Ontario

hands-on science and Technology

An Inquiry Approach With STEM Skills and Connections

Grade 4

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Hands-On Science and Technology for Ontario, Grade 4
An Inquiry Approach With STEM Skills and Connections

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Contents

Introduction to *Hands-On Science and Technology* 1

About *Hands-On Science and Technology* 2
The Goals of the Science and Technology Program 2
Hands-On Science and Technology Strands and Expectations 2
Hands-On Science and Technology Principles 2
The Importance of STEM Education 3
What Does STEM Look Like in a Classroom Setting? 4
What Is Coding? 4
Unplugged Coding Kits 6
The Inquiry Approach to Science and Technology 7
Cultural Connections 8
Indigenous Perspectives and Knowledge 8
References 11
Coding Reproducibles 12

How to Use *Hands-On Science and Technology* in Your Classroom 13

Unit Overview 13
Talking Circles 17
STEM Makerspaces 17
Classroom Environment 18
Planning Units 18
Timelines 18
Classroom Management 18
Classroom Safety 19
Land-Based Learning 19
References 19

Scientific and Engineering Design Processes 20

Scientific Inquiry Skills: Guidelines for Teachers 20
Observing 20
Questioning 20
Exploring 20
Classifying 20
Measuring 21
Communicating, Analyzing, and Interpreting 21
Predicting 23
Inferring 24
Inquiry Through Investigation and Experimentation 24
Engineering Design Process 24
Inquiry Through Research 25
Online Considerations 25
Addressing Students' Early Literacy Needs 26
References 26

The *Hands-On Science and Technology* Assessment Plan 27

Assessment *for* Learning 28
Assessment *as* Learning 28
Assessment *of* Learning 29
Performance Assessment 29
Portfolios 30
Indigenous Perspectives on Assessment 30
Evidence of Student Achievement Levels for Evaluation 31
Important Note to Teachers 31
References 31
Assessment Templates 32
Achievement Chart for Science and Technology 36

Unit 1: Habitats and Communities 39

About This Unit 40
Curriculum Correlation Chart 44
Resources for Students 45
1 What Do We Know About Habitats and Communities? 50
2 Why Do Plants and Animals Live in Certain Habitats? 58
3 Which Organisms Are Found in Our Local Habitats? 63
4 How Do Plants and Animals Adapt to Survive in Their Environment? 69
5 What Relationships Occur Between Populations Within a Community? 75
6 What Are the Characteristics of Herbivores, Carnivores, and Omnivores? 81
7 What Are the Relationships Between Predators, Prey, and Scavengers? 86
8 What Are the Characteristics of Producers, Consumers, and Decomposers? 91
9 What Is a Food Chain? 97
10 What Is a Food Web? 101
11 How Are Plants and Animals Important to Humans and to the Environment? 105
12 What Are Some Natural and Human Impacts on Organisms in the Environment? 110

Unit 2: Light and Sound 115

About This Unit 116
Curriculum Correlation Chart 120
Resources for Students 122
1 What Do We Know About Light? 128
2 How Does Light Travel? 133
3 How Does Light Reflect? 138
4 How Well Does Light Pass Through Different Materials? 144
5 How Can We See Light's Many Colours? 149
6 How Has Light Technology Changed Over Time? 153
7 What Do We Want to Learn About Sound? 157
8 How Is Sound Created? 162
9 What Is Pitch? 166
10 How Do Sound Waves Travel? 170
11 Which Materials Are Insulators or Conductors of Sound? 174
12 How Can We Amplify Sound? 178
13 How Do We Hear Sound, and How Can We Protect Our Sense of Hearing? 182
14 How Do Musical Instruments Use Sound Energy? 187
15 How Can We Design and Construct Musical Instruments Using Various Materials? 192
16 Inquiry Project: What Can We Learn About Sound Technology? 198

Unit 3: Machines and Their Mechanisms 203

About This Unit 204
Curriculum Correlation Chart 207
Resources for Students 208
1 What Do We Know About Machines and Their Mechanisms? 212
2 How Do Wheels and Axles Work? 218
3 How Do Gears Help Make Work Easier? 224
4 What Can We Learn About Gears and Direction of Movement? 229
5 How Can We Design and Construct Devices With Working Gears? 235
6 How Does a Single-Fixed Pulley Make Work Easier? 238
7 How Do Movable and Compound Pulleys Make Work Easier? 243

8 How Can We Design and Construct a Working Pulley System? 250
9 What Are the Advantages and Disadvantages of Using Machines With Pulleys and Gears? 254
10 How Can We Design and Build a System of Pulleys and Gears for a Specific Purpose? 258

Unit 4: Rocks, Minerals, and Geological Processes 261

About This Unit 262
Curriculum Correlation Chart 265
Resources for Students 266
1 What Do We Know About Rocks and Minerals? 270
2 How Can We Compare and Classify Rocks and Minerals? 276
3 How Can Minerals Be Classified? 281
4 How Are Different Types of Rock Formed? 286
5 How Are Fossils Formed? 294
6 What Are Some Uses of Rocks and Minerals by Indigenous Peoples? 300
7 What Are Some Everyday Uses for Rocks and Minerals? 303
8 How Does Mining Impact Habitats and Communities? 308

Appendix: Image Banks 313

About the Contributors 329

Introduction to *Hands-On Science and Technology for Ontario, Grade 4*

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Introduction to *Hands-On Science and Technology*

About *Hands-On Science and Technology*

Hands-On Science and Technology helps develop students' understanding of science and technology concepts and science, technology, engineering, and mathematics (STEM) skills. It also promotes scientific literacy through active inquiry, problem solving, and decision making. Each activity in ***Hands-On Science and Technology*** encourages students to explore, investigate, and ask questions as a means of heightening their curiosity about the world around them. Students solve problems through first-hand experiences and by observing and examining objects within their environment. For students to develop scientific and technological literacy, concrete experience is of the utmost importance—in fact, it is essential.

The Goals of the Science and Technology Program

Science and technology play fundamental roles in the lives of all Canadians. The Ontario science and technology curriculum identifies three main goals for students:

- to develop the skills and make the connections needed for scientific and technological investigation
- to relate science and technology to our changing world, including society, the economy, and the environment
- to explore and understand science and technology concepts

These goals are the foundation for the lessons in ***Hands-On Science and Technology***.

NOTE: *Hands-On Science and Technology* provides numerous opportunities for students to investigate issues related to sustainable development. Asking students the following question can often help to clarify for them what is meant by sustainability: "Is there enough for everyone, forever?" Exploring sustainability also connects to Indigenous worldviews about respecting and caring for the Earth. The three pillars of sustainability are the environment, society, and the economy.

Hands-On Science and Technology Strands and Expectations

The Ontario science and technology curriculum for all grade levels is organized into five strands:

A. STEM Skills and Connections
B. Life Systems
C. Matter and Energy
D. Structures and Mechanisms
E. Earth and Space Systems

Two sets of expectations are listed for each grade in each strand: (1) overall expectations and (2) specific expectations.

The overall expectations describe, in general terms, the knowledge and skills students are expected to demonstrate by the end of each grade.

The specific expectations describe the expected knowledge and skills in greater detail.

The overall and specific expectations for each strand are presented in the Curriculum Correlation Chart in the introduction to each unit of ***Hands-On Science and Technology***. The chart also identifies the lessons within the unit that correspond to each specific expectation.

Hands-On Science and Technology Principles

Hands-On Science and Technology is grounded in a research-based approach that puts students at the centre of the teaching and learning process. The following principles reflect this approach:

- Effective science and technology education involves hands-on inquiry, problem solving, and decision making.

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- The development of students' understanding of science and technology concepts and science, technology, engineering, and mathematics (STEM) skills forms the foundation of science and technology 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 and technology activities must be meaningful and worthwhile and relate to real-life experiences.
- The teacher's role in science and technology education is to facilitate activities and encourage critical thinking and reflection. Children learn best by doing, rather than just listening. Instead of simply telling, the teacher should focus on formulating and asking questions, setting the conditions for students to ask their own questions, and helping students make sense of the events and phenomena they have experienced.
- Science and technology 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 and technology 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 and technology education should be infused with knowledge and perspectives of Indigenous Peoples, as well as other diverse multicultural perspectives.
- Assessment of student learning in science and technology should be designed to focus on performance and understanding and should be conducted through meaningful assessment techniques used throughout each unit. See the detailed overview of the ***Hands-On Science and Technology*** **Assessment Plan** on pages 27–31.
- Science and technology education is inclusive in nature. Learning opportunities should meet the diverse needs of all students through differentiated instruction and individualized learning experiences.

The Importance of STEM Education

The study of science, technology, engineering, and mathematics (STEM) helps students become scientifically and technologically literate citizens. STEM learning integrates and applies concepts and processes related to these subject areas through problem solving and design challenges. The skills that students develop through STEM learning include coding, innovation, computational thinking, and engineering and scientific design. STEM skills and concepts are infused throughout the units and lessons included in ***Hands-On Science and Technology***. Many lessons offer a suggestion for a STEM Makerspace project, which is designed to develop students' STEM skills in direct relation to the lesson. (See page 17 for a detailed overview of STEM Makerspaces.)

In addition, many lessons include coding activities. (See page 4 for more detailed information on coding.) ***Hands-On Science and Technology*** emphasizes the creative coding approach, which focuses on the key skills of creativity, agency, and computing, described in the Harvard Graduate School of Education's *Creative Computing Curriculum* as follows:

Creativity: Computer science and computing-related fields are often introduced to young people in a way that is disconnected from their interests and values—emphasizing technical detail over creative potential. Creative computing supports the development of personal

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connections to computing by drawing upon creativity, imagination, and interests.

Agency: Many young people with access to computers participate as consumers, rather than designers or creators. Creative computing emphasizes the knowledge, practices, and fundamental literacies that young people need to create the types of dynamic and interactive computational media they enjoy in their daily lives.

Computing: Creating computational artifacts prepares young people for more than careers as computer scientists or programmers. It supports young people's development as computational thinkers—individuals who can draw on computational concepts, practices, and perspectives in all aspects of their lives, across disciplines and contexts.

What Does STEM Look Like in a Classroom Setting?

When students engage in STEM learning they actively work in teams, collaborating to find solutions to real-world problems using science, technology, engineering, and mathematics. They use a variety of materials and technologies to innovate and create. They draw plans, gather materials, build prototypes, and test what they have built. They conduct experiments, take measurements, and record their observations. Students use digital technology to create new content such as photos, videos, digital presentations, animations, and games. They engage in programming activities using coding and robotics. Students reflect on their work and understand that there are many possible solutions to a problem. STEM in the classroom is student centred, with the teacher acting as facilitator of the learning. The classroom is humming with excitement as students discuss their ideas and share their work.

What Is Coding?

Coding, also called computer programming, refers to giving a computer a set of specific step-by-step instructions that tell it what to do. These instructions need to be written in a language the computer understands, referred to as a *programming language*. There are many programming languages. They use letters, numbers, and symbols in their instructions. Children first learn to code with easy-to-learn, user-friendly languages that use visual symbols like blocks. Scratch is an example of a programming language made for young people. Familiarize yourself with some coding resources that can be used in the classroom, such as Scratch <https://scratch.mit.edu/>, a free block-based programming language designed for student use, and Code.org, a website that offers free coding courses and activities.

No previous coding experience is necessary to engage students in the Coding Connections activities provided throughout ***Hands-On Science and Technology, Grade 4***. Use the suggested coding as an opportunity to learn alongside students. Making mistakes and using logical reasoning to fix them (*debugging*) are key parts of learning to code. Provide students with plenty of free exploration time when introducing a new program, so they can discover its features before working on a specific task.

The key ideas and coding concepts for students to learn in grade 4 are as follows:

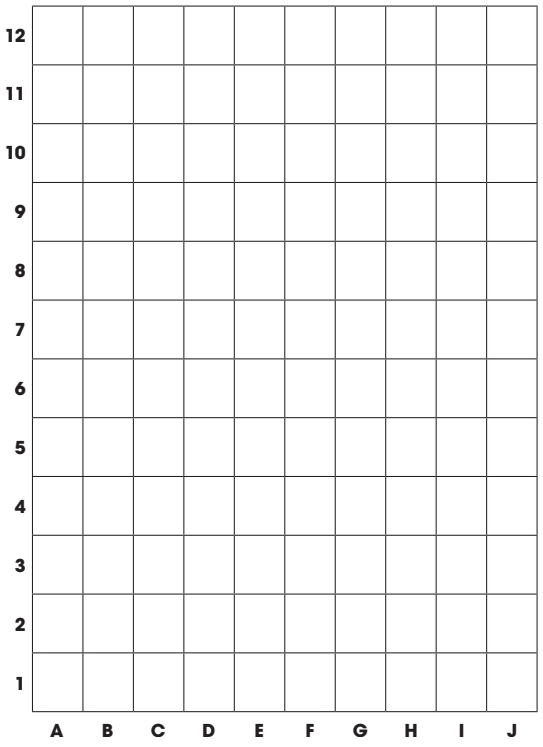
- Computer code is written in a specific order (called a *sequence* or *algorithm*) so the computer knows which step to complete first, next, and so on.
- Code can be written and executed so that multiple things happen at the same time (referred to as *concurrent events*).

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- Code can be written and executed so instructions can be repeated over and over again (referred to as *repeating events* or *loops*).
- Code can be written and executed so that control structures (such as loops) can be placed inside other control structures (referred to as *nested events*).
- Code can be written more *efficiently* (using the fewest number of instructions possible).
- Making mistakes and figuring out how to fix them (*debugging*) is an important part of learning to code.
- Code can be written and executed to model concepts by producing a variety of different *outputs* (what the program produces, e.g., sounds, lights, images, motion, text).

Coding concepts can be taught to students with or without the use of digital technology. ***Hands-On Science and Technology*** includes coding activities for both *plugged* and *unplugged* learning environments.

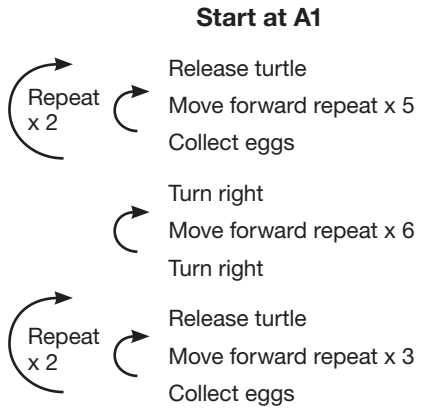
- *Plugged coding* uses the programming languages that a computer understands, therefore requiring the use of digital technology. A typical plugged coding activity for grade 4 is to connect a series of code blocks together, including nested events, to model scientific concepts in Scratch. For example, students might write a program that animates the rock cycle.
- *Unplugged coding* introduces coding and programming through hands-on activities and games. A typical unplugged coding activity for grade 4 is to provide students with a labelled grid (letters along the x-axis and numbers along the y-axis; see example at right), loose parts, and a set of coding cards. Students use the cards to write a program that models real-world concepts (such as the reintroduction of species into the wild). A labelled grid and a set of coding cards are provided on page 12. Print these on 11 x 17 paper.



Students can also describe their program using *pseudocode*, an informal way of expressing the steps in their program (a set of instructions for the computer) without having to follow any rules. Pseudocode is different from programming languages, which have very specific rules and formatting. Although there are no rules when writing pseudocode, computer programmers often follow some conventions when creating it. For students learning to express their own programs using pseudocode, the most important thing to note is that it should be easily understood by other people. For students in grade 4, pseudocode may include a combination of words, numbers, and symbols. For example:

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The following resources can be used to help introduce coding into your classroom:

- Canada Learning Code: <http://www.canadalearningcode.ca/>
- Code.org: <https://code.org>
- Hello Ruby for educators: Love Letters for Computers: <https://www.helloruby.com/loveletters>

NOTE: Check with your board or school to learn which coding apps are available to you and are recommended for use in your classroom.

Unplugged Coding Kits

Prepare unplugged coding kits for students to use with the Coding Connections activities throughout ***Hands-On Science and Technology, Grade 4***. Unplugged coding kits are easy to make using common classroom materials. Include some of the following items in your kits:

- **Loose Parts:** In unplugged coding, students use loose parts as obstacles or goals. Consider including items such as coloured tiles or chips, two-sided counters, multicoloured linking cubes or centimetre cubes, LEGO pieces, game pawns and pieces, small toys, stickers, natural materials (e.g., pebbles, polished stones, shells, pinecones, woodchips), printable images related to the unit's theme, paper, pencils, crayons, markers, and scissors (so students can draw and cut out their own images). Be creative and use what is available.

  Printable Image Cards are included with lessons as needed. Students can also draw additional images on the Blank Cards (see page 12). Print Blank Cards on 11 x 17 paper.
- **Grids:** Students use grids to design challenges and execute code. In the unplugged coding kits, consider including chart paper with gridlines, printable grids of various sizes, game boards with squares (e.g., checkers, chess), and hundreds charts. Create larger grids on tabletops or floors using masking tape. To create a foldable grid, paint or tape a grid onto a blanket, sheet, tablecloth, or drop cloth. Use sidewalk chalk or paint to create grids in outdoor learning spaces.

  A Labelled Grid template is included (see page 12). Print the Labelled Grid template on 11 x 17 paper.

NOTE: The labelled grid uses letters (x-axis) and numbers (y-axis) to refer to specific locations on the grid. Students may initially need support to understand how the labels on the grid (e.g., A1) relate to locations on the grid. With practice, students will begin to understand how the labels make it easier to describe a location.

- **Coding Cards:** Students use coding cards to create algorithms (sequences of actions) that direct the movements of objects or people along the grid. Print the provided Coding Cards (see page 12) on 11 x 17 paper. Students can also draw their own coding cards. Ensure student cards include directional arrows (left, right, up, down), arrows with elbows for right turns and left turns, and stop and go cards (e.g., a red stop sign, a green go sign). As students become

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more familiar with coding, allow them to add cards to the deck. Ask them to explain their reasons for including the new cards. To help students organize their coding cards when initially creating sequences, provide 5 frames or 10 frames to use as a graphic organizer.

The Inquiry Approach to Science and Technology

As students explore science and technology concepts, they are encouraged to ask questions to guide their own learning. The inquiry approach 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 approach, teachers facilitate the learning process. Students initiate questions; gather, organize, interpret, and analyze information; evaluate findings and draw conclusions; and communicate their learning. The process focuses on students' self-reflections as they ask questions, discover answers, and communicate their understanding.

An inquiry approach begins with more structured inquiry, moves to guided inquiry, and, finally, leads to open inquiry:

Structured Inquiry	■ The teacher provides the initial question and structures the procedures to answer it. ■ Students follow the procedures and draw conclusions to answer the question.
Guided Inquiry	■ The teacher provides the initial question. ■ Students are involved in designing ways to answer the question and communicate their findings.
Open Inquiry	■ Students formulate their own question(s), design and follow through with a developed procedure, and communicate their findings and results.

NOTE: According to Banchi and Bell (2008), "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." This requires careful observation and assessment by teachers to ensure that students are ready for open inquiry.

In an inquiry approach to science and technology, questions and ideas form the foundation of the teaching and learning process. The following quotation, included in the Ontario Literacy and Numeracy Secretariat's overview of inquiry-based learning, speaks clearly to this approach:

> While all students ask questions and express interests in world phenomena, it takes creative and responsive teaching to transform wonder into knowledge. To begin, inquiry works best in a classroom in which ideas are placed at the centre. Establishing a culture in which students are encouraged to express ideas but also to respectfully challenge and test one another's ideas is an important first step in the inquiry process. This spirit of inquiry is achieved by welcoming ideas and trusting that even the simplest questions can lead to something greater and not yet evident. Like any good growing system, these questions need time to germinate. Students' ideas can be expressed in many forms (questions, comments, diagrams, pictures, dance, etc.) and serve the important purpose of advancing student understanding of a topic. When the classroom culture is one that views ideas as improvable, students work hard to continuously improve the quality, coherence and utility of ideas—both individually and collectively. (Scardamalia, 2002, quoted in Ontario Literacy and Numeracy Secretariat, 2013, p. 4)

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Cultural Connections

To acknowledge and celebrate the cultural diversity represented in Canadian schools, 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 students' diverse cultures by making connections to curricular expectations. It is also important to explore other cultures represented in the community and beyond to encourage intercultural understanding and harmony.

Throughout ***Hands-On Science and Technology***, suggestions are made for connecting science and technology 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 worldviews of Indigenous Peoples and their approaches and contributions to science are now being acknowledged and incorporated into science and technology education. The intentional integration of Indigenous knowledge in ***Hands-On Science and Technology*** helps to address the Calls to Action of the Truth and Reconciliation Commission of Canada, particularly the calls to "integrate Indigenous knowledge and teaching methods into classrooms" (Action 62) and "build student capacity for intercultural understanding, empathy and mutual respect" (Action 63).

NOTE: The book *Braiding Sweetgrass for Young Adults: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants* by Indigenous scientist Robin Wall Kimmerer (Zest Books, 2022) is an excellent resource for teachers and students. It focuses on how all living things provide us with gifts and lessons.

The traditional territories of Indigenous Peoples cover the entirety of what is now known as Ontario. It is important to recognize the diversity of Indigenous Peoples in Ontario and to focus on both the traditions and contemporary lives of the Indigenous communities in your area. Contact personnel in your school board—Indigenous education leads and consultants and Indigenous Education Councils—to find out what resources (e.g., people, books, videos) are available. Many such resources are featured in ***Hands-On Science and Technology***.

Indigenous Peoples have depended on and shared reciprocal relationships with the land since time immemorial. The environment—including geography, land and waters, vegetation, and climate—shapes their way of life. Since they observe the land and its inhabitants, the environment teaches Indigenous Peoples to survive and determines the methods they use to do so. The land continues to shape Indigenous Peoples' way of life today because of their ongoing, deep connection to it. Cultural practices, stories, languages, and knowledge originate from the land and water.

NOTE: When implementing land-based learning, opportunities abound to consider Indigenous knowledge and perspectives. (See page 19 for more information about land-based learning.) Outdoor learning provides an excellent opportunity to identify the importance of place. For example, if planning a land-based learning activity in a nearby park, use a map of the local area to have students identify the location of the park 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 and where any land-based learning occurs, as well as the traditional names for these locations. The following sites provide maps of Ontario's First Nations that can be used for this purpose:

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- Ontario First Nations Maps: <https://www.ontario.ca/page/ontario-first-nations-maps>
- Maps of Indigenous Communities in Ontario: <https://www.sac-isc.gc.ca/eng/1635957754306/1635957787562>
- First Nation Profiles Interactive Map: <https://geo.aadnc-aandc.gc.ca/cippn-fnpim/index-eng.html>

In addition, the educator's guide *The First Nations and Treaties Map of Ontario as an Instructional Resource* offers maps and information for teachers; it is available at <http://www.edu.gov.on.ca/eng/indigenous/the-first-nations-and-treaties-map-of-ontario.pdf>.

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

- <location of school, e.g., city or town> *is located on the traditional territory of the _____and is within the boundaries set by the_____ treaty_____.*

NOTE: Many Ontario school boards have established protocols for land acknowledgments. Check with Indigenous education leads and consultants in your board to see if there are specific protocols to follow.

When incorporating Indigenous perspectives in the classroom, it is important to value Traditional Ecological Knowledge:

> 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 Western 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. (First Nations Education Steering Committee and First Nations Schools Association, 2019, p. 13)

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

Indigenous Peoples do not view their knowledges as "science," but from a more holistic perspective. As an example, this is reflected in the process of dying porcupine quills that can be used to adorn clothing. When harvesting the quills, consideration and care are shown for the animals. Special honour and gratitude are given for the sacrifice of life that is made so that humans can benefit from having these materials to work with. A quill-working artist uses different berries and plants to make dyes in a variety of colours. If a dyed quill is cut open, the core remains the original colour. When the quill work is exposed to the sun over the years, the colours fade and the quills return to their original state.

Indigenous Peoples have lived in connection to the land and water, and undertaken practices and processes in relation to the environment, since long before the settlers arrived. While the settlers prioritized applying the written terminology of Western science to describe these practices and processes, Indigenous Peoples do not apply rigid definitions or separate knowledge into categories.

Throughout ***Hands-On Science and Technology***, there are many opportunities to incorporate culturally appropriate teaching

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methodologies from Indigenous worldviews. Making connections to the local community is essential to learning about Indigenous knowledge and ways of knowing. 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 unit). An Elder or Knowledge Keeper can guide a nature walk, share stories and experiences, describe 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.

NOTE: In ***Hands-On Science and Technology***, **the term *Knowledge Keeper* refers to individuals who may or may not be recognized as Elders, but who carry the teachings of their community and can be called upon for that expertise. The term *Knowledge Holder* is used interchangeably with *Knowledge Keeper* in some communities (Government of Ontario, 2020–2023).**

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 Ontario. Consider contacting the Indigenous education lead or consultant in your school board, your local Indigenous Education Council, or the Ontario Ministry of Education to access referrals. You may 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 land-based learning.

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 have earned the respect of their community through wisdom, harmony, and balance in their actions and teachings (see Indigenous Corporate Training, 2019).
- 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.

NOTE: It is important 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 knowledge. Think deeply about reciprocity and how you can go beyond inviting Indigenous guests to your classroom. Expand your 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 teachers in your board.

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NOTE: Indigenous resources recommended in ***Hands-On Science and Technology*** 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 stories with more than one author, at least one of the authors is Indigenous. For more information, see the First Nations Education Steering Committee's *Authentic First Peoples Resources* guides at: <http://www.fnesc.ca/authenticresources/>.

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

Unit Overview

Hands-On Science and Technology for Ontario is organized in a format that makes it easy to plan and implement. The book opens with an introduction (which includes assessment reproducibles) and is divided into four units that cover the selected topics of study for the grade level:

- Life Systems: Habitats and Communities
- Matter and Energy: Light and Sound
- Structures and Mechanisms: Machines and Their Mechanisms
- Earth and Space Systems: Rocks, Minerals, and Geological Processes

The units relate directly to the strands, expectations, fundamental concepts, and big ideas outlined in *The Ontario Curriculum, Grades 1–8: Science and Technology* (2022) document. Each unit opens with About This Unit, an introduction to the unit that summarizes the general goals for the unit. It provides background information for teachers, planning tips, and lists of vocabulary related to the unit, as well as other pertinent information such as how to embed Indigenous perspectives into student learning.

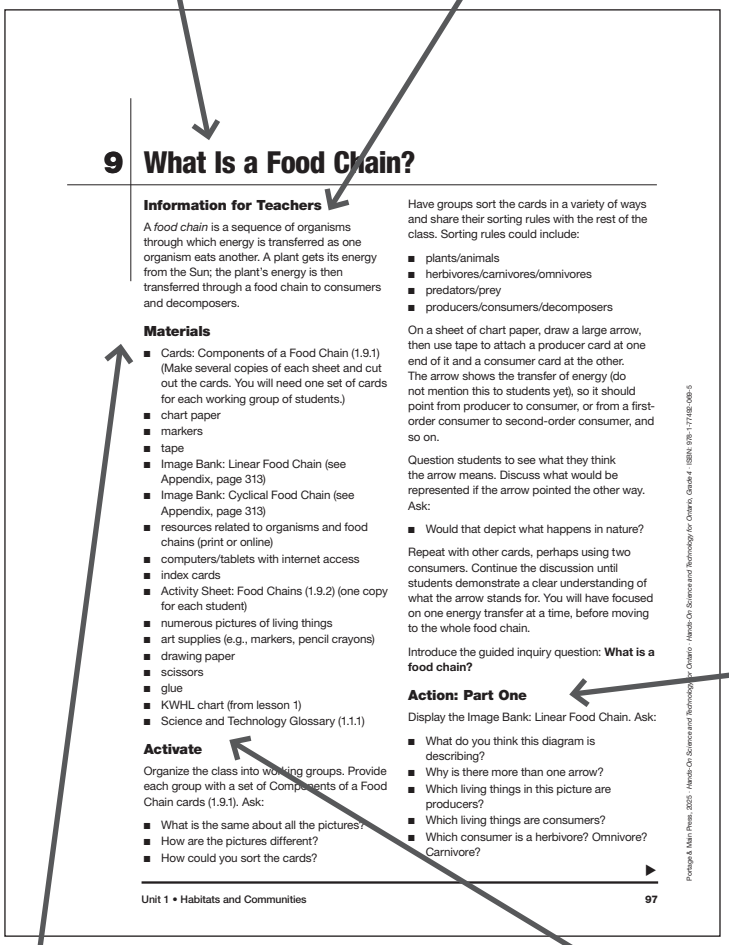
Additionally, About This Unit includes lists of related resources (books and online videos), annotated websites suitable for students, and coding and STEM resources.

Each unit is organized into numbered lessons composed of topics and activities based on the overall and specific expectations. Lessons are arranged in the following format:

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Lesson Title
- posed as a guided inquiry question related to the expectations addressed in the lesson

Information for Teachers
- provides basic scientific and technological knowledge needed for the activities



9 What Is a Food Chain?

Information for Teachers

A *food chain* is a sequence of organisms through which energy is transferred as one organism eats another. A plant gets its energy from the Sun; the plant's energy is then transferred through a food chain to consumers and decomposers.

Materials

- Cards: Components of a Food Chain (1.9.1) (Make several copies of each sheet and cut out the cards. You will need one set of cards for each working group of students.)
- chart paper
- markers
- tape
- Image Bank: Linear Food Chain (see Appendix, page 313)
- Image Bank: Cyclical Food Chain (see Appendix, page 313)
- resources related to organisms and food chains (print or online)
- computers/tablets with internet access
- index cards
- Activity Sheet: Food Chains (1.9.2) (one copy for each student)
- numerous pictures of living things
- art supplies (e.g., markers, pencil crayons)
- drawing paper
- scissors
- glue
- KWHL chart (from lesson 1)
- Science and Technology Glossary (1.1.1)

Activate

Organize the class into working groups. Provide each group with a set of Components of a Food Chain cards (1.9.1). Ask:

- What is the same about all the pictures?
- How are the pictures different?
- How could you sort the cards?

Have groups sort the cards in a variety of ways and share their sorting rules with the rest of the class. Sorting rules could include:

- plants/animals
- herbivores/carnivores/omnivores
- predators/prey
- producers/consumers/decomposers

On a sheet of chart paper, draw a large arrow, then use tape to attach a producer card at one end of it and a consumer card at the other. The arrow shows the transfer of energy (do not mention this to students yet), so it should point from producer to consumer, or from a first-order consumer to second-order consumer, and so on.

Question students to see what they think the arrow means. Discuss what would be represented if the arrow pointed the other way. Ask:

- Would that depict what happens in nature?

Repeat with other cards, perhaps using two consumers. Continue the discussion until students demonstrate a clear understanding of what the arrow stands for. You will have focused on one energy transfer at a time, before moving to the whole food chain.

Introduce the guided inquiry question: **What is a food chain?**

Action: Part One

Display the Image Bank: Linear Food Chain. Ask:

- What do you think this diagram is describing?
- Why is there more than one arrow?
- Which living things in this picture are producers?
- Which living things are consumers?
- Which consumer is a herbivore? Omnivore? Carnivore?

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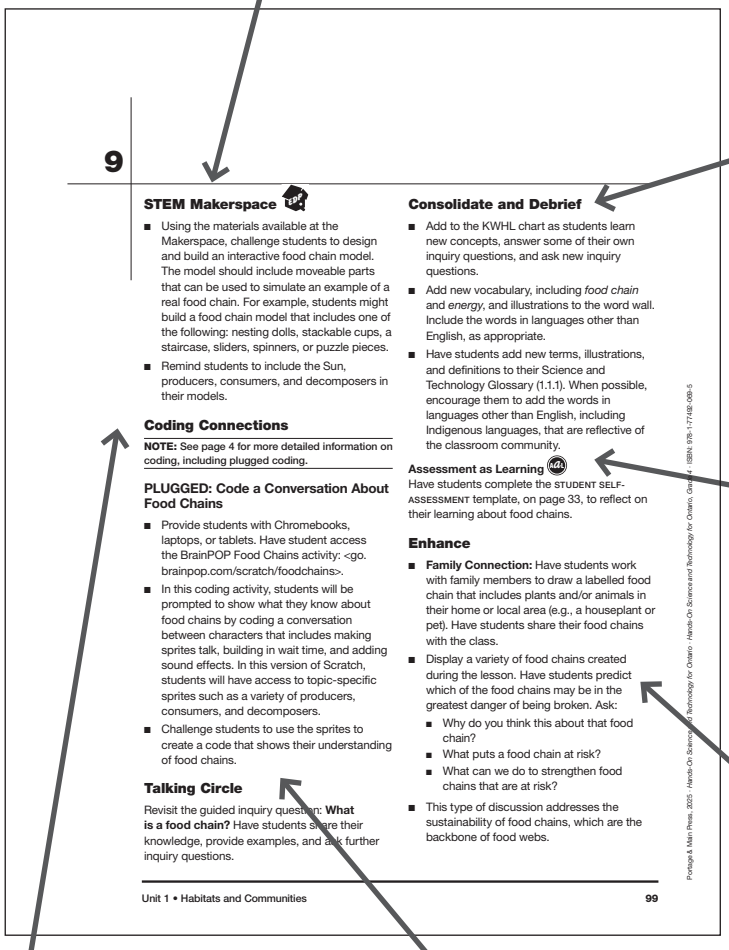
Action
- details a step-by-step procedure, including higher-level questioning techniques, and suggestions for encouraging the development of new knowledge and skills
- identified as Action: Part One, Action: Part Two, and so on (when there is more than one Action activity in a lesson)

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 to encourage discussion
- connects to Image Bank visuals, which may be printed or projected for specific activities (see Appendix on page 313 for thumbnails and free access)

Activate
- activates prior knowledge, piques students' curiosity about related concepts, and introduces the lesson's guided inquiry question
- teachers may choose to record the guided inquiry question for display (e.g., on a sentence strip) so students can refer to it during activities and discussion

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STEM Makerspace
- addresses STEM concepts and skills and promotes personalized learning, open inquiry, discovery, creation, and innovation related to the unit expectations
- suggests materials, equipment, and challenges related to the specific science and technology topics of study, while correlating with other subject areas



9

STEM Makerspace

- Using the materials available at the Makerspace, challenge students to design and build an interactive food chain model. The model should include moveable parts that can be used to simulate an example of a real food chain. For example, students might build a food chain model that includes one of the following: nesting dolls, stackable cups, a staircase, sliders, spinners, or puzzle pieces.
- Remind students to include the Sun, producers, consumers, and decomposers in their models.

Coding Connections

NOTE: See page 4 for more detailed information on coding, including plugged coding.

PLUGGED: Code a Conversation About Food Chains

- Provide students with Chromebooks, laptops, or tablets. Have student access the BrainPOP Food Chains activity: <go.brainpop.com/scratch/foodchains>.
- In this coding activity, students will be prompted to show what they know about food chains by coding a conversation between characters that includes making sprites talk, building in wait time, and adding sound effects. In this version of Scratch, students will have access to topic-specific sprites such as a variety of producers, consumers, and decomposers.
- Challenge students to use the sprites to create a code that shows their understanding of food chains.

Talking Circle

Revisit the guided inquiry question: **What is a food chain?** Have students share their knowledge, provide examples, and ask further inquiry questions.

Consolidate and Debrief

- Add to the KWHL chart as students learn new concepts, answer some of their own inquiry questions, and ask new inquiry questions.
- Add new vocabulary, including *food chain* and *energy*, and illustrations to the word wall. Include the words in languages other than English, as appropriate.
- Have students add new terms, illustrations, and definitions to their Science and Technology Glossary (1.1.1). When possible, encourage them to add the words in languages other than English, including Indigenous languages, that are reflective of the classroom community.

Assessment as Learning

Have students complete the STUDENT SELF-ASSESSMENT template, on page 33, to reflect on their learning about food chains.

Enhance

- **Family Connection:** Have students work with family members to draw a labelled food chain that includes plants and/or animals in their home or local area (e.g., a houseplant or pet). Have students share their food chains with the class.
- Display a variety of food chains created during the lesson. Have students predict which of the food chains may be in the greatest danger of being broken. Ask:
  - Why do you think this about that food chain?
  - What puts a food chain at risk?
  - What can we do to strengthen food chains that are at risk?
- This type of discussion addresses the sustainability of food chains, which are the backbone of food webs.

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Unit 1 • Habitats and Communities 99

Consolidate and Debrief
- suggests activities that review the main ideas of the lesson, focusing on fundamental concepts, big ideas, and overall and specific expectations
- offers ways for students to demonstrate what they have learned through consolidation and reflection, allowing for synthesis and application of inquiry and new ideas
- embeds learning by adding to graphic organizers; having students record, describe, and illustrate new vocabulary and communicate investigations and ideas in a Science and Technology Journal and Glossary; and adding new science and technology vocabulary to the classroom word wall
- 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

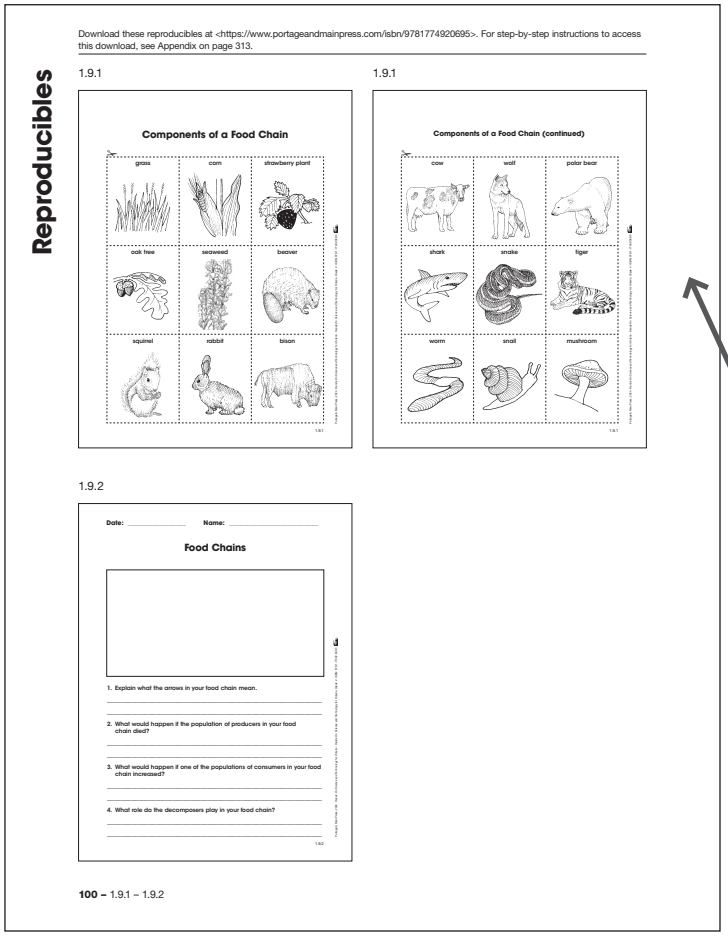
Assessment For, As, and Of Learning
- provides suggestions for authentic assessment, which includes assessment *for* learning, assessment *as* learning, and assessment *of* learning
- focuses on the specific expectations related to the particular lesson (assessment strategies are outlined in the ***Hands-On Science and Technology*** Assessment Plan on page 27)

Enhance
- encourages active participation and learning through Family Connections, tasks that students complete at home with their family members, then bring back to school to share
- suggests additional optional activities to extend, enrich, and reinforce the expectations

Coding Connections
- provides suggestions for plugged and unplugged coding activities; see page 5 for an explanation of plugged and unplugged coding

Talking Circles
- provides students with opportunities to participate in a Talking Circle (see page 17 for more information) to demonstrate their learning through consolidation and to debrief on guided inquiry questions

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Download these reproducibles at <https://www.portageandmainpress.com/isbn/9781774920695>. For step-by-step instructions to access this download, see Appendix on page 313.

Reproducibles

1.9.1

Components of a Food Chain

1.9.1

Components of a Food Chain (continued)

1.9.2

Date: _____ Name: _____

Food Chains

1. Explain what the arrows in your food chain mean.

2. What would happen if the population of producers in your food chain died?

3. What would happen if one of the populations of consumers in your food chain increased?

4. What role do the decomposers play in your food chain?

100 – 1.9.1 – 1.9.2

Reproducibles
- are included as thumbnails following the lesson and can be downloaded by following the step-by-step instructions on page 313
- may be used to guide activities or record data
- may also serve as a template for designing and constructing graphic organizers

NOTE: Activity sheets are meant to be used only in conjunction with, or as a follow-up to, the hands-on activities. The activity sheets are not intended to be the science and technology lesson in itself or the sole assessment for the lesson.

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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 others listen
- the stick is passed 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 (for more information, see First Nations Pedagogy Online, "Talking Circles," at <www.firstnationspedagogy.ca/circletalks.html>)

Consider inviting a local Elder or Knowledge Keeper to share with the class the process of a Talking Circle.

STEM Makerspaces

To address STEM concepts and skills and promote personalized learning, each unit of ***Hands-On Science and Technology*** includes suggestions for STEM Makerspace materials, equipment, and challenges related to the specific science and technology topics of study, while correlating with other subject areas. Suggestions are intended to support open inquiry, discovery, creation, and innovation related to the unit expectations.

A Makerspace is a creative do-it-yourself environment, where students pose questions, share ideas, and explore hands-on projects.

In the school setting, a STEM Makerspace is usually cross-curricular and allows for inquiry, discovery, and innovation. Sometimes, the STEM Makerspace is housed in a common area, such as the library, where it can be used by the whole school community. A classroom STEM Makerspace is usually designed as a centre where students apply knowledge, concepts, and skills acquired in a particular lesson to STEM challenges. Students often create do-it-yourself projects, learning together and collaborating on cross-curricular ideas or classroom themes. It is important to remember that learning is not directed here. The goal is to create conditions for learning and give students the opportunity to work with a variety of age-appropriate tools. The centre may evolve to foster inquiry within a specific topic.

There is no list of required equipment that defines a STEM Makerspace; however, there are some items that should be included such as paper, cardboard, everyday recycled materials, tape, and glue. You may wish to include reusable building materials such as interlocking plastic building blocks, snap cubes, pattern blocks, and straws and connectors. Arts-and-crafts materials such as construction paper, modelling clay, fabric, buttons, and pipe cleaners are often provided.

Consider the following when planning and developing a STEM Makerspace centre:

- Always address safety concerns, ensuring materials, equipment, and tools are safe for student use. Include safety gloves and goggles, as appropriate.
- Consider space and storage needs. Mobile carts and/or bins are handy for storing raw materials and tools.
- With students, write a letter to parents/guardians to explain the purpose of the Makerspace and ask for donations of materials.

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The following resources provide information about including STEM in the classroom:

- Ontario Science Centre STEM Education Toolkit: <https://www.ontariosciencecentre.ca/teachers-plus-students/teacher-resources/stem-education-toolkit>
- Ontario Council for Technology Education: <https://octe.ca/resources/elementary>
- Let's Talk Science: <https://letstalkscience.ca/>

Classroom Environment

The classroom setting is an important component of the learning process. An effective classroom environment is inclusive of the diverse backgrounds and learning needs of all students. The strengths students bring to school are identified and nurtured. At the same time, every student is supported so they can succeed. The classroom must also be a space that encourages inquiry and discussion. To promote inquiry in the classroom:

- Encourage students to ask questions and to appreciate different perspectives.
- Foster a nonthreatening atmosphere in which all students are comfortable sharing.
- Provide lots of opportunities for students to reflect on questions, share ideas, and generate further questions for inquiry.
- Promote discussion with and between students, as they need to talk about ideas with each other and with the teacher to help make meaning.
- Model for students how to gather the information they need so they have an adequate foundation for discussion.
- Ensure questions are clear and vocabulary is appropriate to learners.
- Avoid dominating discussion.
- Provide equal opportunities for all learners to participate.
- Model good questions and questioning strategies.
- Guide students in discovering answers to questions.

An active environment—one that gently hums with students' purposeful conversations and activities—indicates that meaningful learning is taking place. When your class is studying a specific topic, display related objects and materials in the room, including student work; pictures and posters, maps, graphs, and charts made during activities; and anchor charts of important concepts, procedures, skills, or strategies that are co-constructed with students. Visuals serve as a source of information, reinforce concepts and skills that have been stressed during lesson activities, and support students who are visual learners. As a support throughout the unit, display charts outlining success criteria so that vocabulary and concepts are visible to students at all times.

Planning Units

Timelines

No two groups of students explore topics and materials at the same rate, and so planning the duration of lessons and units is an important responsibility of the teacher. In some cases, students will not complete a lesson's activities during one block of time. In addition, students may be especially interested in one topic and want to expand on it. Consider the individual needs of your class; there are no strict timelines for ***Hands-On Science and Technology.*** It is important, however, to spend time on every unit so that students focus on all the curriculum expectations for this grade level.

Classroom Management

Hands-On Science and Technology provides students with many opportunities to participate in hands-on activities; they will benefit more

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from this type of primary experience than if you merely demonstrate the activities. Although hands-on activities are emphasized, how these experiences are managed is up to the teacher, since it is you who ultimately determines how your students function best in the learning environment. In some cases, you may have all students manipulating materials individually; in others, you may choose to organize the class into small groups.

Organizing the class into small groups of three or four students is the most productive and beneficial way to manage the activities. Group work encourages the development of social skills, enables all students to be active in the learning process, and can reduce the cost of materials and equipment. Students learn from their classmates while working in collaborative groups.

When working in collaborative groups, it may be helpful to assign each student a role:

- **leader**: makes sure everyone in the group has an opportunity to share their ideas and opinions
- **recorder**: records the group's data, research, questions, and any other information on the lesson's sheets or charts
- **reporter**: reports the group's ideas, findings, or answers back to the class
- **gopher**: collects and returns all materials needed for each activity

The quantity of materials required will depend on how you conduct activities. If students are working individually, you will need enough materials for each student. If students are working in groups, the materials required will be significantly reduced.

Classroom Safety

The nature of science and technology, and of scientific and technological experimentation, means that safety concerns arise from time to time. In these instances, teachers may decide to demonstrate an activity themselves, while encouraging as much student interaction as possible. Throughout ***Hands-On Science and Technology***, whenever there is a potential safety issue to be aware of, the following icon appears:



Land-Based Learning

Land-based learning replaces the classroom walls with the natural environment. Land-based learning offers all students first-hand opportunities to observe, explore, and investigate the land, waters, and atmosphere of the natural world. Land-based learning promotes a healthy interplay between society and nature and helps students envision a world where there is meaningful appreciation and respect for our natural environment—an environment that sustains all life forms. Many lessons in ***Hands-On Science and Technology*** incorporate land-based learning activities, ranging from a casual walk around the neighbourhood to examine trees to a more involved exploration of local waterways. When land-based learning connections are made in ***Hands-On Science and Technology***, the following icon appears:



References

First Nations Pedagogy Online. "Talking Circles." www.firstnationspedagogy.ca/circletalks.html.

Ontario Ministry of Education. *The Ontario Curriculum, Grades 1–8: Science and Technology*, 2022. https://www.dcp.edu.gov.on.ca/en/curriculum/science-technology.

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Scientific and Engineering Design Processes

Scientific Inquiry Skills: Guidelines for Teachers

Hands-On Science and Technology is based on a scientific inquiry approach. While involved in the lessons, students use a variety of inquiry skills as they answer questions, solve problems, and make decisions. These skills are not unique to science and technology, but are integral to students' development of scientific and technological literacy. They include initiating and planning, performing and recording, analyzing and interpreting, and communicating and working in teams. In the early years, basic skills should focus on scientific inquiry and problem solving.

Use the following guidelines to encourage students' development of inquiry skills in specific areas.

Observing

Students learn to perceive characteristics and changes using all five senses. Encourage students to safely use sight, smell, touch, hearing, and taste to gain information about objects and events. Observations may be qualitative (e.g., texture, colour), quantitative (e.g., size, number), or both.

Observing includes:

- gaining information through the senses
- identifying similarities and differences, and making comparisons

Encourage students to communicate their observations in a variety of ways, including orally, in writing, by sketching labelled diagrams, and by capturing evidence digitally (e.g., using a camera or tablet).

Questioning

Generating thoughtful inquiry questions is an essential skill for students when participating in inquiry-based learning. Encourage students to be curious and to extend their questions beyond those posed to them.

Students should learn to formulate specific questions to investigate, then create, from a variety of possible methods, a plan to find answers to those questions.

Exploring

Students need ample opportunities to manipulate materials and equipment in order to discover and learn new ideas and concepts. During exploration, encourage students to use all of their senses and observation skills.

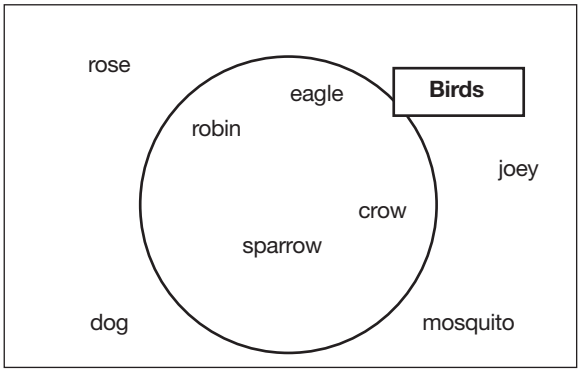
Oral discussion is also an integral component of exploration; it allows students to communicate their discoveries. At a deeper level, discussion allows students to make meaning by discussing inconsistencies/misconceptions and comparing/contrasting their observations with others. This is the constructivist model of learning, which is essential in inquiry-based learning.

Classifying

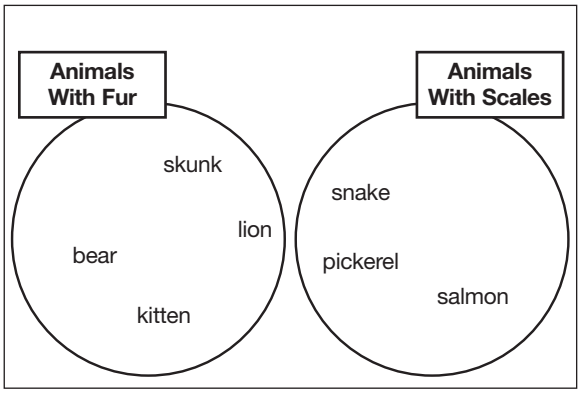
Classification is used to group or sort objects and events and is based on observable properties. For example, objects can be classified into groups according to colour, shape, or size. Two strategies for sorting are the use of sorting mats and Venn diagrams. Sorting mats show distinct groups, while Venn diagrams intersect to show similar characteristics among sets.

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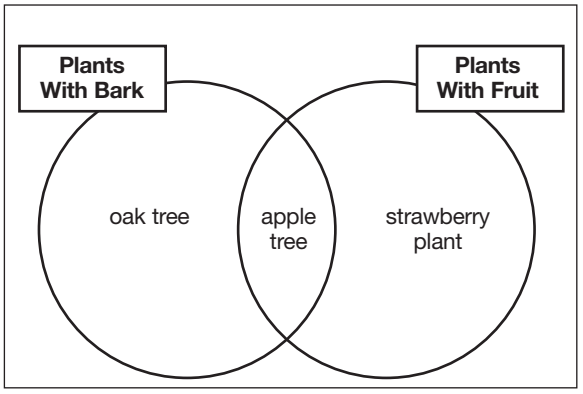
Single Sorting Mat



Double Sorting Mat



Double Venn



Measuring

Measuring is the process of discovering the dimensions or quantity of objects or events and, at the grade 4 level, usually involves comparing, ordering, and measuring objects by length, area, volume, and mass. In the early years, measuring activities first involve the use of nonstandard units of measure; for instance, interlocking cubes or paper clips may be used to determine length. By grade 4, students are using standard measuring units and tools to measure, for example, mass/weight, length, volume, and temperature. They will also measure the passage of time using seconds, minutes, and hours.

An essential skill of measurement is estimating. Encourage students to estimate before they measure, whether in nonstandard or standard units. Estimation provides opportunities for students to take risks, use prior knowledge, and enhance their measuring skills by comparing estimates and actual results.

Communicating, Analyzing, and Interpreting

In science and technology, communication is demonstrated through diagrams, graphs, charts, maps, models, and symbols, as well as written and spoken language. Communicating includes:

- reading and interpreting data from tables and charts
- constructing tables and charts
- reading and interpreting data from pictographs
- constructing pictographs
- constructing labelled diagrams
- constructing models
- using oral and written language
- sequencing and grouping events, objects, and data according to attributes

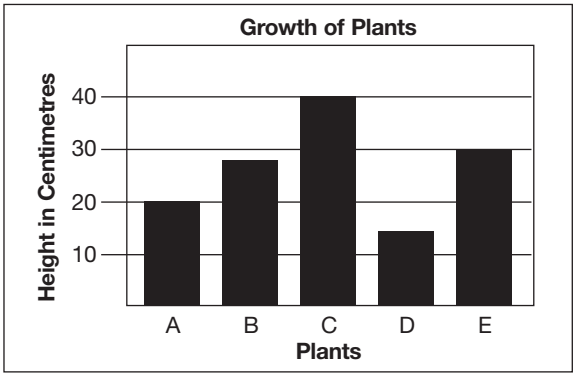
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When presenting students with charts and graphs, or when students make their own charts and graphs as part of a specific activity, the following guidelines should be followed:

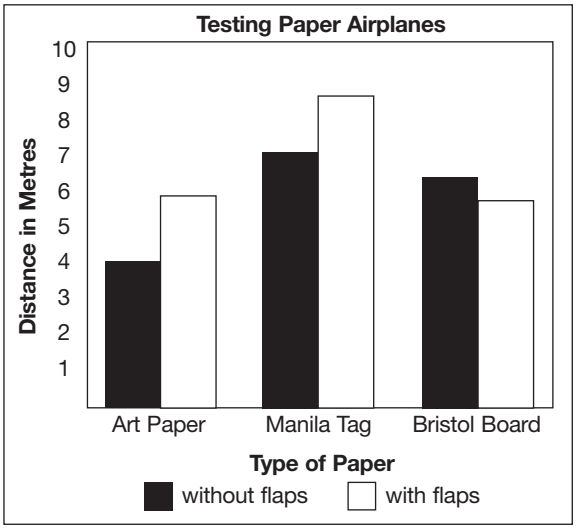
- A **pictograph** has a title and information on one axis that denotes the items being compared. (Note that the first letter of each word of both the title and the axis text is capitalized.) There is generally no graduated scale or heading for the axis representing numerical values.

Favourite Dessert				
				
				
				
				
Cake	Pie	Ice Cream		

- A **bar graph** is another common form of scientific communication that students use in grade 4. Bar graphs should always be titled so the information communicated is easily understood. Titles should be capitalized in the same manner as one would title a story. Both axes of the graph should be labelled and capitalized in the same way. In most cases, graduated markings are noted on one axis and the objects or events being compared are noted on the other. On a bar graph, the bars must be separated by well-defined spaces, as each bar represents a distinct piece of data.



- A **double bar graph** can also be used to communicate scientific results. This type of graph is commonly used when comparing similar attributes in different objects. For example, during an investigation into flight students may construct model airplanes with and without flaps, from different types of paper. The resulting double bar graph may look as follows:



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- A **stem-and-leaf plot** displays data that is organized by place value. The plot clearly shows the greatest, least, and median values in a set of data. The following stem-and-leaf plot shows books read over the summer by 10 students with these results: 6, 7, 10, 12, 12, 15, 19, 21, 23, 25.

Stem	Leaf
0	6 7
1	0 2 2 5 9
2	1 3 5

- A **chart (table)** has an appropriate title, and both columns and rows need specific headings. (Note that the first letter of each word in all titles and headings is capitalized.) In some cases, pictures can be used alongside or in place of words to make the chart easier for young students to understand. Charts can be made in the form of checklists or can include room for additional written information and data.

Checklist Chart

Which Substances Dissolve in Water?		
Substance	**Dissolves in Water**	**Does Not Dissolve in Water**
Beads		√
Sugar	√	
Drink Mix	√	
Rice		√
Pepper		√

Data Chart

Local Snowfall		
Month	**2023/2024 Snowfall (cm)**	**Average Snowfall (cm)**
October	7	5
November	9	8
December	23	20
January	29	25
February	16	18
March	11	10

- A **frequency table** is a means of recording the frequency of occurrence. A tally chart is one type of frequency table commonly used in early years. In this kind of chart, data is recorded as an organized count. The count is grouped in fives so the total can be easily determined by counting by fives.

Favourite Sport		
Sport	**Tally**	**Total**
baseball	𝍸 |	6
hockey	𝍸 𝍸	10
soccer	𝍸 𝍸 ||	12

Communicating also involves using the language and terminology of science and technology. Encourage students to use the appropriate vocabulary related to their investigations (e.g., *object, metal, pliable, absorbent, characteristic*). The language of science and technology also includes terms such as *predict, infer, estimate, measure, experiment*, and *hypothesize*. Use this vocabulary regularly throughout all activities and encourage students to do the same. As students become proficient at reading and writing, they can also be encouraged to use this vocabulary in written form. In each unit, students develop whole-class glossaries (word walls), and their own glossary in which they can record the terms they have learned.

Predicting

Predicting refers to the question, "What do you think will happen?" For example, ask students to predict what they think will happen to a blown-up balloon that is placed in a basin of water. It is important to provide opportunities for students to make predictions and for them to feel safe doing so.

NOTE: Teachers are encouraged to look for connections to Indigenous perspectives and knowledge whenever possible. For example, similar to a balloon, in many Indigenous cultures, fish stomachs and sealskins were traditionally used as flotation devices. The scientific concept is the same.

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Inferring

In a scientific context, inferring generally refers to asking why something occurs. For example, ask students to infer why a blown-up balloon floats when placed in a basin of water. It is important to encourage students to take risks when making inferences. Instead of explaining scientific phenomena to them, give students opportunities to infer using a variety of perspectives, and then build their knowledge base through inquiry and investigation.

Inquiry Through Investigation and Experimentation

When investigations and experiments are conducted in the classroom, it is essential to plan and record both the process and the results. The traditional scientific method uses the following format:

- purpose: what we want to find out, or a testable question we want to answer
- hypothesis: a prediction; what we think will happen and why
- materials: what we used to conduct the experiment or investigation
- method: what we did
- results: what we observed and measured
- conclusion: what we found out
- application: how we can use what we learned

This method of recording investigations may be used in later school years. However, in the early years, it is more useful to focus on a narrative style of reporting that includes the following:

- what we want to know
- what we think might happen
- what we used
- what we did
- what we observed
- what we found out

A simpler four-question narrative that includes the following questions may also be used with any age group.

1. What was I looking for? (Describe the question you were trying to answer or the hypothesis/prediction you were testing.)
2. How did I look for it? (Tell what you did. Include materials and method.)
3. What did I find? (Describe observations and data.)
4. What does this mean? (Draw conclusions and consider applications to real life.)

This narrative may be completed in a variety of ways: oral discussion as a class, recording findings as a class, having students use drawings and writing to communicate independently, or a combination of these.

Throughout ***Hands-On Science and Technology***, a variety of methods are used to encourage students to communicate the inquiry process, including those listed above. Formats such as concept maps and other graphic organizers are also used.

Engineering Design Process

Throughout ***Hands-On Science and Technology***, students have opportunities to use the engineering design process to design and construct objects. For example, in the STEM Makerspace activity included in unit 1, lesson 5, students design and construct an ecosystem in a jar.

The engineering design process involves having students seek solutions to practical problems. The process includes the following 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 in writing and using labelled diagrams.

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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.

The engineering design process also involves research and experimentation.

When the engineering design process is featured in a lesson of ***Hands-On Science and Technology***, the following icon is used:



Inquiry Through Research

In addition to hands-on inquiry, research is another aspect of inquiry that involves finding, organizing, and presenting information related to a specific topic or question. Even at a young age, students can begin to research topics studied in class if they are provided with support and guidelines. This is also an effective way to integrate oral communication, reading, writing, and media literacy expectations from the Ontario language curriculum for grades 1–8 (2023).

Guided research is a teaching and learning strategy that is encouraged throughout ***Hands-On Science and Technology***. It provides an opportunity for students to seek further information about subjects of inquiry, personal interests, or topics of their choice. Students are empowered and engaged in the process. Guided research encourages students and teachers to do the following:

Students	Teachers
■ ask questions of interest related to a topic being studied by the class ■ choose resources ■ collect information ■ make a plan to present findings ■ present research in a variety of ways	■ provide opportunities for students to ask questions of personal interest ■ provide access to appropriate resources ■ model and support the research process ■ offer opportunities for students to present their findings in a variety of ways and to a variety of audiences

In ***Hands-On Science and Technology***, the approach to scientific inquiry and research is one of gradual release, where the teacher provides substantial support in initial inquiry experiences, and gradually presents students with more and more opportunities for directing their own research. Suggestions for guiding research are presented regularly throughout ***Hands-On Science and Technology***.

Online Considerations

As our technological world continues to expand at an accelerating rate and information is increasingly available online, students will turn to the internet more and more. Accordingly, ***Hands-On Science and Technology*** is replete with opportunities for students to use online resources for research and investigation. Discuss online safety protocols with students and be vigilant in supervising their internet use. Review websites and bookmark those that are appropriate for student use.

Discuss plagiarism with students; explain that copying information word for word—from a book, the internet, or any other resource—is wrong. Such information should usually be paraphrased in the student's own words (sometimes including short direct quotations marked as such), and the source of the information cited. Photos, drawings, figures, and other images found online should also only be

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used with permission and citation of the source. Alternatively, students can source images for which permission has already been granted for use, such as through Creative Commons Canada, a nonprofit organization that "promotes and enables the sharing of knowledge and creativity…[and] produces and maintains a free suite of licensing tools to allow anyone to easily share, reuse, and remix materials with a fair 'some rights reserved' approach to copyright." See <http://ca.creativecommons.org>.

Addressing Students' Early Literacy Needs

The inquiry process involves having students ask questions and conduct investigations and research to answer these questions. At the grade 4 level, students may benefit from support for research, reading, and writing. Consider having volunteers, student mentors, or educational assistants help students during these processes. In some cases, such helpers may also scribe for students to communicate their findings.

References

Creative Commons Canada. http://ca.creativecommons.org.

Ontario Ministry of Education. *The Ontario Curriculum, Grades 1–8: Language,* 2023. https://www.dcp.edu.gov.on.ca/en/curriculum/elementary-language/downloads.

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The *Hands-On Science and Technology* Assessment Plan

Hands-On Science and Technology provides a variety of assessment tools that enable teachers to build a comprehensive and authentic daily assessment plan for students. Based on research about the value of quality classroom assessment (Davies, 2020), lessons include suggestions for authentic assessment, which includes assessment for learning, assessment as learning, and assessment of learning.

Ontario's policy on assessment is outlined in the document *Growing Success: Assessment, Evaluation, and Reporting in Ontario Schools* (2010). The document describes the roles of teachers and students in the learning and assessment process:

> In a traditional assessment paradigm, the teacher is perceived as the active agent in the process, determining goals and criteria for successful achievement, delivering instruction, and evaluating student achievement at the end of a period of learning. The use of assessment for the purpose of improving learning and helping students become independent learners requires a culture in which student and teacher learn together in a collaborative relationship, each playing an active role in setting learning goals, developing success criteria, giving and receiving feedback, monitoring progress, and adjusting learning strategies. The teacher acts as a "lead learner," providing support while gradually releasing more and more responsibility to the student, as the student develops the knowledge and skills needed to become an independent learner. (p. 30)

Hands-On Science and Technology supports Ontario's *Growing Success* policy by focusing assessment suggestions on the learning process during performance-based activities. Although many of the suggestions involve student writing, there are no tests or quizzes included with the units. This is because each lesson includes such a wide variety of suggested activities for teachers to choose from that tests and quizzes could not possibly reflect the specific tasks in which students participated. Since assessment needs to be directly connected to learning, ***Hands-On Science and Technology*** suggests assessment strategies that can be used in a variety of ways, and that can be modified for use with individual students or groups of students.

The primary purpose of assessment is to improve student learning. Assessment *for* learning provides students with descriptive feedback and coaching for improvement. Assessment *as* learning helps students self-assess by developing their capacity to set their own goals, monitor their own progress, determine next steps, and reflect on their learning. Assessment *of* learning is summative in nature and is conducted by teachers to identify student progress in relation to learning expectations. The challenge for teachers is to integrate assessment seamlessly with other learning goals. The Ontario assessment model, described in *Growing Success*, uses the following process:

- **Establish learning goals from curriculum expectations**. Develop learning goals from curriculum expectations and include them in lessons, using student-friendly language. Share them with students and use them to guide instruction.
- **Develop success criteria**. Establish success criteria, using assessment task exemplars of student work or the Achievement Chart for Science and Technology (provided on pages 36–38) from *The Ontario Curriculum, Grades 1–8: Science and Technology* (2022), or in collaboration with students. Write these descriptors in student-friendly language to help students understand what successful learning looks like.
- **Provide descriptive feedback**. In conversations with students, identify what criteria they have and have not met, and provide any needed instruction. Work with

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students to determine next steps and how they can improve. This may include differentiating instruction.

- **Use information for peer and self-assessment**. Have students assess their own work and the work of their peers to determine what still needs to be done.
- **Establish individual goals**. Encourage students to determine what they need to learn next and how to get there.

Hands-On Science and Technology encourages assessment strategies that infuse these five elements of the Ontario assessment model, providing assessment suggestions, rubrics, and templates that can be used during the teaching/learning process. Assessment suggestions include tasks related to assessment for learning, assessment as learning, and assessment of learning.

Assessment *for* Learning

It is important to assess students' understanding before, during, and after a lesson. This information will help you determine students' needs and plan next steps in instruction.

Begin by finding out what students already know. This will allow you to identify misconceptions students may have about science and technology concepts and can help when making connections to new learning.

To assess students as they work, use the assessment for learning suggestions provided with many activities. While observing and conversing with students, consider using one or both of the following templates to record assessment for learning data:

- **Anecdotal Record:** To gain an authentic view of student progress, it is critical to record observations *during* lessons. The ANECDOTAL RECORD template (page 32) provides a format for recording observations about individuals or groups.
- **Individual Student Observations**: To focus more on individual students, consider using the INDIVIDUAL STUDENT OBSERVATIONS template (page 32). This template provides more space for comments and is especially useful during conferences, interviews, or individual student performance tasks.

Assessment *as* Learning

It is important for students to reflect on their own learning in relation to science and technology. For this purpose, a STUDENT SELF-ASSESSMENT template is provided (page 32), as well as a STUDENT REFLECTIONS template (page 32).

In addition, the SCIENCE AND TECHNOLOGY JOURNAL (page 33) can be used to encourage students to reflect on their own learning. Print several copies for each student, cut the pages in half, add a cover, and bind the pages together. Students can create their own title pages for their journals. For variety, have students use the blank reverse side of each page for other reflections, such as drawing or writing about:

- new science and technology challenges
- favourite science and technology activities
- real-life experiences with science and technology
- new terminology
- new places explored during investigations

Students may also journal in other ways, such as by adding notes to their portfolios, or by keeping online science and technology blogs or journals to record successes, challenges, and next steps relating to the learning goals.

NOTE: The SCIENCE AND TECHNOLOGY JOURNAL template is provided as a suggestion, but journals can also be made from simple notebooks or recycled paper.

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When working in groups, students will benefit from reflecting on their ability to listen to others respectfully, share ideas, and participate actively in the inquiry process. For this purpose, use the COLLABORATION SKILLS SELF-ASSESSMENT template (page 33).

Assessment *of* Learning AOL

Assessment *of* learning provides a summary of student progress related to accomplishing the learning goals at a particular point in time. To draw conclusions about what a student knows and can do, it is important to gather a variety of assessment data. Consider collecting student products, observing processes, and having conversations with students. Determine which student work is formative and which is summative, and use only the most recent and consistent evidence.

Assessment *of* learning suggestions are provided with the culminating lesson of each unit of ***Hands-On Science and Technology***. To record student results, use the ANECDOTAL RECORD template (page 32), the INDIVIDUAL STUDENT OBSERVATIONS template (page 32), and the RUBRIC (page 34).

Always assess a student's individual accomplishments, rather than the work they do in a group. However, you may assess *how* an individual student works within a group. Such skill development includes the ability to listen to others respectfully, share ideas, and participate actively in the inquiry process. For this purpose, use the COLLABORATION SKILLS TEACHER ASSESSMENT template (page 33).

As mentioned on page 27, ***Hands-On Science and Technology*** does not provide tests and quizzes for units of study. Any formal assessment of students needs to be connected to the specific skills and concepts focused on during lessons, and since each teacher will select different activities from those provided within each lesson, assessment tasks will look different in each classroom. Consider focusing on the various assessment suggestions provided and using the Achievement Chart for Science and Technology on pages 36–38 as your guide.

Performance Assessment

Both assessment *for* learning and assessment *of* learning include performance assessment. Performance assessment is planned, systematic observation and assessment based on students actually doing a specific science and technology activity. Teacher- or teacher/student-created rubrics can be used to assess student performance.

Use the SAMPLE RUBRIC and the RUBRIC template (page 34) for this assessment. For any specific activity, before the work begins, discuss with students success criteria for completing the task. This will ensure that the success criteria relate to the lesson's learning goals. Record these criteria on the rubric.

When conducting assessment *for* learning, review the rubric with students to determine strengths, challenges, and next steps related to learning goals.

When conducting assessment *of* learning, use the rubric to determine summative data. For example, use the rubric criteria to assess student performance, and students can receive a check mark for each criterion accomplished to determine a rubric score from a total of four marks. These rubric scores can then be transferred to the RUBRIC CLASS RECORD template (page 34).

When using the rubric for assessment *of* learning, consider using four levels of achievement to correlate with the Achievement Chart for Science and Technology (pages 36–38).

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For example:

1. achievement that falls much below the provincial standard
2. achievement that approaches the provincial standard
3. achievement that meets the provincial standard
4. achievement that surpasses the provincial standard

Hands-On Science and Technology provides numerous opportunities for students to apply their skills. Consider using the same levels of achievement throughout the year to track student learning and determine when students have a thorough understanding and demonstrate in-depth application of concepts and skills.

Portfolios

A portfolio is a collection of work that shows evidence of a student's learning. There are many types of portfolios—the showcase portfolio and the progress portfolio are two popular formats. *Showcase portfolios* highlight the best of students' work, with students involved in selecting pieces and justifying their choices. *Progress portfolios* reflect students' progress as their work improves and aim to demonstrate in-depth understanding of the materials over time.

Select, with student input, work to include in a science and technology portfolio or in a science and technology section of a multi-subject portfolio. Selections should include representative samples of student work in all types of science and technology activities.

Use the PORTFOLIO TABLE OF CONTENTS template (page 34) and PORTFOLIO ENTRY RECORD (page 35) to organize the portfolio.

Indigenous Perspectives on Assessment

From an Indigenous perspective, assessment is community-based, qualitative, and holistic, and includes input from all the people who influence an individual student's learning—parents, caregivers, Elders, Knowledge Keepers, community members, and teachers. An assessment that includes all these perspectives provides a balanced understanding of what represents success for Indigenous students and their family/community. A strong partnership between parents/guardians/community and school improves student achievement. Be aware that some Indigenous students may feel apprehensive about a formal process of assessment; others may find that Western achievement goals do not fit their worldview. In ***Hands-On Science and Technology***, consideration has been given to assessment from an Indigenous perspective. The following suggestions support this perspective:

- Consider learning and assessment in a holistic way, acknowledging that each student will find identity, meaning, and purpose through connections to the community, the natural world, and values such as respect and gratitude.
- Directly questioning the information being taught is not necessarily common to the process of gaining knowledge within an Indigenous perspective; instead, observation and waiting to gain understanding may be more familiar. Acknowledge this cultural difference and reassure students that the observations they make and their ability to demonstrate their understanding are valid.
- Incorporate family and community in learning and assessment. Include parents/caregivers, siblings, grandparents, aunts and uncles, cousins, and community members such as Elders, Knowledge Keepers, daycare staff,

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babysitters, and coaches. For this purpose, consider using the FAMILY AND COMMUNITY CONNECTIONS: ASSESSING TOGETHER template (page 33). After any lesson or unit, students can take home a copy of this template to complete with family or community members (with permission). This template can also be completed by students in pairs, to enhance the sense of community in the classroom.

- Have students take home one of their self-assessment templates (STUDENT SELF-ASSESSMENT, STUDENT REFLECTIONS, SCIENCE AND TECHNOLOGY JOURNAL, or COLLABORATION SKILLS SELF-ASSESSMENT) to explain it to a family or community member. These templates can also be shared with a peer to enhance the sense of community within the school.

Evidence of Student Achievement Levels for Evaluation

At the end of each unit, determine achievement levels for each student. Assessment *of* learning information gathered throughout the unit can be used to identify these levels, according to the Ontario Achievement Chart for Science and Technology. The most recent and consistent assessment information should be used to determine achievement levels. The Achievement Chart for Science and Technology is provided on pages 36–38.

Important Note to Teachers

Throughout ***Hands-On Science and Technology***, suggestions are provided for assessment *for* learning, assessment *as* learning, and assessment *of* learning. Keep in mind that these are merely suggestions. Use the assessment strategies presented in a wide variety of ways, and build an effective assessment plan using these assessment ideas, as well as your own valuable experiences as a teacher.

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Achievement Chart for Science and Technology

The achievement chart identifies four categories of knowledge and skills and four levels of achievement in science and technology.

1. Knowledge and Understanding – Subject-specific content acquired in each grade (knowledge), and the comprehension of its meaning and significance (understanding)				
Categories	**Level 1**	**Level 2**	**Level 3**	**Level 4**
	The student:			
Knowledge of content (e.g., facts, terminology, definitions)	demonstrates limited knowledge of content	demonstrates some knowledge of content	demonstrates considerable knowledge of content	demonstrates thorough knowledge of content
Understanding of content (e.g., concepts, ideas, theories, principles, procedures, processes)	demonstrates limited understanding of content	demonstrates some understanding of content	demonstrates considerable understanding of content	demonstrates thorough understanding of content
2. Thinking and Investigation – The use of critical and creative thinking skills and inquiry and problem-solving skills and/or processes				
Categories	**Level 1**	**Level 2**	**Level 3**	**Level 4**
	The student:			
Use of initiating and planning skills and strategies (e.g., formulating questions, identifying the problem, developing hypotheses, scheduling, selecting strategies and resources, developing plans)	uses initiating and planning skills and strategies with limited effectiveness	uses initiating and planning skills and strategies with some effectiveness	uses initiating and planning skills and strategies with considerable effectiveness	uses initiating and planning skills and strategies with a high degree of effectiveness
Use of processing skills and strategies (e.g., performing and recording; gathering evidence and data; examining different points of view; selecting tools, equipment, materials, and technology; observing; manipulating materials; proving)	uses processing skills and strategies with limited effectiveness	uses processing skills and strategies with some effectiveness	uses processing skills and strategies with considerable effectiveness	uses processing skills and strategies with a high degree of effectiveness
Use of critical/creative thinking processes, skills, and strategies (e.g., analysing, interpreting, problem solving, evaluating, forming and justifying conclusions on the basis of evidence, developing solutions, considering diverse perspectives)	uses critical/ creative thinking processes, skills, and strategies with limited effectiveness	uses critical/ creative thinking processes, skills, and strategies with some effectiveness	uses critical/ creative thinking processes, skills, and strategies with considerable effectiveness	uses critical/ creative thinking processes, skills, and strategies with a high degree of effectiveness

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3. Communication – The conveying of meaning through various forms				
Categories	**Level 1**	**Level 2**	**Level 3**	**Level 4**
	The student:			
Expression and organization of ideas and information in oral, visual, and/or written forms (e.g., diagrams, models, articles, project journals, reports)	expresses and organizes ideas and information with limited effectiveness	expresses and organizes ideas and information with some effectiveness	expresses and organizes ideas and information with considerable effectiveness	expresses and organizes ideas and information with a high degree of effectiveness
Communication for different audiences (e.g., peers, adults, community members) **and purposes** (e.g., to inform, to persuade) **in oral, visual, and/or written forms**	communicates for different audiences and purposes with limited effectiveness	communicates for different audiences and purposes with some effectiveness	communicates for different audiences and purposes with considerable effectiveness	communicates for different audiences and purposes with a high degree of effectiveness
Use of conventions, vocabulary, and terminology of the discipline in oral, visual, and/or written forms (e.g., symbols, formulae, International System of Units)	uses conventions, vocabulary, and terminology of the discipline with limited effectiveness	uses conventions, vocabulary, and terminology of the discipline with some effectiveness	uses conventions, vocabulary, and terminology of the discipline with considerable effectiveness	uses conventions, vocabulary, and terminology of the discipline with a high degree of effectiveness
4. Application – The use of knowledge and skills to make connections within and between various contexts				
Categories	**Level 1**	**Level 2**	**Level 3**	**Level 4**
	The student:			
Application of knowledge and skills (e.g., concepts and processes; procedures related to the safe use of tools, equipment, materials, and technology; investigation skills) **in familiar contexts**	applies knowledge and skills in familiar contexts with limited effectiveness	applies knowledge and skills in familiar contexts with some effectiveness	applies knowledge and skills in familiar contexts with considerable effectiveness	applies knowledge and skills in familiar contexts with a high degree of effectiveness
Transfer of knowledge and skills (e.g., concepts and processes, safe use of equipment and technology, investigation skills) **to new contexts**	transfers knowledge and skills to new contexts with limited effectiveness	transfers knowledge and skills to new contexts with some effectiveness	transfers knowledge and skills to new contexts with considerable effectiveness	transfers knowledge and skills to new contexts with a high degree of effectiveness

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Making connections within and between various contexts (e.g., connections between sciences; connections to everyday and real-life situations; connections among concepts within science and technology; connections involving use of prior knowledge and experience; connections among science and technology and other disciplines, including other STEM [science, technology, engineering, and mathematics] subjects)	makes connections within and between various contexts with limited effectiveness	makes connections within and between various contexts with some effectiveness	makes connections within and between various contexts with considerable effectiveness	makes connections within and between various contexts with a high degree of effectiveness
Proposing courses of practical action to deal with problems relating to our changing world	proposes courses of practical action of limited effectiveness	proposes courses of practical action of some effectiveness	proposes courses of practical action of considerable effectiveness	proposes highly effective courses of practical action

Source: Ontario Ministry of Education. "Assessment and Evaluation of Student Achievement." Elementary Science and Technology (2022). https://www.dcp.edu.gov.on.ca/en/curriculum/science-technology/context/evaluation.

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Unit 1

Habitats and Communities

About This Unit

In this unit of ***Hands-On Science and Technology for Ontario, Grade 4***, students will become familiar with the basic needs of plants and animals. They will investigate the concepts of habitat and community and explore and compare ways in which communities of plants and animals meet their needs in specific habitats. Through investigation, students will identify factors that can affect habitats and communities of plants and animals. They will explore both the dependency of living things on their habitats and the interrelationships of plants and animals living in a specific habitat. They will describe ways humans can change habitats and the effects these changes have on the living things within them.

Planning Tips for Teachers

- There is no better way to motivate students to learn about animals than having a live animal in the classroom. Students will find the concepts and objectives within this unit more meaningful if they have an animal to observe and care for. Many animals are relatively easy to look after and suitable for the classroom. Fish, for example, are easily cared for, and a fish tank provides an excellent observation centre. Guinea pigs are large enough for students to handle, not fast enough to escape, and usually gentle and affectionate. To introduce a greater variety of animals to students, consider having guest pets (e.g., bird, rabbit, gerbil, snake, gecko) visit the classroom for a month at a time.

SAFETY NOTE: Consider student allergies when selecting a classroom animal. An allergy to one animal should not, however, prevent educators from introducing another animal to the class.

NOTE: Be aware of the ethics and legalities of having live plants and animals in the classroom, and of using biological tissues such as owl pellets. ***Safety in Elementary Science and Technology*** is a helpful resource created by the Science Teachers' Association of Ontario in partnership with the Toronto District School Board to help guide Ontario teachers in these matters: <https://cdn-5cb4e3b3f911cf0dc86f377b.closte.com/wp-content/uploads/2021/08/Safety-in-Elementary-Bd-Version-Updated.pdf>.

- Collect a variety of pictures, books, and videos depicting plant and animal populations, habitats, and relationships within environmental communities. Involve students in collecting resources. Good sources for images include:
  - old calendars
  - magazines (e.g., *Ranger Rick*, *Owl*, *Chickadee*, *Highlights for Children*, *Canadian Geographic*, *National Geographic*)
  - gardening magazines
  - seed catalogues
  - websites (see Resources for Students, pages 46 and 47)
  - departments of agriculture
  - forestry and environmental associations
  - local zoological, wildlife, animal protection, and naturalist organizations
  - government conservation departments and local water/wildlife conservation associations (e.g., Conservation Ontario, Toronto and Region Conservation Authority)

NOTE: Many organizations will provide booklets, posters, and other useful information for teachers. Some may also provide kits or presentations for classrooms.

- Collect a variety of fiction and nonfiction books about animals, plants, and habitats at a range of reading levels appropriate for

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your students. Keep these reading materials at the Habitats and Communities Library (set up in lesson 1, Action: Part Six) for reference throughout the unit.

- Consider recording each lesson's guided inquiry question (e.g., on a sentence strip) for display throughout related investigations.
- Whenever possible, use reusable or recycled items for classroom experiments, activities, and demonstrations. For example, rather than single-use zipper-lock bags, use silicon or sturdy plastic bags that can be washed and reused.
- Lesson 2 suggests an outing to a local lake to experience first-hand the plants and animals that live in that habitat. If taking the class on this trip, arrange the details early.
- Lesson 3 includes a visit to a local habitat (e.g., park, stream, wildlife area, forest, prairie) with a variety of plant and animal populations. Arrange this early.

STEM Makerspace

Add some unit-specific materials to the STEM Makerspace that encourage learning about habitats and communities, in addition to the general materials listed in the Introduction to ***Hands-On Science and Technology for Ontario, Grade 4*** (see page 17). Include items such as a variety of live plants as well as plant parts (e.g., seeds, leaves, bark, fruit). Provide a variety of animal artifacts such as feathers, shells, furs, skeletons, and insect specimens. Read through the STEM Makerspace activities and arrange for any necessary materials ahead of time.

SAFETY NOTE: Discuss safety and respect at the Makerspace with students before beginning this unit. Consider small parts and potential hazards for students of all ages and abilities who will have access to the area.

Indigenous Knowledge and Perspectives

Incorporate Indigenous knowledge and perspectives into lessons whenever possible. Traditional teachings for many Indigenous Peoples that connect to habitats and communities include the following:

- It is important to have a respectful relationship with nature, including all plants and animals.
- Humans have an interconnected relationship with other animals and rely on other animals and plants for sustenance.
- All life—plant, animal, and human—is equal, and all living things are dependent upon one another for survival. For example, the Haudenosaunee grew beans, corn, and squash together. This trio of companion plants is known as the *three sisters*. They were planted together because of the benefits each plant provides to the others. The beans add beneficial nitrogen to the soil. The corn provides a support on which the beans can climb. The squash provides shade for the roots of the other plants, helping to maintain the soil's moisture, and its prickly leaves keep pests away.
- Animals give up their lives to provide humans with what they need for survival; therefore, out of respect, no part of a sacrificed animal should be wasted. When an animal is hunted, every part of it is used for food, clothing, tools, and/or shelter.

Traditionally, Indigenous Peoples' existence was dependent on animals for everything, from signalling seasonal changes, to assisting with agricultural pursuits, to transportation, shelter, clothing, and, of course, food. With a true appreciation of where their food comes from, Indigenous Peoples traditionally have in-depth knowledge of hunting, as well as the animals

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they hunt. They have developed relationships with animals, who, in addition to being integral to survival, are seen as teachers, guides, and companions.

Traditional Ecological Knowledge (TEK) refers to traditional knowledge regarding the sustainability of local resources for generations to come and the relationship of living beings with their environment. This knowledge is based on a cumulative body of knowledge, beliefs, and practices handed down from generation to generation through traditional songs, stories, and oral teachings.

Science and Technology Vocabulary

Throughout the unit, use, and encourage students to use, vocabulary such as:

- *adapt, adaptation, behavioural adaptation, camouflage, carnivore, community, conservation, consumer, decomposer, endangered, energy, extinct, first-order consumer, food chain, food web, habitat, herbivore, living thing, omnivore, organism, photosynthesis, population, predator, prey, producer, scavenger, second-order consumer, species, structural adaptation, third-order consumer, traditional knowledge*

Infuse vocabulary related to scientific and technological inquiry skills into daily lessons. Display this vocabulary in the classroom throughout the year, as it relates to all science and technology units. Have students determine which skills they are being asked to use as they work through particular lessons. Discuss what the skill looks and sounds like as students explore and investigate. Vocabulary related to scientific and technological inquiry skills includes:

- *access, ask, brainstorm, collect, compare, connect, consider, construct, cooperate, create, describe, develop, estimate, explain, explore, find, follow, graph, identify, improve, investigate, measure, observe, order, plan, predict, recognize, record, repeat, research, respond, select, sequence, test*

In lesson 1, students begin a Science and Technology Glossary in which they record new vocabulary introduced throughout the unit. Also in lesson 1, create a word wall for the unit on a bulletin board or poster or chart paper. Record new vocabulary on the word wall as it is introduced. Ensure that the word wall is located where all students can see it and refer to the words during activities and discussion.

NOTE: Include terminology in languages other than English on the class word wall. This is a way of acknowledging and respecting students' cultural backgrounds, while enhancing learning for all students. Use resources such as Google Translate and Microsoft Translator.

To translate terms to Indigenous languages, there are a variety of online dictionaries available. For example:

- The Ojibwe People's Dictionary <ojibwe.lib.umn.edu/>
- Freelang Mohawk-English Dictionary <www.freelang.net/online/mohawk.php>
- Nishnaabemwin Dictionary <https://dictionary.nishnaabemwin.atlas-ling.ca/#/help>
- First Voices: Explore Languages <https://www.firstvoices.com/languages>

Online dictionaries are also available for other languages that may be reflective of the class population.

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Promoting Scientific Inquiry

Throughout the inquiry process, it is essential for both teachers and students to generate thoughtful questions about the scientific information and issues presented. Many questioning systems can be applied to the material within the unit. Simply changing a question can shift the focus from knowledge and understanding to scientific inquiry, which can then lead to use of engineering and scientific design. The chart below shows how questions related to topics of study in this unit, which address specific curriculum expectations, can focus either on knowledge and understanding (as in column two) or can encourage more in-depth inquiry and higher-level thinking (as in column three) and then lead to engineering and scientific design (column four):

Unit Topic	**Knowledge and Understanding** (content questions that range in complexity)	**Scientific Inquiry** (testable questions by students or by scientists)	**Engineering and Scientific Design** (prototype questions designed or critiqued by students)
Habitats	In what natural habitats do salamanders live?	How are the basic needs of radish plants met?	How can I design a habitat to sustain an ant colony?
Adaptations	What behavioural adaptations help the monarch butterfly to survive?	How do bean plants adapt to sunlight conditions?	How can I design a model of a living thing to show its physical adaptations?

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Curriculum Correlation Chart

Overall Expectation	Specific Expectation	Lesson											
		1	2	3	4	5	6	7	8	9	10	11	12
B1. Relating Science and Technology to Our Changing World: assess impacts of human activities on habitats and communities, and analyze actions for minimizing negative impacts and enhancing positive ones	**B1.1** assess positive and negative impacts of human activities on habitats and communities, while taking different perspectives into account											√	√
	B1.2 analyze the impact of the depletion or extinction of a species on its habitat and community, and describe possible actions to prevent such depletions or extinctions					√					√	√	√
B2. Exploring and Understanding Concepts: demonstrate an understanding of habitats and communities and of interrelationships among the organisms that live in them	**B2.1** describe habitats as areas that provide organisms, including plants and animals, with the necessities of life, and identify ways in which a local habitat provides these necessities	√	√	√		√	√	√	√	√	√		
	B2.2 describe a community as a group of interacting species sharing a common habitat, and identify factors that affect the ability of a community of plants and animals to survive in a local habitat	√	√	√		√	√	√	√	√	√		
	B2.3 describe the relationship of organisms in a food chain, and classify organisms as producers, consumers, or decomposers									√			
	B2.4 demonstrate an understanding of a food web as the interconnection of multiple food chains in a natural community										√		
	B2.5 describe how animals are categorized according to their diet, and categorize various animals as carnivores, herbivores, or omnivores						√	√	√	√	√		
	B2.6 describe structural adaptations of a variety of plants and animals and how these adaptations allow the organisms to survive in specific habitats				√								
	B2.7 explain why all habitats have limits to the number of plants and animals they can support					√							

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Resources for Students

NOTE: Resources marked with an asterisk are considered authentic resources. This means that traditional stories reference the Indigenous community they came from, they state the individual that 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 <http://www.fnesc.ca/>.

Books

Black Bears, Al Albertson (Bellwether Media, 2020).

Grizzly Bears: Guardians of the Wilderness, Frances Backhouse (Orca, 2023).

Living Sunlight: How Plants Bring the Earth to Life, Molly Bang and Penny Chisholm (Scholastic, 2009).

A Home for Every Plant: Wonders of the Botanical World, Matthew Biggs (Phaidon, 2023).

Habitat Conservation, Harriet Brundle (KidHaven, 2023).

If You Take Away the Otter, Susannah Buhrman-Deever (Candlewick, 2020).

The Boreal Forest: A Year in the World's Largest Land Biome, L. E. Carmichael (Kids Can, 2020).

The Three Sisters, Michelle Corneau (Strong Nations, 2016).*

A Forest in the City, Andrea Curtis (Groundwood Books, 2020).

How Deep in the Ocean? Ocean Animal Habitats, Monika Davies (Amicus, 2018).

The Polar Bear, Jenni Desmond (Enchanted Lion Books, 2016).

Polar Bear, Candace Fleming (Holiday House, 2022).

DKfindout! Arctic and Antarctic, Anita Ganeri (DK, 2022).

Wolf Island, Celia Godkin (Fitzhenry & Whiteside, 2006).

Stand as Tall as the Trees: How an Amazonian Community Protected the Rain Forest, Patricia Gualinga and Laura Resau (Charlesbridge, 2023).*

Mothers of Xsan Series, Hetxw'ms Gyetxw (Brett D. Huson) (HighWater, 2018–2024).*

A Walk on the Shoreline, Rebecca Hainnu (Inhabit Media, 2020).*

A Walk on the Tundra, Rebecca Hainnu and Anna Ziegler (Inhabit Media, 2018).*

Bringing Back the Wolves: How a Predator Restored an Ecosystem, Jude Isabella (Kids Can, 2020).

A Bee's Difficult Search for Food, Mary Ellen Klukow (Amicus, 2020).

A Frog's Dangerous Home, Mary Ellen Klukow (Amicus, 2020).

A Turtle's Dangerous Journey, Mary Ellen Klukow (Amicus, 2020).

Be a Camouflage Detective: Looking for Critters That Are Hidden, Concealed, or Covered, Peggy Kochanoff (Nimbus, 2021).

Changing Tundra Environments, Elizabeth Krajnik (PowerKids, 2020).

Who Wants Rocks?, Michael Arvaarluk Kusugak (Annick, 1999).*

Elephant Journey: The True Story of Three Zoo Elephants and Their Rescue From Captivity, Rob Laidlaw (Pajama, 2015).

Carnivores, Michael Leach (Enslow, 2020).

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Omnivores and Herbivores, Michael Leach (Enslow, 2020).

Awesome Animals and the Places They Live, Hannah Lippard (Flowerpot, 2019).

A Bear's Life, Ian McAllister and Nicholas Read (Orca, 2017).

Biomimicry: When Nature Inspires Amazing Inventions, Séraphine Menu (Seven Stories, 2020).

Over and Under the Pond, Kate Messner (Chronicle Books, 2017).

A River's Gifts: The Mighty Elwha River Reborn, Patricia Newman (Millbrook, 2023).

Animals Illustrated: Muskox, Allen Niptanatiak (Inhabit Media, 2016).*

Mimic Makers: Biomimicry Inventors Inspired by Nature, Kristen Nordstrom (Charlesbridge, 2021).

Avati: Discovering Arctic Ecology, Mia Pelletier (Inhabit Media, 2021).

Ziis-baak-daa-keng—Maple Syrup Harvesting, Lucy Pitawanakwat and Honourine Trudeau-Wright (Wikwemikong Heritage Organization, 2004).*

A Home Away From Home: True Stories of Wild Animal Sanctuaries, Nicholas Read (Heritage House, 2020).

How Not to Get Eaten, Josette Reeves (DK, 2022).

Habitats, Jon Richards and Ed Simkins (Gareth Stevens, 2020).

Follow the Food Chain Series, Sarah Ridley (Crabtree, 2020).

Wildlife in the City: Habitat Clashes, Anne-Marie Rodger (Crabtree, 2020).

Compost Stew: An A to Z Recipe for the Earth, Mary McKenna Siddals (Dragonfly Books, 2014).

The Giving Tree, Shel Silverstein (HarperCollins, 2014).

What If There Were No Gray Wolves? A Book About the Temperate Forest Ecosystem, Suzanne Slade (Capstone, 2019).

What If There Were No Lemmings? A Book About the Tundra Ecosystem, Suzanne Slade (Capstone, 2011).

Is It a Food Web or a Food Chain?, Emily Sohn (Capstone, 2022).

Rewilding: Bringing Wildlife Back Where It Belongs, David A. Steen (Neon Squid, 2022).

Morning on the Lake, Jan Bourdeau Waboose (Kids Can, 1999).*

Websites

- **https://indigenouspeoplesatlasofcanada.ca/article/environmental-challenges/**
  "Environmental Challenges." John Kim Bell. Indigenous Peoples Atlas of Canada: Description of environmental challenges by an Indigenous activist.
- **www.native-art-in-canada.com/wildrice.html**
  "Harvesting and Processing Wild Rice." Native Art in Canada: Details about wild rice cultivation and harvest by the Ojibwe.
- **https://calgaryguardian.com/historic-homecoming/**
  "Historic Homecoming: Bison Return to Banff." Tyler Dixon. *Calgary Guardian*. February 15, 2017: How the return of wild bison to Banff National Park positively impacted the environment and First Nations communities.
- **https://climateatlas.ca/indigenous-knowledges-and-climate-change**
  "Indigenous Knowledges and Climate Change." Climate Atlas of Canada:

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Discusses Indigenous ways of knowing as key to climate solutions.

- **www.bafn.ca/sturgeon.html**
  "Lake Sturgeon Species at Risk." Bonnechere Algonquin First Nation: Description of the Nipissing First Nation project on the status of the Lake Nipissing sturgeon, and recovery strategies.
- **https://plantidentifier.info/**
  LeafSnap: Online plant encyclopedia and downloadable plant identification app that can identify a plant in a photograph.
- **https://www.hrw.org/report/2020/10/21/my-fear-losing-everything/climate-crisis-and-first-nations-right-food-canada**
  "'My Fear Is Losing Everything': The Climate Crisis and First Nations' Right to Food in Canada." Human Rights Watch. October 21, 2020: Highlights connections between climate change and food poverty.
- **https://www.tanakiwin.com/wp-system/uploads/2013/10/3a-AOO_Returning-Kichisippi-Pimisi-to-the-Ottawa-River-Basin__Dec2012_20121219.pdf**
  Returning Kichisippi Pimisi to the Ottawa River Basin. Algonquins of Ontario. 2012: The importance of the American eel in traditional Algonquin culture, and its conservation.
- **https://www.ontario.ca/page/species-risk-ontario**
  Species at risk in Ontario—Government of Ontario: Searchable table of endangered and threatened animals and plants.
- **https://www.torontozoo.com/tz/ticresources**
  Turtle Island Conservation—Toronto Zoo: Curriculum resources designed to promote the value and awareness of traditional Indigenous knowledge.
- **https://eartheclipse.com/animals/wildlife-sanctuaries-importance.html**
  "Wildlife Sanctuaries: Importance and How Do They Help the Wildlife?" Sonia Madaan. Earth Eclipse: Describes benefits of wildlife sanctuaries, including reducing pollution.

Videos

- **www.youtube.com/watch?v=YX8VQIJVpTg**
  "Adaptation." polkadotplace (2:29).
- **www.youtube.com/watch?v=Dw7z8Fo5ijk**
  "Animal Adaptations." Ima Black (4:22).
- **https://www.pbs.org/video/natureworks-adaptation/**
  "NatureWorks: Adaptation." PBS (14:45).
- **https://youtu.be/uAyVcR17COs**
  "What is Bioremediation?" Microbiology Society (1:53).

Coding and STEM Resources

Coding: Plugged

Code.org

- **https://code.org**
  Free coding lessons and activities designed to help students learn to code.
- **https://studio.code.org/s/coursed-2024**
  12. Nested Loops in Maze: Tutorial introduces students to the concept of using nested loops to write more efficient code.
- **https://studio.code.org/s/csc-adaptations-2023**
  Modeling Animal Adaptations (2023): Series of three tutorials where students use block coding to model and create structural and behavioural adaptations.
- **https://code.org/oceans**
  AI for Oceans: Students learn how artificial intelligence can address real-world problems.

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Tynker

- **https://www.tynker.com/hour-of-code/peep-nature-walk**
  Peep: Nature Walk Project: Following step-by-step instructions, students use Tynker Blocks to code an interactive nature walk.
- **https://www.tynker.com/hour-of-code/ecological-pyramid**
  Ecological Pyramid Project: Students use Tynker Blocks to code an interactive ecological pyramid for an ocean ecosystem.

Scratch

- **https://scratch.mit.edu/**
  Scratch is a free block-based visual programming language that allows students to create animations, stories, and games through coding.
- **https://scratch.mit.edu/educators/**
  Find information about how to use Scratch in a classroom setting, including tutorials, educator guides, and other resources.
- **https://scratch.mit.edu/projects/editor/?tutorial=all**
  Tutorials for students to learn about the different ways they can use Scratch.
- **https://go.brainpop.com/hourofcode/foodchains**
  BrainPOP Food Chains Newscast: Students will code a newscast using Vidcode to show what they know about food chains.

Minecraft Education

- **https://education.minecraft.net/en-us**
  Minecraft Education is an interactive game-based learning platform that allows students to learn and create while playing this popular block-based game. Minecraft Education is available for download on Windows, Mac, and Chromebook. A free demo is available.
- **https://education.minecraft.net/en-us/licensing**
  Information on how to purchase a licence for Minecraft Education. The full version is available with a Microsoft 365 account. Check with your school board to see if you already have licenses available.
- **https://education.minecraft.net/en-us/get-started/download**
  How to download Minecraft Education.
- **https://education.minecraft.net/en-us/challenges/a-case-for-biodiversity**
  Minecraft Classroom Build Challenge: A Case for Biodiversity: Students build an ecosystem, then remove one species to show how it is affected.
- **https://education.minecraft.net/en-us/lessons/pandas-protected-habitat**
  Minecraft Coding Fundamentals: Panda's Protected Habitat: Students use nested loops to move the panda to a safe area.

Coding: Unplugged

- **https://www.torontozoo.com/adoptapond/conservation#blandings**
  Blanding's Turtle Headstarting and Reintroduction—Toronto Zoo: Describes a project to revitalize this species at risk by collecting eggs and raising hatchlings to release into the wild.
- **https://parks.canada.ca/pn-np/on/rouge/nature/conservation/especes-species/tortues-turtles/sauver-les-tortues-save-turtles**
  How You Can Help Save Turtles in RNUP and Ontario—Government of Canada: Information on saving turtles in Rouge National Urban Park.
- **https://codemooc.org/codyroby/EN/**
  CodyRoby: Printable DIY unplugged coding card game.

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- **https://www.norwexmovement.com/helping-black-bear/**
  "Helping the Black Bear Get to the Other Side." Amy Cadora. Norwex Movement. May 29, 2018: Explains habitat fragmentation and how wildlife crossings help animals survive.
- **https://www.pbslearningmedia.org/resource/habitat-mapping-game/habitat-mapping-game/**
  Habitat Mapping Game—PBS Learning Media: Explore habitat fragmentation caused by human construction.

STEM

- **https://earthobservatory.nasa.gov/biome**
  Mission: Biomes—NASA Earth Observatory: Information on Earth's biomes, including climate and vegetation.
- **https://kidzeum.org/learning/step-by-step/biosphere-in-a-jar**
  Biosphere in a Jar—Kidzeum of Health and Science: Instructions for building an ecosystem in a jar.
- **https://ecocation.org/ecosystem-in-a-jar/**
  Ecosystem in a Jar—EcoCation: Guide to creating an ecosystem in a jar.
- **https://education.nationalgeographic.org/resource/carnivore/**
  Carnivore—National Geographic Education: Facts about carnivores, including different types and their place in the food chain.
- **https://education.nationalgeographic.org/resource/decomposers/**
  Decomposers—National Geographic Education: Examples of decomposers and explanations of the roles they play in an ecosystem.
- **https://treecanada.ca/resources/benefits-of-trees**
  The Benefits of Trees—Tree Canada: Explains the environmental, social, and economic benefits of trees and urban forests.
- **https://www.nature.org/en-us/what-we-do/our-priorities/build-healthy-cities/cities-stories/benefits-of-trees-forests/**
  "6 Ways Trees Benefit All of Us." The Nature Conservancy. October 9, 2020: Outlines six benefits of trees to human beings and the environment.
- **https://www.copernicused.com/treesforschools**
  Trees for Schools Program—Copernicus Educational Products: Copernicus donates seedlings and wildflower seeds to schools in Ontario in celebration of Earth Day.
- **https://treecanada.ca/national-tree-day/**
  National Tree Day—Tree Canada: Tools and resources for schools that host and register a National Tree Day Event.
- **https://www.seedstosaplings.ca/**
  Seeds to Saplings: Growing the Stewards of Tomorrow—Seeds to Saplings: Teaches students to collect local native seeds and grow them into saplings.
- **https://www.sciencejournalforkids.org/articles/how-can-we-find-oil-eating-bacteria-to-clean-up-the-sea/**
  "How Can We Find Oil-Eating Bacteria to Clean Up the Sea?" Katherine French and Norman Terry. *Science Journal for Kids and Teens*. August 2020: Outlines an experiment to identify oil-eating bacteria with the goal of preventing damage to the environment.
- **https://microbiologysociety.org/blog/bioremediation-the-pollution-solution.html**
  "Bioremediation: The Pollution Solution?" Rebecca Philp. Microbiology Society. December 8, 2015: Explores the role of microbes in treating pollution generated by the growing global population.

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1 What Do We Know About Habitats and Communities?

Information for Teachers

A *habitat* is the natural home or environment of an animal, plant, or other organism. A *community* is a group of interdependent organisms of different species growing or living together in a specified habitat. A *population* is the total number of plants or animals of the same type (species) in one community (e.g., moose in a forest).

Materials

- chart paper
- markers
- index cards (two for each student)
- student dictionaries
- computers/tablets with internet access (optional)
- Image Bank: Habitats (see Appendix, page 314) (print one image for each group)
- Activity Sheet: Science and Technology Glossary (1.1.1) (several copies for each student)
- Activity Sheet: Habitats (1.1.2) (one copy for each student)
- resources on topics related to habitats and communities (e.g., books, articles, magazines, riddles, posters, websites)
- Task Card: What Can I Learn About Habitats and Communities? (1.1.3) (several copies to leave at the Habitats and Communities Library)
- Activity Sheet: I Recommend (1.1.4) (enough for each student to use at the Habitats and Communities Library)
- variety of pictures of animals

Activate

Discuss with the class the needs of plants and animals. Encourage students to brainstorm what all animals and plants need to survive. Focus on essentials such as food, water, shelter, and space. Record their ideas on chart paper.

Next, provide each student with two index cards. Have them record the name of an animal on one card and the name of a plant on the other.

Organize students into small groups. Have students within each group share their cards with each other. Challenge students to suggest different ways of sorting the cards.

Select a few of the student-generated animal cards to share with the class, and have students share their prior knowledge of how each animal meets its basic needs for food, water, shelter, and space. Then, have students return to their groups and share ideas about how each of their animals meets these needs.

Introduce the guided inquiry question: **What do we know about habitats and communities?**

Action: Part One

On chart paper, construct a KWHL chart for recording ideas:

Habitats and Communities			
What We **Know**	What We **Want** to Know	**How** We Can Find Out	What We **Learned**

Discuss the title of the chart with students. Ask:

- What is a habitat?
- What is a community?
- Why do we need to study habitats and communities?

Have students share ideas. Ask:

- What do you already know about habitats and communities?

Record students' responses in the first column of the chart.

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Next, have students focus on the second column of the chart. Ask:

- As we begin to study habitats and communities, what questions do you have?
- What would you like to learn about habitats and communities?
- What do we need to understand about habitats and communities to better protect them?

Record students' responses in the second column. These responses can be taken into consideration when planning future activities.

Discuss ways students might find answers to their questions, encouraging them to think as broadly as possible. Record all ideas in the third column of the chart; suggestions may include:

- using classroom resources (e.g., books, magazines, articles, posters)
- visiting a community Elder or Knowledge Keeper
- inviting a guest speaker into the classroom
- going on a field trip
- watching videos
- doing research on the internet
- using library resources (e.g., books, magazines, videos)
- using resources from home (e.g., artifacts, art, family experts)
- writing a letter or an email to an expert
- making personal observations
- researching photographs

NOTE: Discuss both the value and limitations of different sources, and the importance of gathering information from numerous sources. Although students can gather factual information from books and internet sites, local stories and traditional knowledge are best gathered from Elders, family, community members, and local organizations.

NOTE: Some Indigenous keepers of knowledge are more comfortable being referred to as Traditional Knowledge Keepers than as Elders. Be respectful of their preference.

Explain to students that as they continue to learn new things about habitats and communities, they will record them in the fourth column of the chart.

Display the KWHL chart in a visible area of the classroom for reference throughout the unit.

Action: Part Two

Have students discuss various places plants and animals live (e.g., forest, pond, marsh, prairie, city). Ask:

- What do we call the place where an animal or plant lives?

Focus on the term *habitat*. Ask:

- What is a habitat?

Have students share prior knowledge and ideas, and record these on chart paper. Co-construct a class definition for the term, then encourage students to check their dictionaries and compare that definition to the class definition.

Explore the concept of habitat further by asking:

- What are some examples of animals and plants and their natural habitats?

On chart paper in a two-column chart, record several animals and plants and their corresponding habitats. For example:

Animal/Plant	Habitat
cactus	desert
black bear	forest
whale	ocean
earthworm	garden
field mouse	tall-grass prairie

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Focus on one of the habitats recorded on the chart, and have students brainstorm a list of plants and animals that live in this habitat. For example:

- desert: snake, cactus, spider, tumbleweed
- forest: squirrel, pine tree, skunk, moss, bear
- ocean: jellyfish, coral, crab, seaweed, dentalium
- garden: beans, corn, squash (three sisters)

Now, focus on the concept of *community*. Ask students:

- What is a community?

Students may be inclined to consider the idea of community from a human perspective, as a place where people live together, relying on one another to meet their needs. Explore this idea with students, discussing that when plants and animals live together in a certain area, they make up a community too.

Next, ask:

- What does the term *population* mean?

Again, students may be inclined to consider the idea of population from a human perspective, which is a good starting point. Encourage them to research the population of their local community.

Then, explore animal and plant populations with students, emphasizing that a population is the total number of plants or animals of the same type (species) in one community. Ask:

- What do living things need to survive? (food, water, shelter, space)
- How do we, as humans, get these things within our community?
- Does a habitat provide all necessities for all animal and plant populations?
- Can all populations get their food from within their habitat?
- Can all populations get their water, shelter, and space from within their habitat?

Review the chart created earlier. Have students discuss how these plants and animals meet their needs in the habitat. For example, ask:

- How does a black bear get food, water, shelter, and space in the forest?
- What could happen to the bear population in a year with very little rainfall?
- How does a whale meet its needs in the ocean?
- What could happen to the whale if the fish it eats are caught by fishers?

Use these examples to explore how living things depend on their habitat for survival.

Action: Part Three

Distribute several copies of Activity Sheet: Science and Technology Glossary (1.1.1) to each student and have students begin a glossary for the unit.

Provide students with the following directions:

- Record new vocabulary, such as *habitat*, *community*, and *population*, in the first column of the chart, and draw an illustration to depict that word in the second column. Include a definition for the term in the third column.

At the end of the unit, students can cut apart the rows on their sheets, alphabetize their words, and create booklets of terminology related to habitats and communities.

NOTE: The Science and Technology Glossary presents an excellent opportunity to celebrate cultural diversity by having students include words in languages other than English. Students may include terms in Indigenous languages, and English-language learners may include terminology in languages spoken at home.

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Use online dictionaries to translate terms to Indigenous languages. For example:

- The Ojibwe People's Dictionary <ojibwe.lib.umn.edu>
- Freelang Mohawk-English Dictionary <www.freelang.net/online/mohawk.php>
- Nishnaabemwin Dictionary <https://dictionary.nishnaabemwin.atlas-ling.ca/>
- First Voices: Explore Languages <https://www.firstvoices.com/languages>

Online dictionaries are also available for other languages that may be reflective of the classroom population.

Action: Part Four

Organize the class into small working groups. Give each group a picture from Image Bank: Habitats and provide a copy of Activity Sheet: Habitats (1.1.2) to each student. Provide students with the following directions:

- In your picture, identify the habitat shown, describe the habitat, and name the plant and animal populations that would live in the habitat. Use print and internet resources to help with this task. Record your findings on the activity sheet.

Once all groups have completed their activity sheet, have them share their pictures and descriptions with the rest of the class.

Action: Part Five

Take students on a walk around the schoolyard to explore the natural environment. Before the walk, discuss with students the importance of respecting nature. Have students brainstorm ways in which they can demonstrate respect and why this is important. For example:

- Never break off branches from trees or pick wildflowers.
- Always clean up after ourselves.

Record these ideas on an anchor chart and save for future reference.

NOTE: Discuss ways to safely use the senses to observe habitats and animals (e.g., listen to a bird, touch the leaves of a tree, smell a flower). Clearly instruct students not to use their sense of taste or to touch any unfamiliar plants that could cause irritation (e.g., poison ivy).

NOTE: Land-based learning, which includes field trips and nature walks, is a valuable way to learn more about living things. This is an excellent opportunity to identify the importance of place. Use a map of the local area to identify the location of the school. This will help students develop a stronger image of their community and surrounding area. Many First Nations and Tribal councils have land use maps or land use projects and staff that might help the class learn about traditional territories and land use.

Identify whose traditional territory the school and schoolyard are on, using one of the following resources:

- Ontario First Nations Maps: <https://www.ontario.ca/page/ontario-first-nations-maps>
- Maps of Indigenous Communities in Ontario: <https://www.sac-isc.gc.ca/eng/1635957754306/1635957787562>
- First Nation Profiles Interactive Map: <https://geo.aadnc-aandc.gc.ca/cippn-fnpim/index-eng.html>

In addition, the educator's guide *The First Nations and Treaties Map of Ontario as an Instructional Resource* offers maps and information for teachers; it is available at <http://www.edu.gov.on.ca/eng/indigenous/the-first-nations-and-treaties-map-of-ontario.pdf>.

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

- *<location of school, e.g., city or town> is located on the traditional territory of the*

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_____ and is within the boundaries set by the _____ treaty _____.

NOTE: Many Ontario school boards have established protocols for land acknowledgments. Check with Indigenous education leads and consultants in your board to see if there are specific protocols to follow.

During the nature walk, encourage students to identify living things (e.g., grass, dandelions, birds, squirrels, mice, insects, students). Ask:

- Is our schoolyard a habitat?

Encourage students to give their opinions and discuss if the requirements for their working definition of *habitat* are met. In many cases, even a grass field will meet the definition, and students will observe this in a way they may not have before. You can continue to explore the schoolyard habitat in more depth throughout the unit, investigating the populations that live there.

Action: Part Six

Set up a Habitats and Communities Library in the classroom. Provide books (fiction and nonfiction), magazines, articles, posters, brochures, fact sheets, riddles, and other materials for students to read about plants, animals, and habitats. Provide numerous copies of Task Card: What Can I Learn About Habitats and Communities? (1.1.3) and Activity Sheet: I Recommend (1.1.4).

NOTE: Ensure resources are high interest, very visual, and at a variety of reading levels. Encourage students to bring in their own books and other resources; review all resources before adding them to the library.

Encourage students visiting the Habitats and Communities Library to read anything they find interesting from the collection, then complete Activity Sheet: I Recommend (1.1.4) to suggest a resource to their classmates.

NOTE: Review with students important reading strategies to use at the library (e.g., skimming, scanning, using visuals on the page).

STEM Makerspace

- Provide students with computers or tablets.
- Have students explore NASA's Mission: Biomes website (or project and explore as a class): <https://earthobservatory.nasa.gov/biome>. The site explains what a biome is and includes information on the Earth's biomes, including climate and vegetation. After exploring the biomes, students can complete To Plant or Not to Plant?, an activity where they will determine which biomes are best suited for specific plants/trees.
- Using their prior knowledge and information from Mission: Biomes, challenge students to use the materials available at the Makerspace to create a habitat game. For example, students could create a memory game where players match plants or animals with their habitat. Students could also use a familiar board game, such as snakes and ladders or checkers, as inspiration. Students should include a set of instructions with their game so others can play it at the Makerspace.

Coding Connections

NOTE: See page 4 for more detailed information on coding, including plugged coding.

PLUGGED: Use Nested Loops to Help the Bee Make Honey

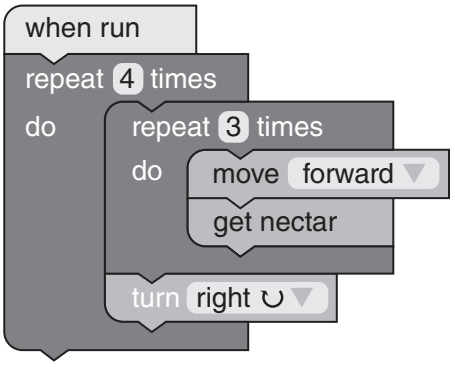
- Provide students with Chromebooks, laptops, or tablets.
- Have students complete the Nested Loops in Maze tutorial (lesson 12) on Code.org: <https://studio.code.org/s/coursed-2024>. This is an excellent introduction to the concept of using nested events in coding that also encourages students to think about

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how bees survive in their habitat. The Nested Loops in Maze tutorial is available in multiple languages and includes video instructions, hints, and an immersive reader.

- Students will learn how to use *nested loops* (a loop inside of another loop) to write more *efficient code*. They will complete a series of puzzles that use nested loops to help a bee collect nectar from flowers to make honey.



NOTE: For more information about nested events and efficient code, see "What Is Coding?" in the Introduction on page 4.

Talking Circle

Revisit the guided inquiry question: **What do we know about habitats and communities?** Have students share their knowledge, provide examples, and ask further inquiry questions.

Consolidate and Debrief

- Add to the KWHL chart as students learn new concepts, answer some of their own inquiry questions, and ask new inquiry questions.
- Begin a word wall to display new terminology that students learn throughout the unit, as well as illustrations. Include *habitat*, *community*, and *population*. Include words in languages other than English, as appropriate.

NOTE: Including terminology in languages other than English on the class word wall is a way of acknowledging and respecting students' cultural backgrounds, while enhancing learning for all.

Assessment of Learning AOL

Provide students with several pictures of animals and have them identify habitats in which each animal could live. Also, have them identify important components of the habitat that help the animal survive. Use the ANECDOTAL RECORD template on page 32 to record results.

Enhance

- **Family Connection:** Provide students with the following sentence starters:
  - A habitat I have visited with my family is _____.
  - This habitat has animals such as _____.
  - This habitat has plants such as _____.

  Have students record the sentence starters in their Science and Technology Journal or agenda and complete them at home. Family members can help students draw and write about this topic. Have students share their completed sentences with the class.
- Visit a zoo with students to observe how staff make the animals' habitats as much like their natural habitats as possible.
- Research or visit habitats such as wildlife preserves, or organizations such as turtle hospitals that create habitats where animals can heal before being relocated to their natural habitat.
- If you have a class pet, discuss the various ways the class has made the animal's home more like its natural habitat.

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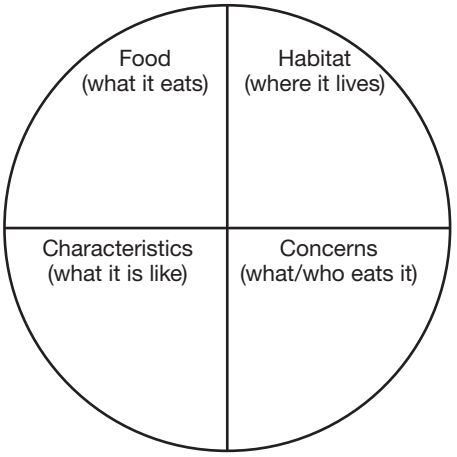
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- Have each student draw a picture of their local habitat (community). Ask students to list how each human survival need is met (e.g., shelter: house, apartment, condo; food: grocery store, market, garden, farm).
- Celebrate cultural diversity by having students research the names of various animals in different languages, especially those reflective of students' origins. Dedicate a classroom bulletin board or poster to this purpose, as in the following example:

Animal Terms in Indigenous Languages

Animal	English	Anishinaabe	Cree
	Squirrel	Ajidamoo	Anikwaca¯s
	Wolf	Ma'iingan	Mahihkan
	Bear	Mahkwa	Maskwa
	Elk	Muwin	Wa¯wa¯skisiw
	Bison	Mashkode-bizhiki	Pa¯swawimisto

- Using a graphic organizer, have students record information and research about animals studied. For example:



- Use a world map to display pictures and names of animals that live in different countries.

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Download these reproducibles at <https://www.portageandmainpress.com/isbn/9781774920695>. For step-by-step instructions to access this download, see Appendix on page 313.

1.1.1

Science and Technology Glossary

Term	Illustration	Definition
Term	Illustration	Definition
Term	Illustration	Definition
Term	Illustration	Definition

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1.1.2

Name: _____

Date: _____

Habitats

Habitat: _____

Description	Plant and Animal Populations

Which habitat in our local area is abundant with plant and animal populations? Describe the habitat and the populations found there.

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1.1.3

What Can I Learn About Habitats and Communities?

Welcome to the Habitats and Communities Library!

1. Review several of the resources in the collection.
2. Choose one resource you want to read.
3. After you have read your selection, complete a copy of the activity sheet: I Recommend.



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1.1.4

Date: _____ Name: _____

I Recommend

Title: _____

Author: _____

Illustrator: _____

1. Draw a picture of something that is described or shown in the resource (e.g., book, magazine, fact sheet).

2. Why did you choose to read this?

3. Would you recommend this resource to a friend? Why or why not?

4. What is one question you still have about the topic in this resource?

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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.

Download the digital resources for this book, including the image banks and reproducibles, using the instructions below. You may return to this link to download the desired files until a new edition is available for pre-order.

1. Go to the Portage & Main Press website at <https://www.portageandmainpress.com/isbn/9781774920695>.

NOTE: The angle brackets (< and >) are not part of the above URL.

2. On the product page, select the button labelled Download Digital Resources. A new page will appear, requesting a password.
3. Type the password POPULATION4 into the password field. The password is case sensitive, so be sure to use the correct capitalization.
4. Select Submit. A new page will appear, listing the download options for this book.
5. Click Retrieve Your Download to download the digital resources, including the image banks and reproducibles for this book.
6. 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.

Unit 1: Habitats and Communities

Lesson 1: What Do We Know About Habitats and Communities?

Habitats



1. A Boreal Forest During an Autumn Sunset



2. Canadian Forest



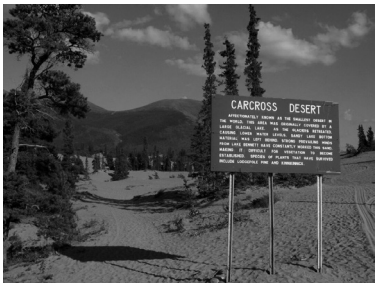
3. A River in Ontario



4. A Beaver Pond in Northern Ontario



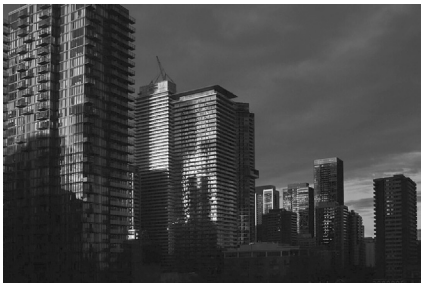
5. Rattray Marsh, Mississauga, Ontario



6. Carcross Desert, Yukon



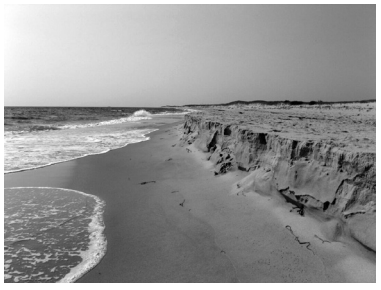
7. Big Cypress National Preserve



8. Toronto, Ontario



9. Mount Robson (South Face), British Columbia



10. Singing Sands Beach, Prince Edward Island

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5 — "Rattray Marsh, Mississauga, Ontario" by Flickr user John Johnston. Used under CC0 1.0 Universal licence.

6 — "carcross desert 1" by Flickr user John Johnston. Used under CC BY 2.0 licence.

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Kellie Ierullo (she/her/hers) has been an educator with the Toronto District School Board for over 20 years, including as a classroom teacher, special education teacher, and now as a teacher-librarian, technology chair, and science/STEM lead educator. Kellie is passionate about helping teachers engage students through meaningful coding and STEM activities and encouraging students to move beyond navigating technology to creating it for themselves. Kellie lives in Woodbridge, Ontario, with her family.

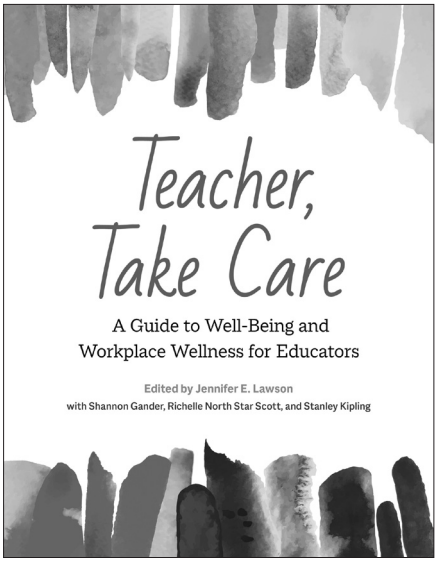
Jennifer H. Manitowabi (she/her/hers) is an Ojibway educator and PhD candidate at Lakehead University. Throughout her career in education in both Canada and the United States, she has worked as a bus driver, classroom teacher, principal, and education director. Jennifer encourages all educators to incorporate Indigenous worldviews in their teaching and to find opportunities to build relationships with the First Nations of Turtle Island. Jennifer is a member of Lac Seul First Nation, where she currently resides, and can often be found creating artwork that celebrates her culture.

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- **Mindfulness & resilience:** Build mental strength and stay motivated
- **Indigenous perspectives:** Connect to Indigenous perspectives of wellness through remarks from Elder Stanley Kipling and Knowledge Keeper Richelle North Star Scott

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