropriate. Engage students in a discussion about safety and respect at the Makerspace before beginning each module. Consider sharp objects, small parts,
and other potential hazards for students of all ages and abilities who will have access to the Makerspace centre. At this age, this exploration needs to be supervised.

- Consider space and storage needs. Mobile carts and/or bins are handy for storing raw materials and tools.
- Work with students to write a letter to parents/guardians, explaining the purpose of the Makerspace, and asking for donations of materials.

In *Hands-On Science*, each module includes a variety of suggestions for Makerspace materials, equipment, possible challenges, and literature links related to the Big Ideas being explored.

The Makerspace process is intended for solving design problems, so it is helpful to have visuals at the Makerspace centre to encourage innovation, creativity, and the use of Applied Design, Skills, and Technologies (see page 18). In addition, although individual inquiry is encouraged, the Makerspace process is often collaborative in nature. Therefore, it is important to focus on skills related to working with others (see the Cooperative Skills Assessment templates on pages 49 and 51).

Before students begin working at a Makerspace centre, review Applied Design, Skills, and Technologies and collaborative skills with students. As a class, co-construct criteria for each skill, record on chart paper, and display at the Makerspace centre. Or, challenge students to create posters for the Makerspace centre that convey what Applied Design, Skills, and Technologies and collaboration look like. Refer to these visual prompts before, during, and after students work at the centre, as a means of guiding and assessing the process.

As students create, photograph their creations to share with the class, and discuss the unique properties of their designs. Model appropriate digital citizenship with students by asking their permission to photograph and share their creations. Facilitate regular debriefing sessions as a class, after students have spent time at the Makerspace centre. Consider focusing this discussion on the Core Competencies (Thinking, Communication, and Personal and Social Skills) as an anchor for reflective practice.

The nature of a Makerspace is such that it provides an excellent venue for personalized learning. As students pose their own inquiry questions, they may choose to use the Makerspace to explore that question further.

**Loose Parts**

Closely related to the open inquiry fostered by the Makerspace, the theory of Loose Parts was first proposed back in the 1970s by architect Simon Nicholson. He believed it is the Loose Parts in our environment that empower our creativity. The theory has begun to influence early years educators intent on offering students opportunities to play freely with objects and materials, and to pose their own questions and investigations. Loose Parts include anything natural or synthetic (e.g., beads, buttons, fabric, washers and nuts, cardboard rolls, pom poms, acorns, leaves) that students can move, control, and manipulate. Loose Parts promote open-ended thinking that leads to problem solving, curiosity, and creativity. Play and learning possibilities are endless, as there is no single outcome that is achieved. Instead, Loose Parts offer opportunities for students to consider a wide range of possibilities and ideas.

When appropriate, provide provocations (questions to inspire play) that offer an entry point for a Loose Parts activity. As an example, while studying living things, teachers may provide bins of stones, twigs, bark, shells, and seed pods with the provocation, “How many different ways can you sort the objects?”
Students may begin with such a sorting task, but expand to build structures, compare and measure, or examine patterns on the various objects.

Throughout *Hands-On Science*, Loose Parts are used to engage students and as an opportunity to expand investigations, generate their own inquiry questions, and personalize learning. Suggestions for Loose Parts exploration are included in the Expand section of lessons. For more information about Loose Parts, see *Loose Parts: Inspiring Play in Young Children* by Lisa Daly and Miriam Beloglovsky and *Loose Parts: A Start-Up Guide* by Sally Haughey and Nicole Hill.

**References**


The Hands-On Science Assessment Plan

Hands-On Science provides a variety of assessment tools that enable teachers to build a comprehensive and authentic daily assessment plan for students. Based on current research about the value of quality classroom assessment (Davies, 2011), suggestions are provided for authentic assessment, which includes student self-assessment and reporting of Core Competencies.

British Columbia’s K–12 Assessment System (see <https://curriculum.gov.bc.ca/assessment-system> and <https://curriculum.gov.bc.ca/classroom-assessment-and-reporting>) states:

Assessment and curriculum are interconnected. Curriculum sets the learning standards that give focus to classroom instruction and assessment. Assessment involves the wide variety of methods or tools that educators use to identify student learning needs, measure competency acquisition, and evaluate students’ progress toward meeting provincial learning standards.

[British Columbia’s] assessment system is being redesigned to align with the new curriculum. Assessment of all forms will support a more flexible, personalized approach to learning and measure deeper, complex thinking. [British Columbia’s] educational assessment system strives to support student learning by providing timely, meaningful information on student learning through multiple forms of assessment. The assessment system has three programs:

1. Classroom Assessment and Reporting
2. Provincial Assessment
3. National and International Assessment

Classroom assessment is an integral part of the instructional process and can serve as a meaningful source of information about student learning. Feedback from ongoing assessment in the classroom can be immediate and personal for a learner and guide the learner to understand their [strengths and challenges] and use the information to set new learning goals.

The primary purpose of assessment is to improve student learning. Hands-On Science provides assessment suggestions, rubrics, and templates for use during the teaching/learning process. These assessment suggestions include tasks related to student self-assessment of the Core Competencies, as well as formative assessment and summative assessment by the teacher.

Student self-assessment helps students develop their capacity to set their own goals, monitor their own progress, determine their next steps in learning, and reflect on their learning in relation to the three Core Competencies—Thinking, Communication, and Social and Personal.

Formative assessment requires that teachers provide students with descriptive feedback and coaching for improvement in relation to the Learning Standards (Curricular Competencies and Content).

Summative Assessment is comprehensive in nature, and is intended to identify student progress in relation to the Learning Standards (Curricular Competencies and Content).

Both summative and formative assessments are an integral part of a balanced classroom assessment plan. Then, when student self-assessment is infused in this assessment plan, a clearer picture emerges of where a student is in relation to the Core Competencies and Learning Standards.

Student Self-Assessment

It is important for students to reflect on their own learning. For this purpose, a variety of assessment templates are provided in Hands-On Science. Depending on their literacy levels, students may complete self-assessments in various ways. For example, the templates may be used as guides for oral conferences between teacher and student, or an adult may act as a
Student Reflections

What I Did

What I Learned

Next Steps in My Learning

My Strengths and Challenges
## Core Competency Self-Reflection Frame

### Communication

<table>
<thead>
<tr>
<th>I Can...</th>
<th>Examples</th>
<th>Next Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can answer questions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can listen to others when they speak.</td>
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<tr>
<td>I can share my learning.</td>
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<tr>
<td>I can work in a group.</td>
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</table>

Date: __________________________  Name: ______________________________________
Family and Community Connections: 
Assessing Together

Family/Community Member’s Name: ____________________________

Draw a picture that shows what you have been learning in science. Work together to label your picture and describe your learning in words.

_____________________________________________________________

_____________________________________________________________

_____________________________________________________________

What do you like best about what you have been learning in science?

_____________________________________________________________

_____________________________________________________________

_____________________________________________________________

What does your family/community member like best about what you have been learning in science?

_____________________________________________________________

_____________________________________________________________

_____________________________________________________________

_____________________________________________________________
What Are the Properties of Energy?
About This Module

This module of Hands-On Science focuses on the properties of energy. Students will conduct investigations that explore the following Big Ideas:

- The motion of objects depends on their properties.
- Light and sound can be produced and their properties can be changed.
- Forces influence the motion of an object.

While investigating these Big Ideas, the Curricular Competencies will be addressed, as students use the following skills, strategies, and processes:

- **QP** questioning and predicting
- **PC** planning and conducting investigations
- **PA** processing and analyzing data and information
- **AI** applying and innovating
- **C** communicating
- **E** evaluating

Energy is the ability to make things move. Forms of energy include gravitational, chemical, nuclear, mechanical, muscular, heat, light, electrical, sound, and radiation.

Energy can come in many different forms, but there are two main forms: kinetic energy and potential energy. These two forms of energy are found in all objects. If an object is in motion (i.e., moving), it has kinetic energy. Energy stored within a motionless object is known as potential energy.

The Sun is the source of all energy for our planet. It gives off several different forms of energy, including light, heat, and radiation. All living things rely on the Sun’s energy for survival.

Until about 300 years ago, humans had few sources of energy. We relied on muscular energy from human and animal labour; heat and light energy from fire (e.g., wood, candles, torches); and mechanical energy from wind (e.g., ships, windmills) and water (e.g., water mills).

During the Industrial Revolution, technologies were developed to access the energy from fossil fuels: coal, oil, and natural gas. When demands for energy exceeded known energy supplies, alternative sources were developed. Today, the two main sources of energy are hydroelectric power and nuclear power.

In this module, students will explore kinetic energy as it relates to objects in motion, as well as forces that affect motion (e.g., static electricity, magnetism). Students will also be introduced to light and sound as forms of energy.

Incorporate Indigenous perspectives and worldviews into lessons whenever possible, including the following:

- Energy flows through every object in the universe, and that energy needs to be kept in balance and harmony. We, as humans, are part of that balance and harmony. We should not over-consume resources, and we need to be respectful whenever we harvest resources. We also need to monitor our own harmony and balance in the physical, mental, emotional, and spiritual realms.
## Curriculum Learning Framework

<table>
<thead>
<tr>
<th></th>
<th>K</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Big Idea</strong></td>
<td>The motion of objects depends on their properties.</td>
<td>Light and sound can be produced, and their properties can be changed.</td>
<td>Forces influence the motion of an object.</td>
</tr>
</tbody>
</table>
| **Sample Guiding Inquiry Questions** | ■ How can you make objects move?  
■ How does the shape or size of an object affect the object's movement?  
■ How does the material the object is made of affect the object's movement? | ■ How can you explore the properties of light and sound?  
■ What discoveries did you make? | ■ What are different ways objects can be moved?  
■ How do different materials influence the motion of an object? |
| **Content**          | ■ effects of pushes/pulls on movement  
[lesson 1, 2, 3, 4, 6, 7, 8, 19]  
■ how things move (e.g., bounce, roll, slide)  
[lesson 1, 2, 3, 4, 5, 6, 7, 8, 19]  
■ effects of size, shape, and materials on movement  
[lesson 1, 2, 3, 4, 5, 6, 7, 8, 19] | ■ natural light sources include the Sun; artificial sources include light bulbs  
[lesson 2, 9, 10, 19]  
■ natural sound sources include crickets; artificial sources include car horns  
[lesson 2, 13, 14, 15, 16, 19]  
■ properties of light (e.g., brightness, colour)  
[lesson 2, 9, 10, 11, 12, 19]  
■ properties of sound  
[lesson 2, 13, 14, 15, 16, 19]  
■ objects are made visible by radiating their own light or being illuminated by reflected light  
[lesson 2, 9, 11, 19]  
■ interactions of light with different objects create images and shadows  
[lesson 2, 9, 11, 12, 19]  
■ light interactions can make plants grow, make shadows, or cause sunburn, depending on the source and location (seasons depend on light from the Sun and how spread out the Sun's rays are)  
[lesson 2, 9, 10, 12, 19]  
■ plants grow toward light  
[lesson 2, 9, 10, 19] | ■ types of forces  
[lesson 1, 2, 3, 4, 5, 6, 7, 8, 17, 18, 19]  
■ contact forces and at-a-distance forces  
■ different types of magnets  
■ static electricity  
[lesson 17, 18, 19]  
■ balanced and unbalanced forces  
■ the way different objects fall depending on their shape (air resistance)  
■ the way objects move over/in different materials (water, air, ice, snow)  
■ the motion caused by different strengths of forces  
[lesson 1, 2, 3, 4, 5, 6, 7, 8, 17, 18, 19] |
| **Core Competencies** | Thinking  
Communicating  
Social and Personal | | |
## Curricular Competencies Correlation Chart

Throughout this module, students will develop Curricular Competencies by participating in rich learning experiences that focus on specific skills, strategies, and processes. The chart below suggests ways in which students explore Curricular Competencies in specific lessons.

<table>
<thead>
<tr>
<th>Curricular Competencies</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Questioning and Predicting</strong></td>
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<tr>
<td>Demonstrate curiosity and a sense of wonder about energy.</td>
<td>✓</td>
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<tr>
<td>Observe objects and events in familiar contexts.</td>
<td>✓</td>
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</tr>
<tr>
<td>Ask simple questions about energy.</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Make simple predictions about energy.</td>
<td>✓</td>
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<tr>
<td><strong>Planning and Conducting Investigations</strong></td>
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<td>Make exploratory observations using their senses.</td>
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<td>Record observations.</td>
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<td>Safely manipulate materials.</td>
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<td>Make simple measurements using nonstandard units.</td>
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<td><strong>Processing and Analyzing Data and Information</strong></td>
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<tr>
<td>Experience and interpret the local environment.</td>
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<td>Recognize First Peoples stories (including oral and written narratives), songs, and art, as ways to share knowledge.</td>
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<td>Discuss observations about energy.</td>
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<tr>
<td>Represent observations and ideas by drawing charts and simple pictographs.</td>
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<td>Sort and classify data and information using drawings, pictographs, and provided tables.</td>
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</table>
### Curricular Competencies

<table>
<thead>
<tr>
<th>Competency Description</th>
<th>Grades 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19</th>
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</thead>
<tbody>
<tr>
<td>Compare observations with predictions through discussion.</td>
<td>√  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √</td>
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<tr>
<td>Identify simple patterns and connections related to energy.</td>
<td>√  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √</td>
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#### Applying and Innovating

- **Take part in caring for self, family, classroom, and school through personal approaches.**
  - Grades: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
  - √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √

- **Transfer and apply learning to new situations.**
  - Grades: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
  - √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √

- **Generate and introduce new or refined ideas when problem solving.**
  - Grades: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
  - √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √

#### Communicating

- **Share observations and ideas orally, or through written language, drawing, or role-play.**
  - Grades: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
  - √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √

- **Express and reflect on personal experiences of place.**
  - Grades: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
  - √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √

#### Evaluating

- **Compare observations of energy with those of others.**
  - Grades: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
  - √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √  √

- **Consider some environmental consequences of their actions as related to energy.**
  - Grades: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
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How Do Living and Nonliving Things Move?

Materials

- Template: “The Elephant,” by Hap Palmer (copy onto chart paper) (3.4.1)
- Template: Elephant Fact Cards (3.4.2)
- Where Are You? by Sarah Williamson
- access to school gym or another large space
- computer/tablet with internet access
- markers
- chart paper
- Hula-Hoops (one for each student)
- beanbags (one for each student)
- stopwatch
- pencil crayons
- markers
- access to outdoor playground equipment (e.g., swings, teeter-totters, slides, turn-around structures)*
- pencils with erasers
- straight pins
- scissors
- Learning-Centre Task Card: How Does Air Make Objects Move? (3.4.3)
- Template: Pinwheel (3.4.4)
- pyramid chart (from lesson 3)

*NOTE: Although not all playground equipment is necessary, different types of equipment will help to illustrate the concepts in this lesson.

Engage

Display and read to students the words from the Template: “The Elephant,” by Hap Palmer (3.4.1):

The Elephant
by Hap Palmer

The elephant moves very slowly
Oh, so very slowly
He doesn’t like to move too fast
Because he is so big and heavy

But should he see a tiger
Or spy a mean old hunter
He will start to run and shake the ground
And make them all fall down

Rumble, rumble, rumble
Hear the jungle rumble
Rumble, rumble, rumble
Hear the jungle rumble

Trees shake and sway
As the birdies fly away
Lions run and hide
With their babies by their side

Rumble, rumble, rumble
Hear the jungle rumble
Rumble, rumble, rumble
Hear the jungle rumble (repeat)

The elephant moves very slowly
Oh, so very slowly
He doesn’t like to move too fast
Because he is so big and heavy


Next, show students the related video, “The Elephant – by Hap Palmer,” at: <https://www.youtube.com/watch?v=xSsDbeWFJ8>. In the video, the song is accompanied by footage of elephants, as well as children role-playing jungle themes.

Play the song (from the video) again. This time have students pretend they are elephants. Hap Palmer suggests the following actions to accompany the song:

1. Bend forward from the waist, and let your arms hang down.
2. Clasp your hands together to form the elephant’s trunk.
3. Swing your trunk from side to side as you travel with slow, heavy steps.
4. When the song mentions the elephant moving faster, run with quick, heavy steps.

Hap Palmer provides the following facts about elephants on his website (see <www.happalmer.com>) that may help to add some variety to students' movements for this activity. Cut out and display the fact cards from the Template: Elephant Fact Cards (3.4.2):

Date: __________________  Name: __________________

Elephant Fact Cards

An elephant walks and runs with a shuffling step, barely lifting its feet from the ground. With its padded feet, an elephant moves with surprisingly little noise.

An elephant's huge ears pick up sounds of other animals from as far as 3 km away. When an elephant is curious about a sound, its ears stand straight out.

An angry or frightened elephant can run more than 40 km/h.

A sudden, strange noise can cause a herd of elephants to panic. The animals may charge at the source of the noise or stampede away from it.

Elephants are excellent swimmers. An elephant gives itself a shower by shooting a stream of water through its trunk.

An elephant sniffs the air and the ground almost constantly with its trunk. It frequently waves its trunk high in the air to catch the scent of food or enemies.

An elephant can run more than 40 km/h.

When frightened or angry, elephants sometimes use their trunks to make a loud, shrill cry called trumpeting.

An angry or frightened elephant can run more than 40 km/h.

Explore Part One

Explore position and motion as related to the elephant song. Ask students:

■ When you were pretending you were elephants, what were some of the different movements you made? (walked with slow, heavy steps; sometimes ran with quick, heavy steps; bent forward, let arms hang down; clasped hands together to form trunk; swung trunk from side to side)

■ How do trees in the song move? (shake and sway)

■ How do the birds move?

Have students identify the names of local animals, and describe how they move. Encourage them to role-play how these animals move in their natural environments.

Focus on position, and encourage students to use positional words to answer the following questions. Ask:

■ Where are the birds in the story?

■ Where do you think the tiger is?

■ Where do you think the hunter is?

As students use positional words to describe relative location, record these on chart paper.

Now, read the book, Where are You?, by Sarah Williamson. Have students use the words on the chart paper to describe location of the worm. Record additional positional language words identified while reading the book.

Explore Part Two

Have the class conduct this activity in the school gym or other large space. Give a Hula-Hoop to each student. Explain to students that they are now going to put objects into motion. Ask:

■ What does the term motion mean?
Have students share their ideas, and record these on chart paper.

Now, explain to students they will use force to put the Hula-Hoops in motion. Ask students:

- What is a force?

Have students share their ideas, and record these on chart paper. Discuss that a force is a push or a pull. Tell students they will be applying a force when they move the Hula-Hoops. Ask:

- How many different ways you can put your Hula-Hoop into motion? Show me.
- Can you make your hoop go in some of the directions about which we have been talking?

Students will be able to roll their Hula-Hoops forward, backward, to the left and to the right, and rotate them around their waist and their arms. They will also be able to raise the Hula-Hoops up over their head. If they then drop the Hula-Hoops (from above their head), the hoops will fall down to the floor. As students do each activity, discuss motion and position for both the Hula-Hoop and the student.

Now, have students place their Hula-Hoops side by side (with a bit of space in between each hoop) along a line on the gym floor (if needed, use masking tape to create a line). Have students stand a short distance away from their hoops, and then challenge them to throw a beanbag into their Hula-Hoops. Talk about how their position (where they are standing), in relation to the position of the hoop, affects their ability to hit the target. Ask:

- From what distance is the target easy to hit?
- What happens if you move farther back?
- What happens when you stand with your back to the Hula-Hoop and try to hit the target?

Have students share their ideas and experiences.

Extend the discussion to focus on movement of living and nonliving things. Ask:

- Are beanbags living or nonliving?
- How did the beanbags move during this activity? What made them move?
- Are Hula-Hoops living or nonliving?
- How did the Hula-Hoops move during this activity? What made them move?
- Are you living or nonliving?
- How did you move during the activity? What made you move?

Have students share their ideas and experiences.

**Explore Part Three**

Take students to either the school playground or another local playground with some playground equipment with moving parts, and gather around the playground equipment. Bring a stopwatch.

Have students look at the playground equipment (e.g., swings, teeter-totter, slide, turn-around structures). In pairs, have them discuss what they feel, think, and wonder about the playground. This is an opportunity to express and reflect on personal experiences of place. Ask:

- What is the position of the object compared to where you are standing?
- Is everyone’s description similar or different? Why?
- Is any playground object moving right now?
- What can we do to set it in motion?

Now, encourage students to try to set the objects in motion. Have them take a closer look at the swing. Ask:

- What part of the swing always remains still?
- What parts of the swing move?
Have a few students sit still on the swings, and ask other students to make the swings move. Then, have the students in the swings use a pumping action with their legs to keep the swings going. Ask:

- What happens when you stop pumping your legs?
- How long do you think the swing will move on its own?

Have students use a stopwatch to measure the time it takes for the swing to change from full motion to no motion. Students can then compare the time to their estimates.

Investigate each piece of playground equipment, examining the moving parts and discussing how each part moves. Explore spinning or moving structures. Ask:

- How does it move?
- To get it to spin, what do you have to do?
- If you want to stop it, what do you need to do?

At the slide, ask:

- Does the slide move?
- How do you move when you are on the slide?
- What would happen if the slide were flat? Would you still move?

While students are on the playground equipment, have them explore their own position in relation to the equipment (e.g., swing, slide, spinning structures). Ask:

- Are you on the slide/swing/spinning structure, behind it, over it, under it?

When students are in motion, ask:

- Which words can you use to describe how you are moving? (e.g., around, spinning, up and down, back and forth)
- What do you see from the top of the slide?

- How is this different from what you see when you are at the bottom of the slide?

**Explore Part Four**

Back in the classroom, discuss and record different kinds of motion observed in the playground. Ask:

- Which objects moved?
- In which ways did you move when you were on the playground equipment?

Discuss other objects that move. On chart paper, make a two-column chart, and title the columns “Moving Object” and “How It Moves.” Have students brainstorm a list of moving objects. Record their ideas on the chart. Include objects in the classroom, school, home, and community.

Now, discuss the various ways that each object moves (e.g., swings, spins, turns), and record these on the chart.

Challenge students to collect some of these objects (e.g., manual eggbeaters, tape recorders, CD players, turntables, drills, toy cars) for further study. Encourage them to record their ideas and experiences through drawing and words. Have students use the SCIENCE JOURNAL template on page 37.

**Expand**

Provide students with an opportunity to further explore how living and nonliving things move by posing their own questions for individualized inquiry. They may wish to:

- Initiate a project at the Makerspace centre, such as designing and constructing a model of a living thing that moves, and researching its features that enable movement (e.g., eagle, fox, salmon).
■ Explore Loose Parts related to movement with provide collections of toy cars, spinning tops, gears, and pulleys. Consider including provocations such as:
   ■ How do these objects move?
   ■ Can you make two objects move together?
   ■ Create their own graphic organizer to sort and display living and nonliving things in terms of how they move (e.g., fly, swim, crawl, walk, float, spin, twirl). Stickers or images from magazines can be pasted onto the graphic organizer.
   ■ Explore items collected in Explore Part Four. Do a compare/contrast between different objects that move.
   ■ Write a picture book about how animals move.
   ■ Research the movement of nonliving things (e.g., bicycles, motorcycles, or wind turbines) (see Inquiry Through Research, page 26).
   ■ Explore how natural (e.g., limbs) and constructed levers (e.g., seesaw, pliers, scissors) move similarly or differently.
   ■ Conduct an investigation or experiment based on their own inquiry questions.

As students explore and select ideas to expand learning, provide support and guidance as needed, and offer access to materials and resources that will enable students to conduct their chosen investigations.

Learning Centre

At the learning centre, provide pencil crayons, pencils with erasers, straight pins, scissors, a copy of the Learning-Centre Task Card: How Does Air Make Objects Move? (3.4.3), and several copies of the Template: Pinwheel (3.4.4):

---

How Does Air Make Objects Move?

1. Cut out the pinwheel along the dotted lines.
2. Poke a pencil tip through the five dots—four at the corners of the pinwheel and one in the centre—to make five holes.
3. Fold the corners into the centre.
4. Push a pin through the centre hole (it should also go through the four folded corner holes) and into the pencil eraser.
5. Check to make sure the pinwheel spins freely.
6. Describe the movement you see.
Have students make pinwheels to demonstrate movement caused by wind energy. Students can decorate their templates, cut out the pinwheel along the dotted lines, and then use a pencil tip to prick through the five dots at the four corners of the template and in the centre, making five holes. Next, have students fold the corners into the centre, and push a pin through the centre hole (and, subsequently, all other holes) into the pencil eraser. Tell students to make sure the pinwheel is able to spin freely.

When students have made their pinwheels, take the class outdoors on a breezy day to investigate wind energy. Ask students to describe the movement of the pinwheel blades in terms of direction and speed. Introduce the terms clockwise and counterclockwise, as well as to the right and to the left. Have students experiment with making the blades move in both directions.

**Embed Part One: Talking Circle**

Revisit the guided inquiry question: How do living and nonliving things move? Have students share their experiences and knowledge, provide examples, and ask further inquiry questions.

**Embed Part Two**

- Add to the pyramid chart as students learn new concepts, answer some of their own inquiry questions, and ask new inquiry questions.
- Add new terms and illustrations to the word wall. Include the words in languages other than English, such as Indigenous languages, as appropriate.
- Focus on students’ use of the Core Competencies. Have students reflect on how they used one of the Core Competencies (Thinking, Communicating, or Personal and Social Skills) during the various lesson activities. Project one of the Core Competency Discussion Prompts templates (pages 38-42), and use it to inspire group reflection. Referring to the template, choose one or two “I Can” statements on which to focus. Students then use the “I Can” statements to provide evidence of how they demonstrated that competency. Ask questions directly related to that competency to inspire discussion. For example:
  - What are you proud of in your learning today? (Personal Awareness and Responsibility)

Have students reflect orally, encouraging participation, questions, and the sharing of evidence. (See page 29 for more information on these templates.)

As part of this process, students can also set goals. For example, ask:
- What would you do differently next time and why?
- How will you know if you are successful in meeting your goal?

To encourage self-reflection, provide prompts that students can use to cite examples of how they have used the Core Competencies.
in their learning. For this purpose, the CORE COMPETENCY SELF-REFLECTION FRAMES (pages 43-47) can be used throughout the learning process. There are five frames provided to address the Core Competencies: Communication, Creative Thinking, Critical Thinking, Positive Personal and Cultural Identity, and Personal Awareness and Responsibility. Teachers can conference individually with students to support self-reflection, or students may complete prompts using words and pictures.

Again, have students set goals by considering what they might do differently on future tasks and how they will know if they are successful in meeting their goal.

**NOTE:** Use the same prompts from these sheets over time to see how thinking changes with different activities.

**Enhance**

- **Family Connection:** Provide students with the following sentence starters:
  - Some living things that move in our home are __________.
  - Some nonliving things that move in our home are __________.

Have students complete the sentence starters at home. Family members can help students draw and write about this topic. Have students share their sentences with the rest of the class.

- **Connect the learning-centre activity to a discussion about wind farms in your local area.** Visit a wind farm, or view a video about wind turbines. Have students describe the movement of the turbine blades.

- **Have students bring in toys that move in different ways (e.g., rolling, spinning, bouncing, vibrating) to explore.**
Appendix: Image Banks

Images appearing in the appendix are thumbnails from the Image Banks referenced in the lessons. Corresponding full-page, high-resolution images can be printed or projected for the related lessons, and are found on the Portage & Main Press website at: <www.portageandmainpress.com/product/HOSENERGYK2>. This link and password can also be used to access the reproducible templates for this module.

Please follow these steps to retrieve the images and reproducible templates for this book.

2. Type the password _____ into the password field.
3. Select Add to Cart.
4. Select View Cart.
5. Select Proceed to Checkout. No coupon code is required.
6. Enter your billing information or log in to your existing account using the prompt at the top of the page.
7. Select Place Order.
8. Under Order Details, click the link for your download.
9. Save the file to the desired location on your computer.

**NOTE:** This is a large file. Download times will vary due to your internet speeds.
Lesson 15: How Do Musical Instruments Use Sound Energy?

Indigenous Instruments

1. Haida Drum
   Materials: wood, animal skins, cotton fibre, metal

2. Tsimshian Drum
   Materials: animal skin, wood, paint, metal

3. Coast Salish Box Drum
   Materials: wood, paint, metal

4. Kwikwasut’inuxw, Kwakwaka’wakw Whistle
   Materials: wood, resin, twine, pitch

5. Northwest Coast Clappers
   Materials: wood, fibre cording

6. Nisga’a Rattle
   Materials: wood, stone, bark, paint

Image Credits:
3 – Box Drum Object ID #A7279, photographed by Derek Tan. Courtesy of UBC Museum of Anthropology, Vancouver, Canada.
5 – Clappers Object ID #1505/1, photographed by Kyla Bailey. Courtesy of UBC Museum of Anthropology, Vancouver, Canada.

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About the Contributors

Jennifer Lawson, PhD, is the originator and senior author of the Hands-On series in all subject areas. Jennifer is a former classroom teacher, resource/special education teacher, consultant, and principal. She continues to develop new Hands-On projects, and also serves as a school trustee for the St. James-Assiniboia School Division in Winnipeg, Manitoba.

Rosalind Poon has been a science teacher and Teacher Consultant for Assessment and Literacy with the Richmond School District for the past 18 years. In her current role, she works with school teams to plan and implement various aspects of the curriculum by collaborating with teams in professional inquiry groups on topics such as descriptive feedback, inquiry, assessment, and differentiation. Her passions include her family, dragon boating, cooking with the Instant Pot and making sure that all students have access to great hands-on science experiences.

Deidre Sagert specializes in early years education, and is currently working as the Early Years Support Teacher for the St. James-Assiniboia School Division. She brings 20 years of experience to her current role where she mentors early years teachers in incorporating play-based learning and inquiry into all subject areas. She is passionate about ensuring all students have access to a stimulating environment where they are engaged in hands on experiences and authentic learning. She enjoys spending time with her family in nature for rejuvenation and inspiration.

Melanie Nelson is from the In-Shuk-Ch and Stó:lo Nations, and has experience teaching kindergarten through grade 12, as well as adults in the Lower Mainland of British Columbia. She has taught in mainstream, adapted, modified, and alternate settings, at the classroom, whole school, and district levels. Trained as an educator in science, Melanie approaches Western science through an Indigenous worldview and with Indigenous ways of knowing. Her Master of Arts thesis explored the experience of Indigenous parents who have a child identified as having special needs in school, and she is currently completing a Doctor of Philosophy in School Psychology at the University of British Columbia.

Lisa Schwartz has been a Teacher Consultant for Assessment and Literacy with the Richmond School District for the past six years. As a consultant, Lisa facilitates professional learning with small groups and school staffs on topics such as the redesigned curriculum, Core Competencies, differentiation, inquiry, and assessment. She also works side by side with teachers co-planning, co-teaching and providing demonstration lessons to highlight quality, research-based instruction that supports all learners. Lisa is passionate about engagement, joyful learning and success for all students.
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