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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 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 ■ problem solving and making effective decisions, and applying them to real-world contexts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>■ effectively reading, writing, speaking, listening, viewing, and representing ■ 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 ■ contributing to the care of themselves, others, and the larger community</td>
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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 grades three to five. Each module explores the Big Ideas, Core Competencies, and Learning Standards for grades three to five. 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, leads to 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 encourages 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 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.

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. Since 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](https://www.aadnc-aandc.gc.ca/DAM/DAM-INTER-BC/STAGING/texte-texte/fnmp_1100100021018_eng.pdf).

Incorporate land acknowledgement 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, in the place traditionally known as _______.**

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 for 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 Peoples 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**

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<th>Element</th>
<th>Description</th>
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<tr>
<td><strong>Environment</strong></td>
<td>using the local land (place-based learning)</td>
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<tr>
<td><strong>Engage</strong></td>
<td>inspiring curiosity and activating knowledge</td>
</tr>
<tr>
<td><strong>Explore</strong></td>
<td>investigating science concepts through hands-on experiences</td>
</tr>
<tr>
<td><strong>Elders</strong></td>
<td>connecting local Knowledge Keepers to learning</td>
</tr>
<tr>
<td><strong>Explain</strong></td>
<td>describing observations and sharing new knowledge</td>
</tr>
<tr>
<td><strong>Elaborate</strong></td>
<td>extending and enhancing learning</td>
</tr>
<tr>
<td><strong>Evaluation</strong></td>
<td>providing opportunities for students to demonstrate understanding and skills</td>
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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 grade-three to grade-five 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 grades three to five, 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 at early literacy stages, through drawings and simple text, while others write several sentences and construct detailed labelled diagrams. 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 early numeracy skills to estimate and measure, while other students may be capable of working with a variety of measuring devices, using more complex numeracy skills. 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)

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

**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.

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

**Engage**
- Discuss the location for the place-based learning experience. Also provide objects and photographs collected during the learning location, 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)

**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 209 for thumbnails and free access)

**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 modeling, guided practice, and individual skills
- includes suggestions for Makerspace projects and Loose Parts exploration

**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)

- 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
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 29–33)

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)

Enhance
- enriches and elaborates on the Big Idea, Core Competencies, and Learning Standards with optional activities
- encourages active participation and learning through Family Connections

How to Use Hands-On Science in Your Classroom

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.

How to Use
- Hands-On Science in Your Classroom
- Hands-On Science for British Columbia
- Living Things for Grades 3–5
- ISBN: 978-1-55379-875-0

Living Things

3

1

How to Use Hands-On Science in Your Classroom

15
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**

Each lesson encourages the class to participate in a Talking Circle to consolidate learning and debrief on guided inquiry questions. 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/circletalks.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 different multiple intelligences 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 20).

<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:

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
</table>
| **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 3–5*, students design and construct a wildlife feeder 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. |
**Makerspaces**

To foster open inquiry and promote personalized learning, each module of *Hands-On Science* suggests a Makerspace 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 Makerspaces 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 at the Makerspace 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 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. 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 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 52).

Before students begin working at a Makerspace, 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. Or, challenge students to create posters for the Makerspace 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. 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 those questions further.

**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 into 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>
<td></td>
<td></td>
</tr>
<tr>
<td>I can share my learning.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can work in a group.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Family and Community Connections: Assessing Together

Family/Community Member’s Name: ________________________________

Work together to draw a labelled picture that shows what you have been learning in science. Then, describe your learning in sentences.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

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?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
How Do Living Things Survive in Their Environment?
About This Module

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

- Living things are diverse, can be grouped, and interact in their ecosystems.
- All living things sense and respond to their environment.
- Multicellular organisms have organ systems that enable them to survive and interact within their environment.

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

See the Curricular Competencies Correlation Chart, page 67, for more information.

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

- maintain a respectful relationship with nature, with an intention to sustain natural resources for generations to come
- understand that all life—plant, animal, and human—is equal and that all living things depend on one another for survival
- understand that humans have special relationships with animals, which are seen as teachers, guides, and companions, and are key to human survival
- acknowledge that life is cyclical and that all plants and animals (e.g., insects, amphibians, fish, birds, reptiles, mammals) have daily, annual, and multi-year life cycles
- recognize that the First Peoples Principles of Learning ultimately support the well-being of the self, the family, the community, the land, the spirits, and the ancestors (see page 11)

**Place-Based Learning**

When implementing place-based learning, there are many opportunities 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 place-based learning location is in relation to the school. This will help students develop a stronger image of their community and the surrounding area.

Identify on whose traditional territory the school is located, the traditional territory of the location for the place-based learning, and the traditional names for both. Use the following maps for this purpose: “First Nations in British Columbia,” from Indigenous Services Canada at <www.aadnc-aandc.gc.ca/DAM/DAM-INTER-BC/STAGING/texte-text/inacmp_1100100021016_eng.pdf> and “First Nations Map of British Columbia” from Vancouver Island University at <https://aboriginal.viu.ca/first-nations-map-british-columbia>. 
## Curriculum Learning Framework:
### What We *Know* and *Understand*

In keeping with the Know, Do, Understand model highlighted in BC’s *New Curriculum*, consider the Big Ideas in the first row of this chart to reflect what we *know*. The Content, listed in the third row, reflects what we *understand*, while the Curricular Competencies Correlation Chart, page 67, represents what we *do*.

<table>
<thead>
<tr>
<th>Big Idea</th>
<th>Content</th>
<th>Sample Guided Inquiry Questions</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>
| Living things are diverse, can be grouped, and interact in their ecosystems. | - biodiversity in the local environment  
- different types of living things in an ecosystem  
- characteristics of local plants, animals and fungi  
- populations: all the members of the same type of living thing (species) in an area  
- communities: different populations in an area living together [lesson 1, 2, 3, 4, 5, 6, 7, 11, 12, 13, 14, 20]  
- knowledge of local First Peoples  
- the interconnection between living and non-living things in the local environment  
- our shared responsibility to care for the local environment (i.e., stewardship) | - What is biodiversity?  
- Why is biodiversity important in an ecosystem?  
- What are some causes of biodiversity in British Columbia’s wetlands?  
- What is the effect of wind on mountains?  
- How does local First Peoples knowledge of living things demonstrate interconnectedness?  
- How can you observe the concept of interconnectedness within ecosystems in your local area? | All living things sense and respond to their environment. | Multicellular organisms have organ systems that enable them to survive and interact within their environment. | How do living things sense, respond, and adapt to stimuli in their environment?  
- How is sensing and responding related to interdependence within ecosystems?  
- How does the order of seasons impact local plants and animals?  
- How do organ systems interact with one another?  
- How do organ systems interact with their environment to meet basic needs?  
- How do the systems of the human body work together? |
| | - sensing and responding:  
  - humans (e.g., the five senses)  
  - other animals (e.g., echolocation, UV sensors, magnetoreception, infrared sensing)  
  - plants (e.g., response to light, touch, water, gravity) [lesson 11, 12, 14, 20]  
  - biomes as large regions with similar environmental features such as similar temperature and precipitation (e.g., climate: long-term weather patterns), including terrestrial biomes and aquatic/marine biomes [lesson 7, 20] | | | | |
| | - basic structures and functions of body systems:  
  - digestive: mouth, stomach, intestines, etc.  
  - musculo-skeletal: muscles and skeleton  
  - respiratory: trachea, lungs and diaphragm  
  - circulatory: heart, blood, blood vessels [lesson 15, 16, 17, 18, 19, 20] | | | | |
# Curricular Competencies Correlation Chart: What We Do

Throughout this module, students will develop Curricular Competencies by participating in rich learning experiences that focus on specific skills, strategies, and processes.

| Curricular Competencies | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|-------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|
| **Questioning and Predicting** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Demonstrate curiosity about the natural world, scientific topic, or problem. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observe objects and events in familiar and unfamiliar contexts. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Identify questions about familiar objects and events that can be investigated through scientific inquiry. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Make predictions based on prior knowledge and the findings of their inquiry. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Planning and Conducting Investigations** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Suggest ways to plan and conduct an inquiry to find answers to their questions or to solve problems. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Decide which variable should be changed and measured for a fair test. |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Consider ethical responsibilities when deciding how to conduct an experiment. | ✓ |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Safely use appropriate tools to make observations and measurements, using formal measurements and digital technology as appropriate. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Make observations about living and nonliving things in the local environment. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observe, measure, and record data. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Processing and Analyzing Data and Information** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Experience and interpret the local environment. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Identify First Peoples perspectives and knowledge as sources of information. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
How Do Animals Adapt to Survive in Their Environment?

Information for Teachers

Adaptations allow animals to survive in their habitat. There are two types of adaptations: structural and behavioural.

Structural adaptations are physical features that protect the organism, help it get its food, or help it to move. For example, a hawk has a hooked beak that can rip and tear food, and a sparrow has a short, pointed beak that can crack open seeds. Camouflage is another form of structural adaptation that protects animals.

Behavioural adaptations are actions that help an organism survive in a given habitat (e.g., migration, bird calls, mating rituals).

In order to study adaptations, the following information is provided on the characteristics of three different bears. Further information can be gathered through research as a class.

Polar Bear
- long, slender necks and slender heads
- black skin, which absorbs heat from the Sun
- white fur (Polar bear fur is pigment-free. It scatters visible light, but allows other frequencies to reach their black skin.)
- lives in the Arctic (mostly on polar ice)
- eats fish and seals
- thick fur (for keeping warm)
- webbing between toes (for swimming)

Grizzly Bear
- long claws (for digging up food)
- distinctive hump of muscle between shoulders
- lives on edges of forest
- feeds mostly in mountain meadows
- eats roots, gophers, and smaller rodents; occasionally kills larger animals for food

Black Bear
- short claws
- lives in a variety of habitats (forest, brush, chaparral)
- eats mostly nuts, berries, fruit, rodents, and insects; occasionally kills larger animals for food
- smaller than polar and grizzly bears, with a pointier head

Materials
- resources about bears
- Image Bank: Bears (see Appendix, page 209) (print several copies of each picture)
- printer access
- chart paper
- markers
- writing paper
- projection device
- computers/tablets with internet access (optional)
- stories about plant and animal adaptations from different cultures, including books by Indigenous authors (see Explore Part Six)
- resources about a variety of plants and animals in different habitats
- modelling clay
- shoeboxes
- art supplies (e.g., coloured paper, cardboard, pipe cleaners, paint, crayons, markers, scissors, glue, tape)
- natural materials (e.g., leaves, twigs, stones)
- Template: Video Viewing Guide (1.12.1)
- Learning-Centre Task Card: How Is Camouflage a Structural Adaptation? (1.12.2)

Engage
Organize the class into working groups, and provide each group with pictures of the three bear species from the Image Bank: Bears. Have students examine and discuss the pictures,
looking for similarities and differences among the three types of bears.

On chart paper, draw a triple-intersecting Venn diagram, as in the following example:

Model how to present similarities and differences on a Venn diagram. Ask:

■ What is one way all three bears are similar?

Record one idea (e.g., four legs) in the centre section of the Venn diagram, where all circles intersect. Ask:

■ What is one way the polar bear is different from the other two bears?

Record one idea (e.g., webbing between toes) in the appropriate section of the Venn.

When students are confident with the process, distribute chart paper and a marker to each group. Have students use the class Venn as a model to draw a triple-intersecting Venn diagram on the chart paper. In their groups, ask students to record similarities and differences among the three bears. Provide an opportunity for each group to present its findings, and discuss as a class.

Next, introduce the idea of adaptations. Ask:

■ Why do you think the three species of bears have different characteristics?

Have students share their ideas.

Introduce the guided inquiry question:

How do animals adapt to survive in their environment?

Explore Part One

Provide an opportunity for students to research the physical characteristics of each bear and its habitat. On chart paper, construct the following graphic organizer:

<table>
<thead>
<tr>
<th>Diagram</th>
<th>Grizzly Bear</th>
<th>Black Bear</th>
<th>Polar Bear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Habitat</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Provide each student with writing paper and have them use the above chart as a guide for making their own graphic organizer to record research. Provide flexibility and encourage students to modify the chart as they choose. Have students conduct research to complete the chart.

When students have completed their research, discuss their findings as a class. Ask:

■ Think about how each bear looks. How do the bear’s physical characteristics help it survive where it lives?

■ Think about what each bear eats. Why does it eat this food?

■ What physical characteristics of each bear help it get the food it eats?

■ What are a grizzly bear’s needs?

■ How does a grizzly bear meet its needs in its habitat?

■ What are a polar bear’s needs?

■ How does a polar bear meet its needs in its habitat?

■ What are a black bear’s needs?

■ How does a black bear meet its needs in its habitat?
If you moved polar bears to central Canada, and you moved grizzly bears to the Arctic coast, do you think the bears would be able to survive in their new homes? Why or why not?

Discuss with students that these bears have adapted to their environment in order to survive. All plants and animals have adapted to their environments in order to survive.

Review the definition of adaptation the class created in lesson 11. Discuss whether the definition is still accurate. Have students suggest changes to the definition based on their new knowledge of the term.

**Explore Part Two**

Show students the NatureWorks video “Adaptation” <video.nhptv.org/video/1492015101/> which focuses on adaptations of various animals and plants, distinguishing between structural and behavioural adaptations.

Have students create their own video viewing guide to complete while watching the video. Or have them use the Template: Video Viewing Guide (1.12.1):

---

**Video Viewing Guide**

<table>
<thead>
<tr>
<th>Name of video:</th>
<th>Diagrams:</th>
<th>Main idea:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>New terms used:</th>
<th>Interesting facts:</th>
<th>New questions I have:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Download this template at <www.portageandmainpress.com/product/HOSLIVINGTHINGS35>.

After watching the video, have students share their ideas, observations, and inquiry questions with the class.

**Explore Part Three**

On chart paper, create a chart as in the following example:

<table>
<thead>
<tr>
<th>Animal</th>
<th>Structural Adaptation</th>
<th>Behavioural Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opossum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Porcupine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frog</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owl</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As a class, complete the chart for several animals, distinguishing between structural and behavioural adaptations.
Explore Part Four
Organize the class into working groups, and provide each group with chart paper, markers, and resources about a variety of animals in different environments. Have the groups explore the resources to identify ways animals have adapted to their habitats. Have them record their findings in a manner of their choice, or using diagrams and sentences. Examples may include:

- The snowshoe hare has a white coat in winter and a tan coat in summer.
- Chameleons change colour to blend in with their surroundings.
- Geese fly south in the winter.
- Black bears hibernate to escape the cold of winter.
- The nesting killdeer bird fakes a broken wing to keep predators away from its nest.
- Some desert animals are active at night to escape the heat during the day.
- A walking stick insect looks like a twig to hide from predators.

Have each group present their findings to the class.

Next, discuss adaptations that are examples of camouflage. Ask students:

- What is the term for using colour to hide in one’s environment?
- Which animals use camouflage?
- How do humans use camouflage? (e.g., naturalists/wildlife photographers; soldiers)

Display students’ charts in the classroom, and encourage them to add to the list of adaptations throughout the module.

Explore Part Five
As a class, investigate ways that technological developments mirror physical adaptations.

Create a display for the classroom that illustrates this. For example:

- Scuba/snorkeling fins are similar to a duck’s webbed feet.
- A fishing net is similar to a spider’s web.
- An airplane is designed to be similar to the body of a bird.
- A canoe is shaped much like a fish’s streamlined body.
- To camouflage soldiers, the fabric used for military uniforms is made to resemble the colours and patterns in natural terrain and plant life.

Have students collect human-made objects that reflect structural adaptations from nature. For each object, ask students to include pictures of the organism after which the object has been modelled.

Explore Part Six
Investigate alternative explanations for animal adaptations based on knowledge from a variety of cultures. For example, read Indigenous stories that explain how animals got their unique features, such as:

- Nanabosho: How the Turtle Got Its Shell by Joe McLellan
- How the Coho Got His Hooked Nose by Teresa Michell
- How the Robin Got Its Red Breast by Sechelt Nation

After reading stories from several different cultures, have students write their own stories to explain distinct animal characteristics. Examples may include:

- how the skunk got its stripe
- how the giraffe got its long neck
- how the fox got its bushy tail
- why the polar bear is white
- how the cactus got its needles
how the porcupine got its quills
why the sunflower turns to the Sun

Expand

Have students explore animal adaptations further by posing their own inquiry questions for personalized learning. They may wish to:

■ Initiate a project at the Makerspace, such as creating a model of a fictional animal that has certain features that allows it to survive in an urban setting.
■ Conduct research on adaptations of specific animals.
■ Write a picture book about animal adaptations.
■ Create puppets and plan a puppet show to tell the story of how an animal got its unique features. Students may refer to the books used in Explore Part Six, or use their own stories.
■ 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 resources about a variety of plants and animals in different habitats, as well as shoeboxes, modelling clay, a variety of art supplies (e.g., coloured paper, cardboard, pipe cleaners, paint, crayons, markers, scissors, glue, tape), various natural materials (e.g., leaves, twigs, stones), and a copy of the Learning-Centre Task Card: How Is Camouflage a Structural Adaptation? (1.12.2):

1. Research to find out more about camouflage as a structural adaptation in animals.
2. Examine images of animal habitats to see how each type of animal is able to camouflage itself in its environment.
3. Create animals from Plasticine, and then create a diorama that camouflages one of the animals.

Download this template at <www.portageandmainpress.com/product/HOSLIVINGTHINGS35>.

Challenge students to make animals from modelling clay and then create dioramic environments that camouflage at least one type of animal. Before students visit the learning centre, co-construct criteria for the project. For example, the diorama should:

■ represent a specific local or regional habitat
■ represent at least three plant populations within that habitat
■ represent at least three animal populations within that habitat
■ camouflage at least one animal

Record the criteria on chart paper and place it at the learning centre for students to refer to as they work on their dioramas.
When students have constructed their learning-centre dioramas, have them challenge other students to find the hidden animals.

**Student Self-Assessment**

Have students take home a copy of the FAMILY AND COMMUNITY CONNECTIONS: ASSESSING TOGETHER assessment template on page 57. Have them complete the template with a family or community member (with permission) to reflect on their learning about how animals adapt to their environment, by recording observations.

**Embed Part One: Talking Circle**

Revisit the guided inquiry question: *How do plants and animals adapt to survive in their environment?* Have students share their knowledge and experiences, provide examples, and ask further inquiry questions.

**Embed Part Two**

- Add to the KWHL 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.
- Have students add new terms, definitions, and illustrations to their Science Glossary (1.3.1). When possible, encourage them to add words and examples in languages other than English, including Indigenous languages, reflective of the class cultural makeup.
- 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 for how they demonstrated that competency. Ask questions directly related to that competency to inspire discussion. For example:
  - How did you explore materials to learn about plant and animal adaptations today? (Critical Thinking)

Have students reflect orally, encouraging participation, questions, and the sharing of evidence. (See page 29 in the Introduction 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. Conference individually with students to support self-reflection, or have students complete the prompts on their own.

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 templates over time to see how thinking changes with different activities.

Enhance

- **Family Connection:** Provide students with the following sentence starter:
  - An example of an animal in or near my home that adapts to its environment is ________.

  Have students complete the sentence starter at home. Family members can contribute ideas as the student draws and writes about this topic. Have students share their sentences with the class.

- Return to the discussion about bears. Consider why some bears are trapped and moved to locations that are long distances away from where they are found. If the bears are not taken far away, they will return to the original location (e.g., for food, shelter) because they have become habitualized to the readily available food sources and are dangerous to the humans in that area. Have students conduct research to learn about being “bear smart” when hiking or camping. Then, have students create booklets of “bear smart” tips to bring with them when hiking or camping.

- Make a connection to mathematics by discussing the symmetry evident on a butterfly. Have students draw a butterfly, then colour the butterfly, so it is camouflaged in the classroom “habitat.” Have them observe the various surfaces around the room and decide how to colour their butterflies. Then, have students hide their butterflies around the classroom. Pair students with peers from other classrooms, and have the peer try to find their partner’s butterfly.

- Have students use an app (e.g., Comic Life) to create comic strips to show behavioural adaptations in animals.

- Connect to previous lessons by discussing with students how zoos work to build suitable enclosures for their animals. Explore bear enclosures at your local zoo, and examine how they are built specifically to fit that population. Explain how looking at designs and assessing their suitability is also a component of Applied Design, Skills, and Technologies.

- Expand on the activity from Explore Part Five. Have students identify other technological developments mirroring natural physical adaptations that they did not consider previously (e.g., a submarine’s shape resembles a whale; helicopter blades resemble maple seeds). Record all their ideas on chart paper, including those from Explore Part Five.

  When they have exhausted all ideas, distribute to each student a piece of art paper, and have them fold their paper in half. Tell students to each choose one adaptation mirroring human design. On one half of their paper, have them draw the human design (e.g., airplane) and on the other half the natural phenomenon (e.g., a bird). Tell students to label their drawings, being sure to include the adaptation. Bind all the pages into a class book titled “Mirror Images.”

  **NOTE:** Ensure students fold their art paper in the same direction, so the bound pages will have the same orientation in the completed class book.

- Show videos that provide more information about adaptations. For example:
  - “Animal Adaptations” <https://www.youtube.com/watch?v=Dw7z8Fo5ijk>
  - “Adaptation” <https://www.youtube.com/watch?v=YX8VQlUVpTg>

  Have students create a video viewing guide or use the Template: Video Viewing Guide (1.12.1) to take notes while they watch the videos.
Appendix: Image Banks

Images in this 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/HOSLIVINGTHINGS35/>.

NOTE: This is a large file. Download times will vary due to your internet speeds.
Lesson 12: How Do Animals Adapt to Survive in Their Environment?

Bears

1. Polar Bear
2. Polar Bear
3. Polar Bear Eating Meat
4. Polar Bear Paws
5. Polar Bear Habitat
6. Grizzly Bears
7. Grizzly Bear Shoulder Hump
8. Grizzly Bear Habitat
9. Grizzly Bear Claws

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3 – *Toxicodendron rydbergii* (poison ivy), Photo ID #23653. Courtesy of Gordon Neish.
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5 – When I was a child by jeannie debs. Used under CC by 2.0 licence.
6 – Dandelion by Newtown graffiti. Used under CC by 2.0 licence.
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8 – Yellow Waterlily by Patrick Standish. Used under CC by 2.0 licence.
10 – Plants_NR_84 by USDA NRCS Montana. Used under Public Domain Mark 1.0 licence.
10. Grizzly Bear Catching Salmon
11. Grizzly Bears Eating Blueberries
12. Black Bear

13. Black Bear
14. Black Bear Claws
15. Black Bears Eating Grass

16. Black Bear Habitat

Image Credits:

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6 – Grizzly Bears by Denali National Park and Preserve, photographed by NPS/Jacob W. Frank. Used under CC by 2.0 licence.
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11 – Grizzly Bears in Blueberries by Denali National Park and Preserve, photographed by NPS/Jacob W. Frank. Used under CC by 2.0 licence.
12 – Black bear, Northeast Entrance by Yellowstone National Park, photographed by Neil Herbert. Used under Public Domain Mark 1.0 licence.
13 – Black bear in motion, Lamar Valley by Neil Herbert. Used under Public Domain Mark 1.0 licence.
14 – Black bear near Phantom Lake by Neil Herbert. Used under Public Domain Mark 1.0 licence.
15 – Black bear sow with cub, Tower Fall by Neil Herbert. Used under Public Domain Mark 1.0 licence.
16 – Yearling black bears (cinnamon), Slough Creek by Neil Herbert. Used under Public Domain Mark 1.0 licence.
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.

Melanie Nelson is from the In-SHUCK-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.

Hetxw’ms Gyetxw (Brett D. Huson) is from the Gitxsan Nation of the Northwest Interior of British Columbia, Canada. Growing up in this strong matrilineal society, Brett developed a passion for the culture, land, and politics of his people, and a desire to share their knowledge and stories. Brett has worked in the film and television industry, and has volunteered for such organizations as Ka Ni Kanichihk and Indigenous Music Manitoba. Brett is the author of the Mothers of Xsan series of children’s books. The first book in the series is The Sockeye Mother, which won The Science Writers and Communicators Book Award.

Desiree Marshall-Peer (MA, BSC) is a Cree-Ojibway educator focusing on re-envisioning the British Columbia education system in innovative ways. Desiree has several years’ experience with the BC Ministry of Education renewed curriculum and competencies, with input on graduation transformations, and assessment. She has certification in Design Thinking and Maker philosophy. Desiree is currently a professor at the UBC-Okanagan School of Education.
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