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hands-on science and Technology

An Inquiry Approach With STEM Skills and Connections

Grade 3

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Hands-On Science and Technology for Ontario, Grade 3
An Inquiry Approach With STEM Skills and Connections

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Introduction to *Hands-On Science and Technology for Ontario, Grade 3*

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 young 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; therefore, 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***. Most 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, most 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. When children first learn to code, they use easy-to-learn, user-friendly languages that use visual symbols like blocks. Familiarize yourself with some coding resources that can be used in the classroom, such as Scratch <https://scratch.mit.edu/>, a free program 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 coding activities. Use the suggested coding activities throughout ***Hands-On Science and Technology, Grade 3*** 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 3 are as follows:

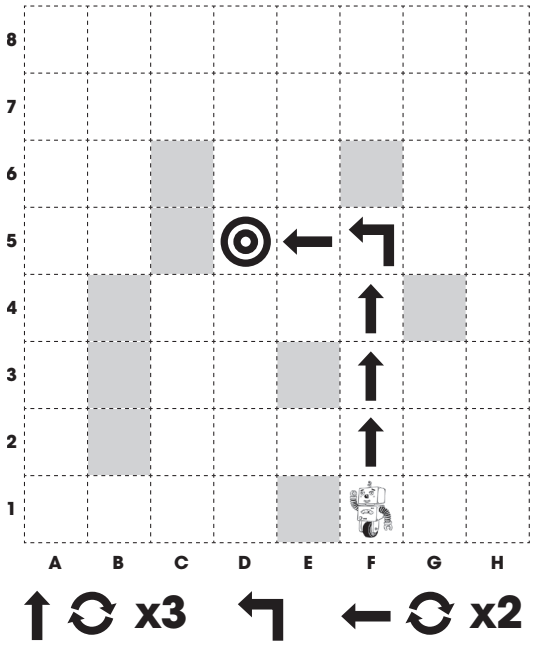
- Computer code is written in a specific order (called a *sequence or algorithm*), so the computer knows which step to complete first, next, and so on.
- Code can be written and executed so that multiple things happen at the same time (referred to as *concurrent events*).

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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 more efficiently (using the fewest instructions possible).
- Making mistakes and figuring out how to fix them (*debugging*) is an important part of learning to code.

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 3 is to connect a series of code blocks together, including repeat blocks, to animate a sprite (an image or character that students program to move around or interact with other sprites) in Scratch.
- *Unplugged coding* introduces coding and programming through hands-on activities and games. A typical unplugged coding activity for grade 3 is to provide students with a labelled grid (letters along the x-axis and numbers along the y-axis) and a set of coding cards with directional arrows (including turns and loops). Students use the cards to create the most efficient code to arrive at a destination (as shown in the example, the cards are used on the grid to show the path the robot takes to reach the target). A Labelled Grid template and a set of Coding Cards are provided on page 12. Print these on 11 x 17 paper.



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 3***. Unplugged coding kits are easy to make using common classroom materials. Include some of the following items in your kits:

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- **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 with unit-specific images are included with each unit. Students can also draw additional images on the Blank Cards (see page 12). Print Image Cards and 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 Coding Cards included (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 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.

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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 passage, 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)

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

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methods into classrooms" (Action 62) and "build student capacity for intercultural understanding, empathy and mutual respect" (Action 63).

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 the land since time immemorial. The environment—including geography, vegetation, climate, and natural resources—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.

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, use a map of the local area to have students identify the location of the land-based learning activity 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:

- 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.sac-isc.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,

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> 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 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 dyeing 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 methodologies from an Indigenous worldview. 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 module). 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

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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 are recognized because they have earned the respect of their community through wisdom, harmony, and balance in their actions and teachings (see Indigenous Corporate Training, 2012).
- 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.

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: Growth and Changes in Plants
- Matter and Energy: Forces and Motion
- Structures and Mechanisms: Strong and Stable Structures
- Earth and Space Systems: Soils in the Environment

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. About This Unit 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.

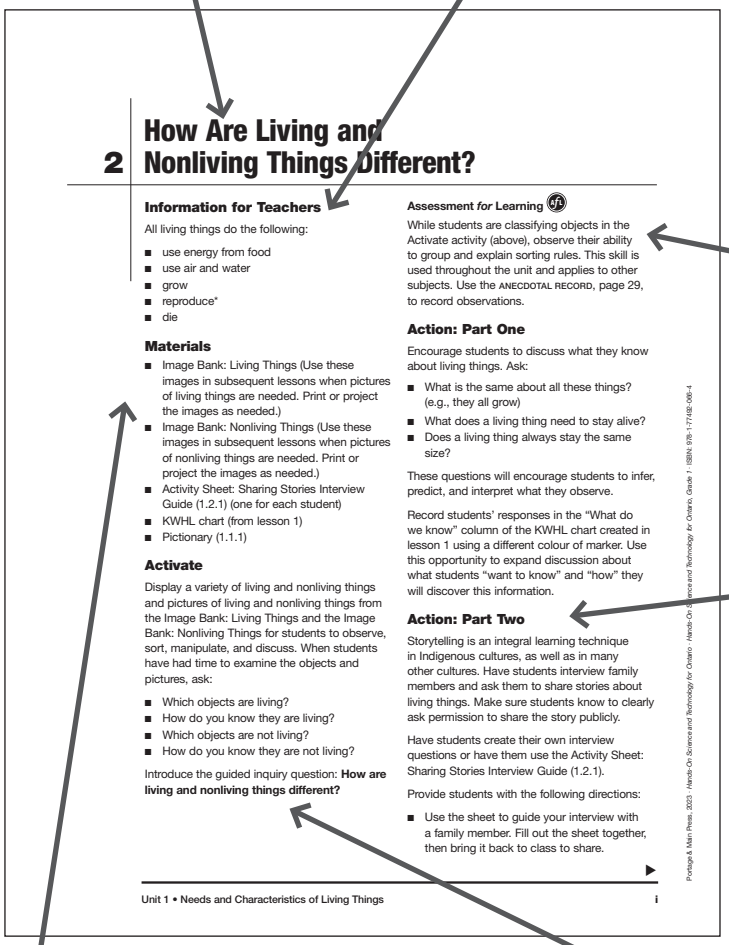
Additionally, About This Unit includes lists of related resources (books and online videos), annotated websites suitable for students, and coding and STEM resources.

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



2 How Are Living and Nonliving Things Different?

Information for Teachers

All living things do the following:

- use energy from food
- use air and water
- grow
- reproduce*
- die

Materials

- Image Bank: Living Things (Use these images in subsequent lessons when pictures of living things are needed. Print or project the images as needed.)
- Image Bank: Nonliving Things (Use these images in subsequent lessons when pictures of nonliving things are needed. Print or project the images as needed.)
- Activity Sheet: Sharing Stories Interview Guide (1.2.1) (one for each student)
- KWHL chart (from lesson 1)
- Pictionary (1.1.1)

Activate

Display a variety of living and nonliving things and pictures of living and nonliving things from the Image Bank: Living Things and the Image Bank: Nonliving Things for students to observe, sort, manipulate, and discuss. When students have had time to examine the objects and pictures, ask:

- Which objects are living?
- How do you know they are living?
- Which objects are not living?
- How do you know they are not living?

Introduce the guided inquiry question: **How are living and nonliving things different?**

Assessment *for* Learning

While students are classifying objects in the Activate activity (above), observe their ability to group and explain sorting rules. This skill is used throughout the unit and applies to other subjects. Use the ANECDOTAL RECORD, page 29, to record observations.

Action: Part One

Encourage students to discuss what they know about living things. Ask:

- What is the same about all these things? (e.g., they all grow)
- What does a living thing need to stay alive?
- Does a living thing always stay the same size?

These questions will encourage students to infer, predict, and interpret what they observe.

Record students' responses in the "What do we know" column of the KWHL chart created in lesson 1 using a different colour of marker. Use this opportunity to expand discussion about what students "want to know" and "how" they will discover this information.

Action: Part Two

Storytelling is an integral learning technique in Indigenous cultures, as well as in many other cultures. Have students interview family members and ask them to share stories about living things. Make sure students know to clearly ask permission to share the story publicly.

Have students create their own interview questions or have them use the Activity Sheet: Sharing Stories Interview Guide (1.2.1).

Provide students with the following directions:

- Use the sheet to guide your interview with a family member. Fill out the sheet together, then bring it back to class to share.

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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)

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 295 for thumbnails and free access)

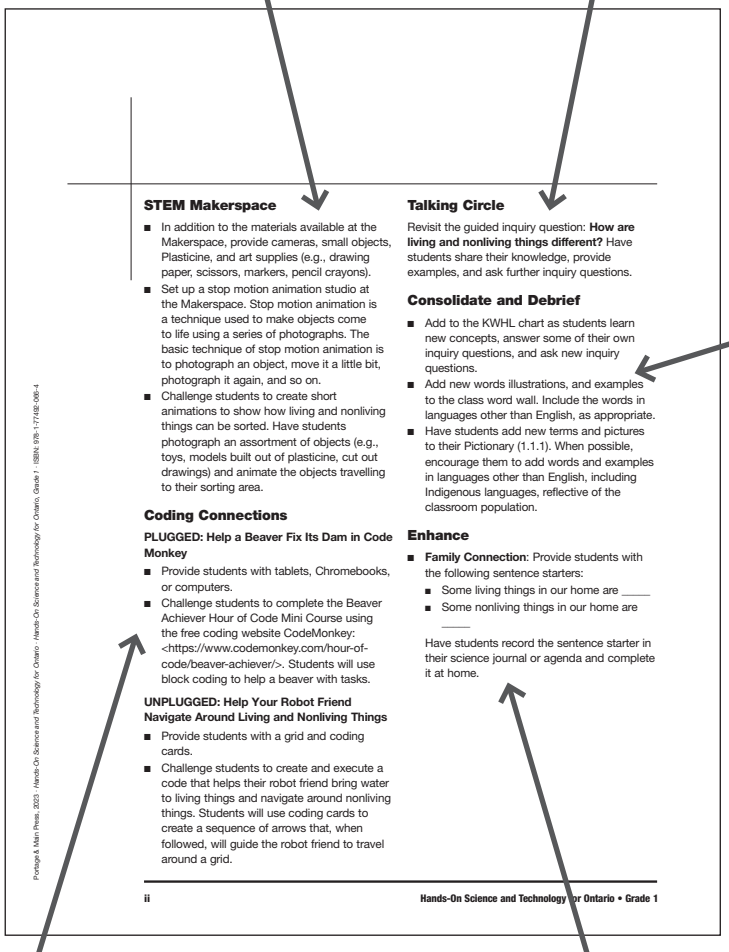
Activate
- activates prior knowledge, piques students' curiosity about related concepts, and introduces the lesson's guided inquiry question
- teachers may choose to record the guided inquiry question for display (e.g., on a sentence strip) so students can refer to it during activities and discussion

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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

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

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 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



STEM Makerspace

- In addition to the materials available at the Makerspace, provide cameras, small objects, Plasticine, and art supplies (e.g., drawing paper, scissors, markers, pencil crayons).
- Set up a stop motion animation studio at the Makerspace. Stop motion animation is a technique used to make objects come to life using a series of photographs. The basic technique of stop motion animation is to photograph an object, move it a little bit, photograph it again, and so on.
- Challenge students to create short animations to show how living and nonliving things can be sorted. Have students photograph an assortment of objects (e.g., toys, models built out of plasticine, cut out drawings) and animate the objects travelling to their sorting area.

Coding Connections

PLUGGED: Help a Beaver Fix Its Dam in Code Monkey

- Provide students with tablets, Chromebooks, or computers.
- Challenge students to complete the Beaver Achiever Hour of Code Mini Course using the free coding website CodeMonkey: <https://www.codemonkey.com/hour-of-code/beaver-achiever/>. Students will use block coding to help a beaver with tasks.

UNPLUGGED: Help Your Robot Friend Navigate Around Living and Nonliving Things

- Provide students with a grid and coding cards.
- Challenge students to create and execute a code that helps their robot friend bring water to living things and navigate around nonliving things. Students will use coding cards to create a sequence of arrows that, when followed, will guide the robot friend to travel around a grid.

Talking Circle

Revisit the guided inquiry question: **How are living and nonliving things different?** 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 words illustrations, and examples to the class word wall. Include the words in languages other than English, as appropriate.
- Have students add new terms and pictures to their Pictionary (1.1.1). When possible, encourage them to add words and examples in languages other than English, including Indigenous languages, reflective of the classroom population.

Enhance

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

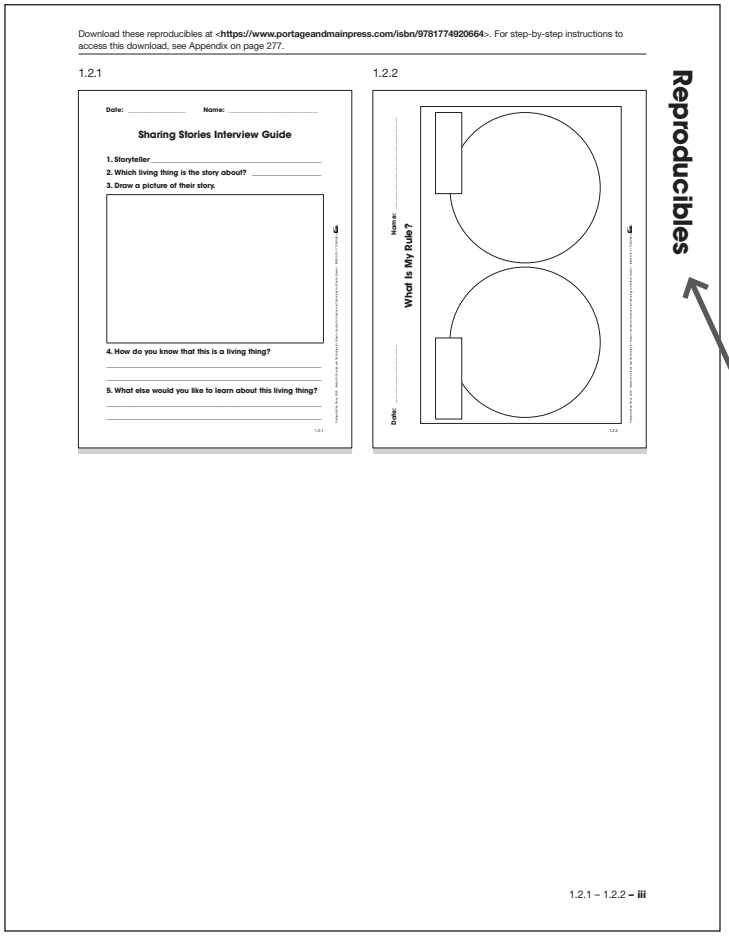
  Have students record the sentence starter in their science journal or agenda and complete it at home.

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

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

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Download these reproducibles at <**https://www.portageandmainpress.com/isbn/9781774920664**>. For step-by-step instructions to access this download, see Appendix on page 277.

1.2.1

Date: _____ Name: _____

Sharing Stories Interview Guide

1. Storyteller _____
2. Which living thing is the story about? _____
3. Draw a picture of their story.

4. How do you know that this is a living thing?

5. What else would you like to learn about this living thing?

1.2.1

1.2.2

Name: _____

What Is My Rule?

Date: _____

1.2.2

1.2.1 – 1.2.2 – **iii**

Reproducibles

Reproducibles
- are included as thumbnails following the lesson
- 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 around in a clockwise direction
- each person talks until they are finished, being respectful of time
- the Talking Circle is complete when everyone has had a chance to speak
- a person may pass the stick without speaking if they choose (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 a variety of suggestions for STEM Makerspace materials, equipment, and challenges related to the specific science and technology topics of study, while correlating with other subject areas. Suggested materials and challenges 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, which means it can be used by the whole school community. A classroom STEM Makerspace is usually designed as a centre where students use knowledge, concepts, and skills acquired in a particular lesson and apply them 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. Rather, the goal is simply to create conditions for learning to happen 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. Additionally, arts-and-crafts materials such as construction paper, modelling clay, fabric, buttons, and pipe cleaners are often integrated into Makerspace offerings.

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.

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

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. The following are suggestions that can be used 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

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important, however, to spend time on every unit in the book so that students focus on all the curriculum expectations established 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 from this type of primary experience than if you merely demonstrate the activities. Although hands-on activities are emphasized throughout this book, 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 working 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 your class is working in collaborative groups, it may be helpful to assign each student a role, as follows:

- **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 do arise from time to time. In these instances, teachers may decide to demonstrate an activity themselves, while still 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 safety 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:



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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' acquisition of scientific and technological literacy. They include initiating and planning, performing and recording, analyzing and interpreting, as well as 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.

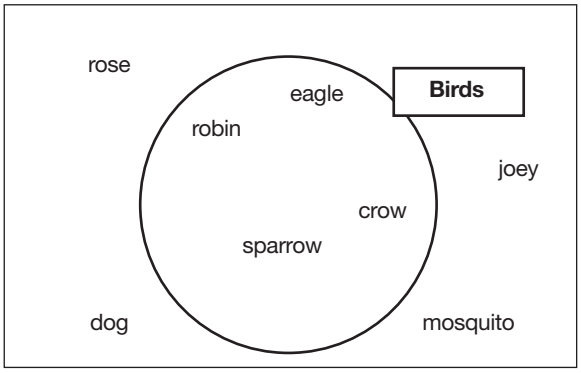
Oral discussion is also an integral component of exploration; it allows students to communicate their discoveries. At a deeper level, discussion allows students to make meaning by discussing inconsistencies/misconceptions and comparing/contrasting their observations with others. This is the constructivist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

Classifying

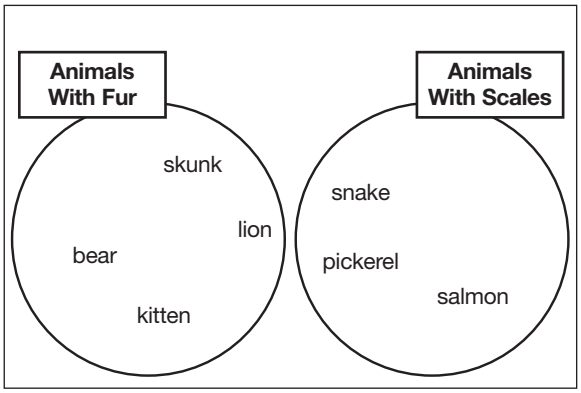
Classification is used to group or sort objects and events and is based on observable properties. For example, objects can be classified into groups according to colour, shape, or size. Two strategies for sorting are the use of sorting mats and Venn diagrams. Sorting mats show distinct groups, while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

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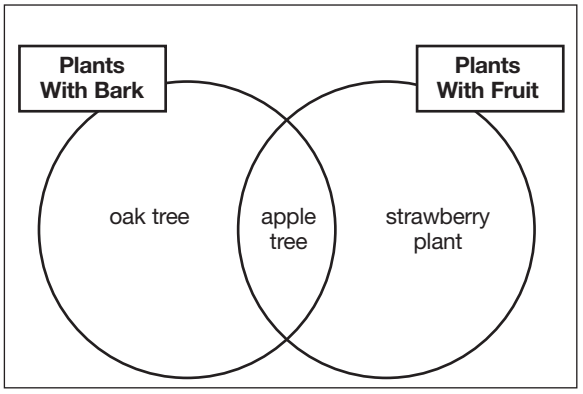
Single Sorting Mat



Double Sorting Mat



Double Venn



Measuring

Measuring is the process of discovering the dimensions or quantity of objects or events and, at the grade 3 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. In grade 3, students use 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 achieved 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 **tally chart** is a means of recording data as an organized count. The count is grouped in fives so the total can easily be determined by counting by fives.

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

- 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

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.

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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.

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. Again, it is important to encourage students to take risks when making inferences. Instead of explaining scientific phenomena to them, give students opportunities to infer for themselves 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 technological problem-solving skills to design and construct objects. For example, in unit 1 lesson 7, students design and construct mini greenhouses to grow herbs.

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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.
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***. Guided research provides an opportunity for students to seek further information about subjects of inquiry, personal interests, or topics of their choice. Accordingly, 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

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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 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 3 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.

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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, 2011), 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 page 36) 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

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with 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 over a longer period of time, 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

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 page 36 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 (page 36).

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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.
- 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, babysitters, and coaches. For this purpose, consider using the FAMILY AND COMMUNITY CONNECTIONS: ASSESSING TOGETHER template (page 33). After any lesson or module, 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.

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- 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 page 36.

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 teachers.

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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

Growth and Changes in Plants

About This Unit

This unit of ***Hands-On Science and Technology for Ontario, Grade 3***, focuses on the study of plants—their physical characteristics, along with each characteristic's specific function, their requirements for survival, and their growth patterns. Students will investigate, grow, and observe plants in their local environment. They will learn about similarities and differences in the physical characteristics of different plant species, as well as the changes that take place in different plants as they grow. Students will also learn about the importance of plants for the survival of humans and other animals, and the effects of both human activities and changes in environmental conditions on plants.

Planning Tips for Teachers

- Collect a variety of live plants and an assortment of seeds and bulbs for examination and use in the classroom. Bean plants grow well and quickly, so students can observe them develop from seed to adult plant in a reasonably short period of time.
- Collect a variety of containers in which to put soil to grow the plants.
- Consider setting up a plant centre in a sunny area of the school or classroom where students can observe, record, and discuss changes in plants on a regular basis.
- Collect numerous photos and pictures of plants for use in activities. Resources for collecting pictures include:
  - websites
  - wall calendars
  - departments of forestry and natural resources
  - seed catalogues
  - forestry and environmental associations
  - gardening and plant books and magazines
  - horticultural societies
  - brochures and flyers
  - simplified plant guides/books
  - nature-walk brochures from local, provincial, and national parks
  - photographs from home
- Contact government departments and associations well before starting the unit for related materials and services (e.g., booklets, posters, videos, presentations) for classroom use.
- It is not necessary to teach this unit (or any other unit) in one block. Consider splitting up the unit's activities to focus on plants during fall and spring when outdoor plant life is abundant, or consider studying plants on an ongoing basis throughout the year. Each unit of the curriculum does not need to be taught as a discrete unit. For example, many meaningful links can be made by teaching this unit in conjunction with Soils in the Environment (Unit 4).
- Whenever possible, use reusable or recycled items for classroom experiments and demonstrations. For example, rather than single-use zipper-lock bags, use silicone or sturdy plastic bags that can be washed and reused.
- Lesson 11 includes an option to grow sod in a pan from seed. Start growing the sod a few weeks before doing this experiment. See lesson 11 for more information about this activity (see page 104).
- Consider recording each lesson's guided inquiry question (e.g., on a sentence strip) for display throughout related investigations.
- Have students make land-based journals for use throughout the unit. Use notebooks with sturdy covers or drawing paper and clipboards. Provide a zipper-lock bag for each student to carry their journal and journal supplies (e.g., pencils, sharpeners, pencil crayons [rather than markers, which will bleed if wet], stretch gloves [for journaling on cooler days]). ▶

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- Add unit-specific materials to your STEM Makerspace centre, in addition to the general materials listed in the introduction (see page 17), that encourage learning about growth and change in plants. Include items such as a collection of live plants, as well as plant parts (e.g., slices of tree trunks, seeds, leaves, bark, fruit, and vegetables). Provide magnifiers, tweezers, soil samples, spray bottles, containers, and measuring devices.

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

Indigenous Perspectives and Knowledge

Indigenous perspectives on the natural environment are based on sustainability. Many plants traditionally used by Indigenous Peoples in Ontario are either no longer in existence or in danger of being lost forever. Indigenous perspectives, which are common to many cultures, are embedded throughout this unit with these understandings in mind:

- People from all cultures respect and appreciate nature's gifts.
- All life forms, no matter how small, are important and significant.
- By respecting plants, we are protecting the Earth.
- Plants have homes and communities just like people and other animals do.
- Plants have powers to heal. Plants help people and other animals survive.
- Indigenous science helps us understand how plants grow and develop.
- Western science helps us understand how plants grow and develop.
- We can learn about plants from each other.

Indigenous Peoples' Uses for Plants

Food: The Indigenous Peoples in what is now Canada farmed and gathered wild plants for food. Peoples in the Eastern Woodlands region cultivated maize, beans, and squash (known as the Three Sisters). Sagamite, a soup made of cornmeal with added fish, meat, or squash, was a staple. There is also evidence that the people living farther west on the Prairies, where the Red and Assiniboine rivers meet, grew similar crops. Tobacco and sunflowers were also grown.

In Ontario, hundreds of species of wild plants can be harvested for food, including seeds, nuts, and grains (e.g., hazelnuts, acorns, whitebark pine seeds, wild rice). Berries and fleshy fruits (e.g., saskatoons, blueberries, huckleberries, crabapples, rosehips, wild cherries) are an important source of vitamins. So are wild greens, the shoots and leaves of various plants, and leaf vegetables (e.g., mustard greens, lambsquarters, watercress). Roots (e.g., wild onion, balsam root, wild turnip) are harvested later in the season. Fungi (e.g., wild mushrooms) and certain tree barks can also be eaten. In northern areas, people harvest lichens; in coastal areas, they harvest certain species of algae and seaweed. Sap from birch and maple trees is collected in spring.

Medicinal plants: Many plants can be used to treat illnesses and ailments. Some are administered as teas, such as Labrador tea (used for kidney ailments) or yarrow (to cure colds and fever). Some plants are used as inhalants or as poultices (e.g., a poultice from the purple coneflower root treats sores and swelling). Others are mixed with fats to make ointments. Yet others are used as smudges in healing ceremonies (see sacred plants, below).

Sacred plants: Tobacco, sweetgrass, cedar, and sage are known as the four sacred medicines by the Anishinaabe; they are also

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used by other First Nations Peoples in North America. These medicines are used mainly in smudging ceremonies; their smoke is part of prayer and cleansing ceremonies. It is believed that the smoke from the sacred plants acknowledges the spirits that help people communicate well. Among the Anishinaabe, tobacco is the first medicine offered in a ceremony to communicate with the spirit world. Sweetgrass is used in healing and purification. Sage is known for its healing properties, and cedar for purification and as a guardian spirit.

Utility plants: Plants are also useful for day-to-day life. Wood from various trees is used to build structures (e.g., shelters or frames for wigwams and longhouses). For transportation, wood is used to make canoes, snowshoe frames, and toboggans. It is also used for tools and implements (e.g., arrows and spear shafts, digging sticks, chisel and adze handles, scrapers) and toys and games. Bark is used to create containers and canoes, and as wrapping and lining. Plant fibres are used to make rope, fabric, mats, and baskets.

Science and Technology Vocabulary

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

- *adaptation, air, basic needs, carbon dioxide, coniferous, deciduous, fibrous, flowers, leaves, life cycle, light, nutrients, ovule, oxygen, photosynthesis, pistil, pollen, root, seeds, soil, space, stamen, stem, taproot, water*

Infuse vocabulary related to scientific 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, diagram, display, draw, estimate, examine, explain, explore, find, follow, graph, identify, improve, investigate, label, measure, observe, order, plan, predict, recognize, record, repeat, research, respond, select, sequence, test*

In lesson 1, have students start a Science and Technology Glossary in which they can record new vocabulary introduced throughout the unit. Also in lesson 1, create a word wall for the unit on a bulletin board, 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, or online dictionaries. For example:

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

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

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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 ways in which plants are beneficial to society and the environment, and ways in which human activity has an impact on plants and plant habitats	**B1.1** assess ways in which plants are important to humans and other living things, taking different perspectives into consideration, and identify ways in which humans can protect native plant species and their habitats						√	√		√	√	√	√
	B1.2 assess ways in which human activities have an impact on plants and plant habitats, and identify personal actions that they could take to minimize harmful effects and enhance positive ones									√	√	√	√
	B1.3 assess the benefits and limitations of locally grown food						√	√					
B2. Exploring and Understanding Concepts: Demonstrate an understanding of characteristics and uses of plants and of plants' responses to the natural environment	**B2.1** describe the basic needs of plants, including the need for air, water, light, heat, nutrients, and space, and identify environmental conditions that may threaten plant survival	√		√		√			√				
	B2.2 identify different parts of plants, including the root, stem, flower, stamen, pistil, leaf, seed, cone, and fruit, and describe how each part contributes to plants' survival within their environment	√	√	√	√		√						
	B2.3 describe changes that different plants undergo in their life cycles			√		√							
	B2.4 describe ways in which a variety of plants adapt and/or react to their environment and to changes in their environment			√	√				√				

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Overall Expectation	Specific Expectation	Lesson											
		1	2	3	4	5	6	7	8	9	10	11	12
	B2.5 demonstrate an understanding that most plants get energy directly from the Sun through the process of photosynthesis, which involves the absorption of carbon dioxide and the release of oxygen	√		√									
	B2.6 describe ways in which people, including Indigenous Peoples, from various cultures around the world use plants for food, shelter, medicine, and clothing						√	√		√	√		
	B2.7 describe various plants used for food, including those grown by First Nations, Métis, and Inuit, and identify local settings where these plants are grown or found						√	√		√	√		
	B2.8 describe ways in which plants and animals, including humans, depend on each other							√			√		√

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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

The Amazing Life Cycle of Plants, Kay Barnham (Barron's, 2018).

Siha Tooskin Knows the Best Medicine, Charlene and Wilson Bearhead (HighWater Press, 2020).*

It All Starts With a Seed: How Food Grows, Emily Bone (Usborne Books, 2017).

Food Chains, Brenda Boreham (Strong Nations, 2013).*

Stand Like a Cedar, Nicola I. Campbell (HighWater Press, 2021).*

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

Relatives With Roots: A Story About Métis Women's Connection to the Land, Leah Marie Dorion (The Gabriel Dumont Institute, 2011).*

The Giving Tree: A Retelling of a Traditional Métis Story, Leah Marie Dorion (The Gabriel Dumont Institute, 2009).*

Jen and the Great One, Peter Eyvindson (Pemmican Publications, 2015).

Manoomini-miikaans: The Wild Rice Road, Michael Fisher, Perry Bebamash, and Isabelle Osawamick (Saginaw Chippewa Indian Tribe of Michigan, 2013).*

Wild Berries, Julie Flett (Simply Read Books, 2013).*

The Story of Manoomin, Fond du Lac Head Start (Fond du Lac Band of Lake Superior Chippewa, 2013).*

Busy, Busy Leaves, Nadia Higgins (Capstone Publishing, 2018).

Experiment With Photosynthesis, Nadia Higgins (Lerner Publishing Group, 2015).

Living in Harmony, The Anishinaubaemowin series, Basil Johnston (Kegedonce Press, 2012).*

A Native American Thought of It: Amazing Inventions and Innovations, Rocky Landon and David MacDonald (Annick Press, 2008).*

How Do Plants Grow? Terri Mack (Strong Nations, 2012).*

Jayden's Impossible Garden, Mélina Mangal (Free Spirit Publishing, 2021).

Lessons From Mother Earth, Elaine McLeod (Groundwood Books, 2010).*

Sweetgrass, Theresa Meuse (Nimbus Publishing, 2022).*

Plantzilla, Jerdine Nolen (Harcourt Voyager Books, 2005).

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

Giving Thanks: A Native American Good Morning Message, Chief Jake Swamp (Lee & Low Books, 2017). *

Environmental Activist Wangari Maathai (STEM Trailblazer BIOS), Jennifer Swanson (Lerner Publications, 2018).

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The Apple Tree, Sandy Tharp-Thee (The RoadRunner Press, 2015).

Greta and the Giants: Inspired by Greta Thunberg's Stand to Save the World, Zoë Tucker (Frances Lincoln Children's Books, 2019).

Let's Eat: Sustainable Food for a Hungry Planet, Kimberley Veness (Orca Book Publishers, 2017).

Wangari's Trees of Peace: A True Story From Africa, Jeanette Winter (Clarion Books, 2018).

Websites and Apps

- **https://pioneerthinking.com/natural-dyes/**
  Pioneer Thinking—Making Natural Dyes from Plants: A thorough guide to creating coloured fabric using dyes made from plants.
- **https://en.wikipedia.org/wiki/List_of_food_origins**
  Wikipedia—List of Food Origins: This list of popular foods from contemporary diets includes what part of the world they originally came from. Some examples from the list: potatoes, corn, tomatoes, chilies, avocados, vanilla, chocolate, turkey, peanuts, and maple syrup.
- **https://publications.gc.ca/collections/Collection/R32-195-1998E.pdf**
  Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC)—The Learning Circle: Classroom Activities on First Nations in Canada. Scroll down the page to read or listen to "The Lily Root." This story will help students understand the importance of some plants as medicine for Indigenous Peoples. Includes discussion questions and a recording.
- **https://freerice.com/**
  Freerice—World Food Programme: An educational quiz that donates rice to people in developing countries around the world.
- **https://www.telegraph.co.uk/gardening/tools-and-accessories/best-gardening-apps-how-identify-unknown-plants-flowers-2021/**
  "The 10 best gardening apps to identify unknown plants and flowers." Miranda Evans. The Telegraph. August 18, 2021: A list of apps to identify plants and flowers.
- **https://www.oneearth.org/how-birds-shape-the-landscape/**
  "How Birds Shape the Landscape." Channing Sargent. OneEarth. August 25, 2022. Article about the different ways birds conduct seed dispersal.
- **https://www.instructables.com/Haircut-Chia-Pet-Grass-Heads-Great-for-Summer-Br/**
  Haircut Chia Pet Grass Heads! Great for Summer Break!—Instructables: Instructions for making a chia pet grass head.
- **https://scotts.com/en-us/outdoor-recreation/how-to-make-grass-heads.html**
  How to Make Grass Heads—Scotts: Instructions for making grass heads.
- **https://www.foodhero.org/recipes/plant-part-salad**
  Plant Part Salad—Food Hero: A salad recipe that includes all the parts of a plant.
- **https://www.7generations.org/how-to-harvest-and-prepare-wild-rice-manoomin/**
  How to Harvest and Prepare Wild Rice (Manoomin)—Seven Generations Education Institute: Information about the importance

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of wild rice in Anishinaabe culture and the process of harvesting and preparing it for consumption.

- **https://climatekids.nasa.gov/greenhouse-effect**
  What Is the Greenhouse Effect?—NASA Climate Kids: A student-friendly explanation of the greenhouse effect.
- **https://www.todaysparent.com/family/easy-earth-day-activity-for-kids-plant-a-tree/**
  "Easy Earth Day activity for kids: plant a tree." Amy Baskin. Today's Parent. April 13, 2016: Article about how to plant a tree.
- **http://www.greenbeltmovement.org/**
  The Green Belt Moment: An environmental organization that empowers communities to conserve the environment and improve livelihoods—founded in 1977 by Professor Wangari Maathai.

Apps

- **https://plantidentifier.info/**
  LeafSnap: An app that can be used to identify a plant by taking a photo of the plant.
- **https://piccollage.com**
  PicCollage: An app for creating digital presentations that combine text, photos, and drawings.
- **https://kidpix.app/**
  Kid Pix: A free web-based drawing program that allows students to save their original creations.

Videos

- **https://www.youtube.com/watch?v=gNtF_KYRtSc**
  "Grass Seed Germination and Grass Growing Time Lapse." Temponaut Timelapse (3:10).
- **https://www.youtube.com/watch?v=0D3UGZwJNYw**
  "Life of a Tree | Beginner Scratch Animation Tutorial." First Code Academy (23:42).
- **https://www.youtube.com/watch?v=upUDTbBv1tA**
  "Go Plant a Tree | Plum Landing on PBS Kids." Plum Landing (2:54).
- **https://www.tvokids.com/school-age/ravens-quest/videos/hope**
  "Raven's Quest: Hope." TVO Kids (6:59).
- **https://pbswisconsineducation.org/story/manoomin/**
  "The Ways: Manoomin." PBS Wisconsin Education (4:23).
- **https://www.youtube.com/watch?v=RRta4aGJKfc**
  "Landscape Architecture for Kids: What is a Green Roof?" University of Nebraska-Lincoln (3:54).

Coding and STEM Resources

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**
  Find tutorials for students to learn about different ways they can use Scratch.

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Code.Org and Hour of Code

- **https://code.org**
  Free coding lessons and activities designed to help students learn to code.
- **https://studio.code.org/hoc/1**
  Hour of Code Mazes: Angry Birds and Plants vs. Zombies. In this tutorial students will use block coding to program a variety of characters to navigate mazes using the most efficient code possible.
- **https://studio.code.org/s/coursec-2023/lessons/9/levels/1**
  Code.org—The Harvester: Harvesting Crops with Loops. Part of the Computer Science Fundamentals course at Code.org, students will use block coding to harvest pumpkins and corn using loops (repeating events) to harvest more efficiently.
- **https://robotmagic.org/magic/l_bluepen50_1_1**
  FarmBot—Plant with Code (loops and variables). The FarmBot tutorial allows students to use block coding to program a robot farmer to plant seeds that grow into flowers. This tutorial introduces students to the use of loops (repeating events) to make code more efficient by using fewer steps.
- **Code.org Sprite Lab**
  Sprite Lab is an open programming environment where students use block-based programming to create simple animations. Find Sprite Lab at <https://code.org>. Select New Project at the top right of the page. From the dropdown menu, select Sprite Lab.

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 Education account. Check with your school board to see if you already have licences available.
- **https://education.minecraft.net/en-us/get-started/download**
  Instructions for how to download Minecraft Education.
- **https://education.minecraft.net/en-us/challenges/bee-creative**
  Bee Creative Classroom Build Challenge: Students can build a pollinator garden in Minecraft. To access the challenge, select "Open in Minecraft" to access the world, then select "Create World" to import it onto student devices with Minecraft installed.
- **https://education.minecraft.net/en-us/resources/classroom-build-challenge**
  Information about Minecraft Education Classroom Build Challenges, including current and past challenges, resources to create your own classroom build challenges, and printable build challenge activities.

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1 What Do We Know About Plants and Their Needs?

Information for Teachers

A plant is a living thing that produces its own food through photosynthesis. Plants need sunlight, water, a growing medium (soil), and carbon dioxide (from air).

NOTE: Mushrooms and fungi are not plants, as they lack the chlorophyll necessary for photosynthesis.

The Activate activity involves taking students on a guided walk through a park, forest, or nature preserve to look for examples and evidence of plants in the natural environment. To incorporate Indigenous perspectives into this activity, consider inviting a local Elder or Knowledge Keeper to lead the nature walk. This activity can be a bridge-building endeavour between the school, families, and the community.

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

NOTE: Certain protocols should be followed when inviting an Elder or Knowledge Keeper into your classroom. Consult your school board's Indigenous education leads and consultants or your local Indigenous Education Council. For example, the Lakehead District School Board has protocols available at <https://www.lakeheadschools.ca/wp-content/uploads/2021/10/Elder-Senator-Protocol.pdf>.

Materials

- chart paper
- cameras
- land-based journals and supplies (see page 40 for information about land-based journals)
- stories by Indigenous authors about plants (see Activate)
- Image Bank: Local and Exotic Plants (See Appendix, page 295; print duplicate copies of each image.)
- large sticky notes (one for each student)
- markers (various colours)
- Activity Sheet: Science and Technology Glossary (1.1.1)
- Task Card: What Can I Learn About Plants? (1.1.2)
- Recording Sheet: I Recommend (1.1.3)

Activate

Plan a walk to a park, forest, or nature preserve to observe plants. Consider inviting an Elder or Knowledge Keeper to guide the walk. They can share knowledge about plants or tell traditional stories related to the plants.

Before the walk, explain to students that they will be looking for evidence and examples of plants in a natural environment. Ask:

- What do you think we will see? Smell? Hear? Feel?
- What kinds of living things might we see?

Have students share their background knowledge, predictions, inferences, and ideas about the plants they might see on the walk.

Discuss with students the importance of respecting nature. Encourage students to remember that some of the impacts we have on our environment can cause damage, and to be mindful of seeking to understand, not dominate, as they learn. Have them brainstorm ways in which they can demonstrate respect. For example:

- Never break off branches from trees or pick wildflowers.
- Collect only a few objects to take back to the classroom.
- Always clean up after ourselves.

Create an anchor chart with these guidelines to display in the classroom. Review the anchor chart each time students visit a natural environment.

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SAFETY NOTE: Discuss ways to safely use the senses to observe a living thing (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.

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 land-based learning in relation to 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 is on, as well as the traditional territory of the location for the nature walk (if different) using one of the following resources:

- Maps of Indigenous Communities in Ontario: <https://www.sac-isc.gc.ca/eng/1635957754306/1635957787562>
- First Nation Profiles Interactive Map: <https://geo.sac-isc.gc.ca/cippn-fnpim/index-eng.html>
- The First Nations and Treaties Map of Ontario as an Instructional Resource: An Educator's Guide: <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.

During the walk, have students look for examples of plants in the natural environment. For example:

- trees (coniferous and deciduous)
- shrubs
- grasses
- flowering plants

Have students photograph examples for use back in the classroom. In their land-based journals, encourage students to describe the plants they observe using words and labelled diagrams.

Follow up the land-based learning experience by reading stories by Indigenous authors about plants. For example:

- *The Giving Tree: A Retelling of a Traditional Métis Story* by Leah Marie Dorion
- *How Do Plants Grow?* by Terri Mack

Introduce the guided inquiry question: **What do we know about plants and their needs?**

Action: Part One

On chart paper, construct the following chart:

Plant Name	Plants in Our Local Area (✓)	Use(s) of Plants

Have students brainstorm various plants, including vegetables, flowers, shrubs, weeds, trees (including fruit trees), and herbs. Then, have them go over the list and select the plants they think can grow in the local area, checking

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these off in the second column of the chart. In the third column, have students list any use(s) of the plants.

Action: Part Two

Provide each student with one of the plant pictures from Image Bank: Local and Exotic Plants and one large sticky note. Be sure to distribute two copies of each image. Tell students to keep their pictures to themselves. Have them examine their picture and record on the sticky note what they see and what they think the name of the plant is, or what they think an appropriate name might be based on the plant's appearance. Have students attach the sticky note to their picture.

Explain there are two copies of each picture, so two students have the same one.

Challenge students to find their partner—the classmate who has the same picture—by moving around the classroom. Make sure students do not show their picture to anyone; each must first share an oral description of their plant, and then guess the other student's plant by name (e.g., prickly stem, red flower at the top, medium-sized leaves—a rose) to determine if their pictures are a match. If a match does not seem likely, those two students can move on and continue their search for the classmate with the same plant picture.

After all pairs have shared, ask:

- What do the pictures have in common? (They are all plants. The plants all have green parts. They all need water, sunlight, and air to grow.)
- How are they different? (different types of plants, grow in different locations, different uses)

Have students share their ideas and prior knowledge.

Action: Part Three

On chart paper, construct a KWHL chart as in the following example:

What Do We Know About Plants and Their Needs?			
What We Know	**What We Want to Know**	**How We Can Find Out**	**What We Learned**

Discuss the first part of the chart's title with students. Ask:

- What is a plant?

Have students share ideas. Record this information in the first column of the chart using one colour of marker. Let students know there are many good ideas, and they will use the information on the chart to agree on a definition for *plant*.

Record the term *plant* on a separate sheet of chart paper. Co-construct a class definition for the term and record the definition on the chart paper.

Discuss the second part of the KWHL chart's title. Ask:

- What do plants need to survive?

Have students share their ideas. Use a different colour of marker to record this information in the first column of the chart. Remind students that there are many good ideas, and they will use the information on the chart to agree on some basic things that plants need to survive.

Create a class list of things plants need to survive and grow. Record these on a separate sheet of chart paper with the same colour of marker.

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

- As we begin to study plants, what questions do you have about them?
- What would you like to learn about plants?

Have students share their ideas. Record these in the second column of the chart. This provides an opportunity for students to share special interests; consider these interests when planning future activities.

Introduce the concept of *sustainability* with regard to how we use and need plants (e.g., growing crops, building materials, exploring natural areas). Introduce the three pillars of sustainability—social (human health and well-being), environmental, and economic. Challenge students to notice when sustainability of plants is challenged or protected.

Throughout the unit, as students share questions, discuss ways they might find answers to these questions. Encourage them to think of a variety of ways to learn new ideas or to find answers to scientific questions. For example:

- researching classroom resources (e.g., books, magazines, posters)
- inviting guest speakers to the classroom
- going on field trips
- watching videos
- reading websites, blogs
- researching library resources
- researching resources from home (e.g., books, artifacts, family experts)
- writing letters to experts
- conducting experiments
- making observations
- going on nature walks in the community
- taking photographs

NOTE: Introduce resources students may not think of (e.g., simplified plant guides; nature-walk brochures from local, provincial, and national parks; gardening books).

Record these ideas in the third column of the KWHL chart.

Explain to students that as they explore plants and learn new things about them, they will record these ideas in the fourth column of the chart.

Display the KWHL chart in a visible area of the classroom, along with the class definition of the term *plant* and the list of what plants need to grow and survive. Students can refer to this information throughout the unit.

Finally, discuss with students how this topic—plants and their needs—might apply to their own lives. Ask:

- How could you use what you learn about plants during your life?

Discuss examples (e.g., gardening, cooking, potential future careers, camping).

Action: Part Four

Distribute several copies of the Activity Sheet: Science and Technology Glossary (1.1.1) to each student.

Provide students with the following directions:

- Begin your Science and Technology Glossary for the unit. Record the term *plant* and include a definition and an illustration.

By the end of the unit, students will have completed several sheets. Have them cut apart the rows, alphabetize their words, and create booklets of vocabulary related to growth and changes in plants.

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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 or languages spoken at home.

Action: Part Five

Set up a Plants Library in the classroom. Provide resources in a wide range of media (e.g., picture books, nonfiction books, magazines, articles, posters, brochures, fact sheets, riddles, internet sites) that include information about local plants and plants from around the world. Ensure resources are high interest, very visual, and in a range of reading competencies. Encourage students to bring in their own books or other resources to add to the library (review all resources before adding them to the library). Provide a copy of the Task Card: What Can I Learn About Plants? (1.1.2) and copies of the Recording Sheet: I Recommend (1.1.3).

When students visit the Plants Library, encourage them to read anything they find interesting. Once they have read their selections, have students complete the Recording Sheet: I Recommend (1.1.3) to make a reading suggestion to their classmates.

NOTE: Review different reading strategies with students for use at the Plants Library (e.g., skimming, scanning, and using visuals on the page).

STEM Makerspace

- In addition to the materials available at the Makerspace, provide various leaves, grasses, and flowers. Also provide light-sensitive paper, dishtowels, a shallow tray with water inside, a heavy book, and a stopwatch or timer.

NOTE: Keep the light-sensitive paper inside its packaging until it is ready to be used. This activity works best outdoors on a sunny day.

- Have students remove a sheet of the paper from the package and place it on a flat surface, then quickly arrange some of the plant leaves, grasses, and flowers on the paper, keeping each item in one spot. Have students set the stopwatch or timer for five to seven minutes. Ensure they do not move anything out of its place. When time is up, have students quickly remove the items from the paper and submerge the paper into the tray of water for a few minutes. When they remove the page, have them place it in between the two halves of a folded dish towel and place the heavy book on top to help press out the water. Have students wait several hours before unwrapping the print.
- Invite students to use materials available at the Makerspace to design and build a picture frame for their print.

NOTE: If light-sensitive paper is unavailable, a similar effect can be achieved using construction paper. Arrange leaves, grasses, and flowers on the construction paper and cover in plastic wrap (with the ends weighed down by rocks or other heavy objects to keep it in place). Leave out in the sun for several hours before removing the plastic wrap and plant parts. The negative space around the plants will have faded, leaving an imprint behind.

Coding Connections

NOTE: For more information about coding, see "What Is Coding?" in the Introduction on page 4.

Plugged: Help FarmBot Plant Flower Seeds

- Provide students with computers, Chromebooks, or tablets. Have students access FarmBot at <https://robotmagic.org/magic/l_bluepen50_1_1>.
- Challenge students to use block coding to program a robot farmer to plant seeds that grow into flowers.

▶

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1

- FarmBot introduces students to the use of loops (repeating events in which instructions are repeated a specified number of times), which make code more efficient by using fewer steps. The tutorial includes hints to help students along the way. Each level becomes progressively more challenging. Students can repeat levels as often as needed. The final level is an open canvas where students can experiment with planting their own garden.

NOTE: For information about Code.org and Hour of Code programs such as FarmBot, see Coding and STEM Resources, page 47.

Talking Circle

Revisit the guided inquiry question: **What do we know about plants and their needs?** 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 class word wall to display new terms introduced throughout the unit. Include the words in languages other than English, as appropriate.

Enhance

- **Family Connection**: Provide students with the following sentence starter:
  - Plants we have in our home, yard, and community are _____.

  Have students record the sentence starter in their science journal or agenda and complete it at home. Family members can help students draw and write about this topic. Have students share their completed sentences with the class.
- Find apps that students can use to identify plants. For example, with LeafSnap <https://plantidentifier.info> users can take a photo of a leaf and the app will identify the tree species. Other apps can be found at <www.telegraph.co.uk/gardening/tools-and-accessories/the-best-apps-to-identify-unknown-plants-and-flowers/>.

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Download these reproducibles at <https://www.portageandmainpress.com/isbn/9781774920688>. For step-by-step instructions to access this download, see Appendix on page 295.

1.1.1

Science and Technology Glossary

Illustration	Illustration	Illustration
Term	Term	Term
Definition	Definition	Definition

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1.1.1

1.1.2

What Can I Learn About Plants?

Welcome to the Plants 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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1.1.2

1.1.3

Date: _____ **Name:** _____

I Recommend

Title: _____

Author: _____

Illustrator: _____

1. Draw your own version of an interesting picture from the book.

2. Why did you choose to read this?

_____

_____

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

_____

_____

4. What is one question you still have about a topic in this book?

_____

_____

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1.1.3

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/9781774920688>.

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 xxxxxxxxxxxxxxxxx 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: Growth and Changes in Plants

Lesson 1: What Do We Know About Plants and Their Needs?

Local and Exotic Plants



1. Wild Rice in Lake



2. Wild Rice Plant



3. Corn Plant With Cobs



4. Corn Field



5. Squash Plant



6. Flowering Zucchini Plant



7. Growing Bean Plant



8. Highbush Cranberries



9. Blueberry Plant



10. Sage Plant



11. Cedar Tree



12. Tobacco Plant

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13. Sweetgrass



14. Birch Trees



15. Sugar Maple Tree



16. Chokecherry Tree



17. Monarch Butterfly on Swamp Milkweed



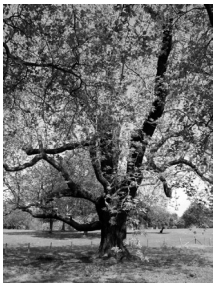
18. Poison Ivy



19. Black-Eyed Susans



20. White Trilliums



21. Black Walnut Tree



22. Pineapple Plant With Immature Fruit



23. Pineapple Plants



24. Flowering Cactus

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25. Flowering Cactus



26. Banana Tree



27. Banana Tree



28. Orange Tree



29. Orange Tree



30. Venus Flytrap

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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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