Ontario

hands-on science and Technology

An Inquiry Approach With STEM Skills and Connections

Grade 2

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Hands-On Science and Technology for Ontario
Hands-On Science and Technology for Ontario, Grade 2
An Inquiry Approach With STEM Skills and Connections

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Introduction to *Hands-On Science and Technology*

About *Hands-On Science and Technology*

Hands-On Science and Technology helps develop students' understanding of science and technology concepts and science, technology, engineering, and mathematics (STEM) skills. It also promotes scientific literacy through active inquiry, problem solving, and decision making. Each activity in ***Hands-On Science and Technology*** encourages students to explore, investigate, and ask questions as a means of heightening their curiosity about the world around them. Students solve problems through first-hand experiences and by observing and examining objects within their environment. For 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 25–29.
- 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 15 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?

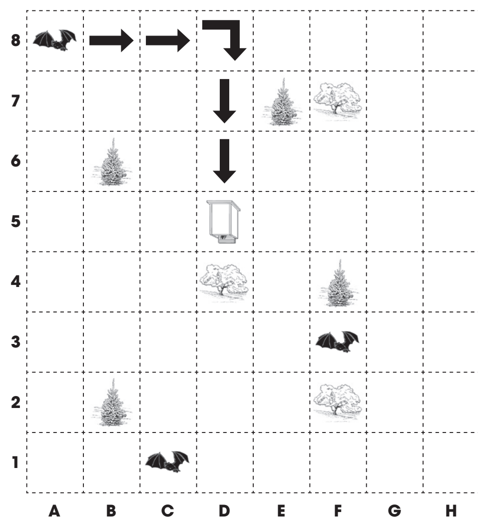
Coding, also called computer programming, refers to giving a computer a set of specific step-by-step instructions that tell it what to do. These instructions need to be written in a language the computer understands, referred to as a *programming language*. There are many programming languages. They 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. ScratchJr and Scratch are examples of programming languages made for children. Familiarize yourself with some coding programs that can be used in the classroom, such as ScratchJr, a free app designed for student use, and Code.org, a website that offers free coding courses and activities.

The key ideas and coding concepts for students to learn in grade 2 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*).
- 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. In ***Hands-On Science and Technology***, there are 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. *Unplugged coding* includes learning activities that introduce coding and programming through hands-on activities and games.

A typical unplugged coding activity for grade 2 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 on them. Students use the arrows to create concurrent paths that, when followed simultaneously, will map out different routes to arrive at the same destination.



A typical plugged coding activity for grade 2 is to connect multiple series of code blocks together to create codes that will output motion and sound at the same time in ScratchJr.

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

- Canada Learning Code: <http://www.canadalearningcode.ca/>
- Code Studio: <https://studio.code.org/courses>
- Hello Ruby for educators: Love Letters for Computers: <https://www.helloruby.com/loveletters>
- Coding in Elementary: A Professional Learning Resource for Ontario Educators: <http://www.edugains.ca/resourcesTELO/CE/CodingInterface/interface.html>
- ScratchJr: <https://www.scratchjr.org/>, <https://www.scratchjr.org/learn/interface>

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

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. Open inquiry is not commonly implemented in grade 2 classrooms, as students are still in the development stage of building research skills.

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 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 17 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 shown on the map 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.aadnc-aandc.gc.ca/cippn-fnpim/index-eng.html>

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

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

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

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

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

> Traditional Ecological Knowledge, or TEK, is the most popular term to denote the vast local knowledge First Peoples have about the natural

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> world found in their traditional environment. […] TEK is, above all, local knowledge based in people's relationship to place. It is also holistic, not subject to the segmentation of Western science. Knowledge about a specific plant may include understanding its life cycle, its spiritual connections, its relationship to the seasons and with other plants and animals in its ecosystem, as well as its uses and its stories. (First Nations Education Steering Committee and First Nations Schools Association, 2019, p. 13)

Indigenous Peoples developed technologies and survived on this land for millennia because of their knowledge of 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 view them from a more holistic perspective, as is reflected in these words from the president of the Science Museum of Minnesota, Dr. Eric J. Jolly (Cherokee):

> When I weave a basket, I talk about the different dyes and how you make them and how the Oklahoma clay that we put on our baskets doesn't permeate the cell walls, it deposits on the outside. It makes a very nice dye but if you cut through the reed you'll see white still on the inside of the reed, whereas if I make a walnut dye and if I use as my mordent, alum and I use as my acid cider, that walnut dye will permeate the cell walls. You cut through the reed and it's brown through and through. Now what I've just described is the difference between osmosis and dialysis. That Western science calls those scientific terms is really wonderful, but it's not scientific terms if you are a basket weaver. Our culture incorporates so much of what people would call scientific knowledge and ways of thinking so naturally that we haven't parsed it out and put it in a book and said this is our science knowledge versus our weaver's knowledge. When I weave a basket I also tell the stories of the spirituality and not just the ways of which I dyed it. A basket weaver is as much a scientist, as an artist, and a spiritual teacher. We'd never think that you'd separate out just the science part, but you can't weave a basket without knowing the science. (Cited in Mack et al., 2012, pp. 50–51)

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

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local issues related to Indigenous Peoples in Ontario. Consider contacting the Indigenous education lead or consultant in your school board, your local Indigenous Education Council, or the Ontario Ministry of Education to access referrals. You may also consider contacting local Indigenous organizations for referrals to Elders and Knowledge Keepers. Such organizations may also be able to offer resources and opportunities for field trips and land-based learning.

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

- Elders and Knowledge Keepers have a deep spirituality that influences every aspect of their lives and teachings. They 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 sacred 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 Animals
- Matter and Energy: Properties of Liquids and Solids
- Structures and Mechanisms: Simple Machines and Movement
- Earth and Space Systems: Air and Water 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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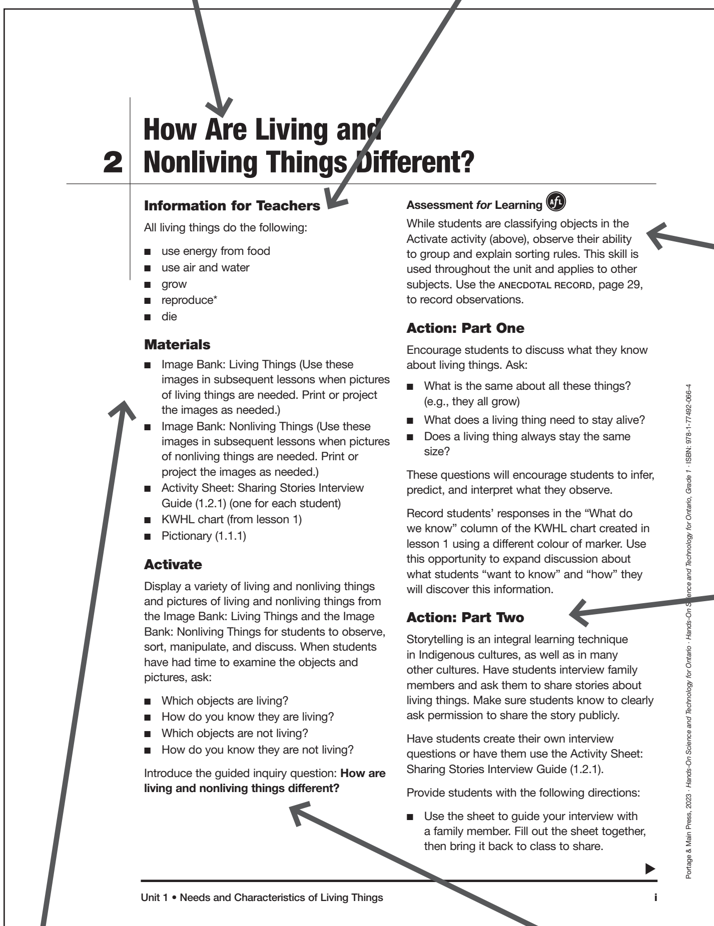
Lesson Title
- posed as a guided inquiry question related to the expectations addressed in the lesson

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 AfL

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.

Unit 1 • Needs and Characteristics of Living Things i

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 ***Hands-On Science and Technology*** Assessment Plan on page 25)

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)

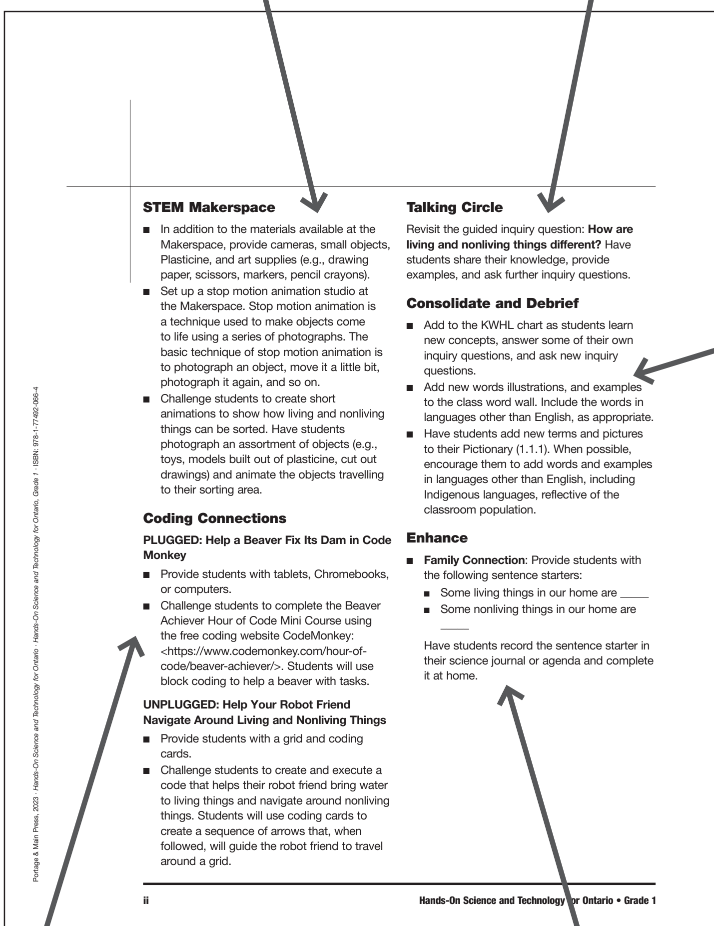
Materials
- lists all materials required to conduct the main activities
- includes items for display purposes or for recording students' ideas
- suggests visual materials (e.g., large pictures, sample charts, diagrams) to assist in presenting ideas and questions and to encourage discussion
- connects to Image Bank visuals, which may be printed or projected for specific activities (see Appendix on page 325 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

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 15 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 4 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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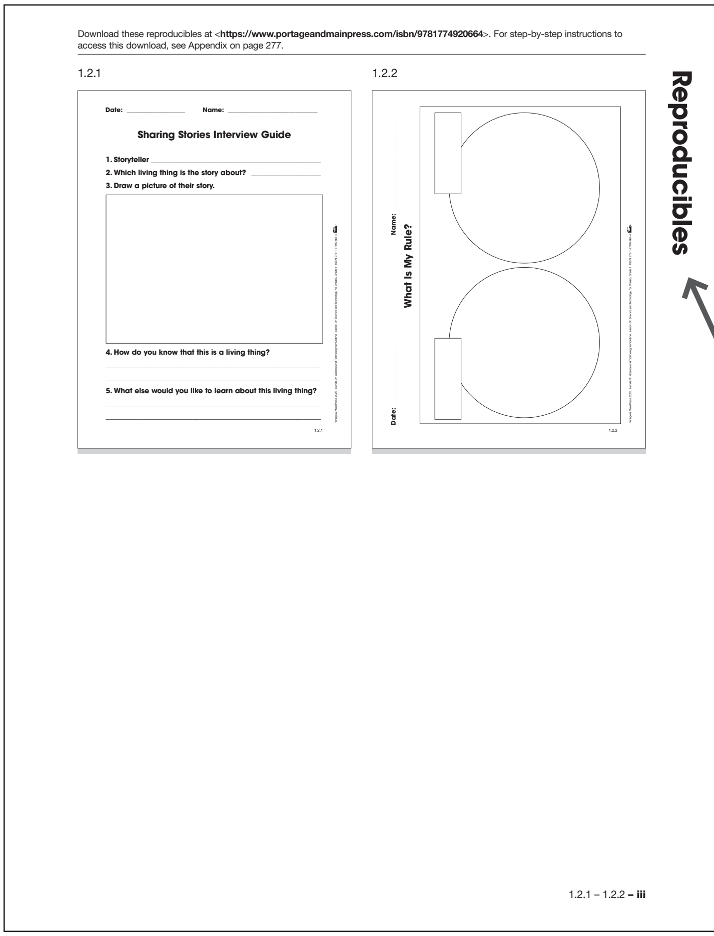
Download these reproducibles at <**https://www.portageandmainpress.com/isbn/9781774920664**>. For step-by-step instructions to access this download, see Appendix on page 277.

Reproducibles

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?

1.2.2

Name: ______

Date: ______

What Is My Rule?

1.2.1 – 1.2.2 – **iii**

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://www.octe.ca/en/resources>
- 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 primary grades, 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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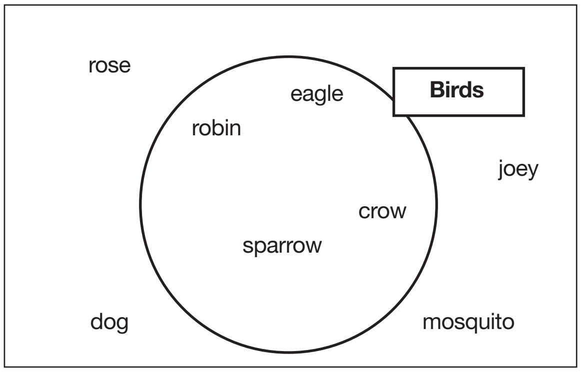
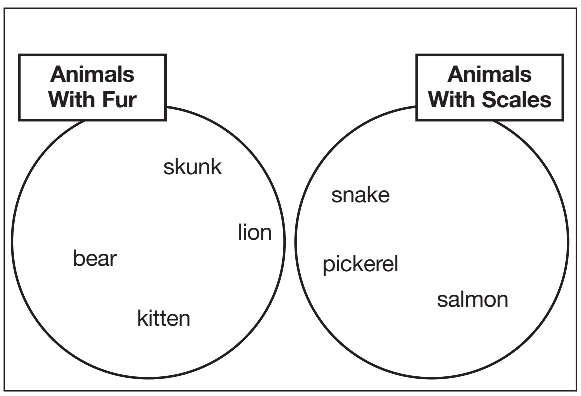
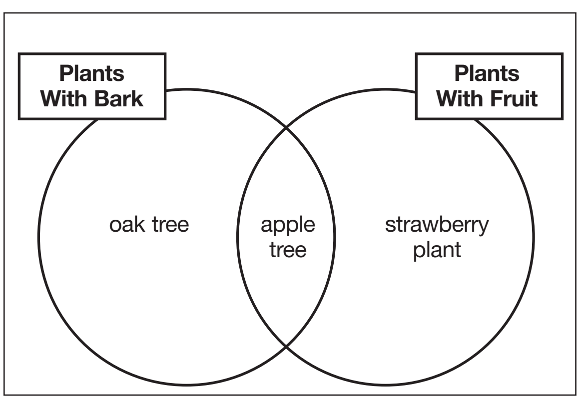
Single Sorting Mat



Double Sorting Mat



Double Venn



Measuring

Measuring is the process of discovering the dimensions or quantity of objects or events and, at the grade 2 level, usually involves measuring objects by length, area, volume, or mass. In the primary grades, 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 2, students use some nonstandard measurement as they build understanding of how to observe, compare, and communicate dimensions and quantity. This is a critical prelude to measuring with standard units.

However, students are also introduced to standard measurement of length using centimetres and metres, and measurement 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

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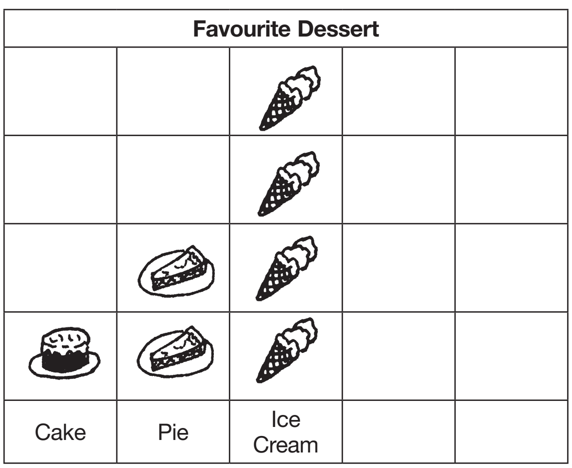
- constructing models
- using oral and written language
- sequencing and grouping events, objects, and data according to attributes

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.



- 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	**2016/2017 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

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become proficient at reading and writing, they can also be encouraged to use this vocabulary in written form. In each unit, students develop whole-class glossaries (word walls), and their own glossary in which they can record the terms they have learned.

Predicting

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

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 primary grades, 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.

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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 8, students design and construct models of a bird's nest using natural materials, with a focus on creating a nest that is both strong and comfortable.

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 (2006).

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

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with opportunities for students to use online resources for research and investigation. Discuss online safety protocols with students and be vigilant in supervising their internet use. Review websites and bookmark those that are appropriate for student use.

Discuss plagiarism with students; explain that copying information word for word—from a book, the internet, or any other resource—is wrong. Such information should usually be paraphrased in the student's own words (sometimes including short direct quotations marked as such), and the source of the information cited. Photos, drawings, figures, and other images found online should also only be 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 2 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,* 2006. http://www.edu.gov.on.ca/eng/curriculum/elementary/language18currb.pdf.

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 34) from *The Ontario Curriculum, Grades 1–8: Science and Technology* (2022), or in collaboration with students. Write these descriptors in student-friendly language to help students understand what successful learning looks like.
- **Provide descriptive feedback**. In conversations with students, identify what criteria they have and have not met, and provide any needed instruction. Work with

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

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

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

Assessment *for* Learning

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

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

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

- **Anecdotal Record:** To gain an authentic view of student progress, it is critical to record observations *during* lessons. The ANECDOTAL RECORD template (page 30) 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 30). 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 30), as well as a STUDENT REFLECTIONS template (page 30).

In addition, the SCIENCE AND TECHNOLOGY JOURNAL (page 31) 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 31).

Assessment *of* Learning AOL

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

Assessment *of* learning suggestions are provided with the culminating lesson of each unit of ***Hands-On Science and Technology***. To record student results, use the ANECDOTAL RECORD template (page 30), the INDIVIDUAL STUDENT OBSERVATIONS template (page 30), and the RUBRIC (page 32).

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 31).

As mentioned on page 25, ***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 34 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 32) 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 32).

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 34).

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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 32) and PORTFOLIO ENTRY RECORD (page 33) 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 31). 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 34.

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.

References

Davies, Anne. *Making Classroom Assessment Work* (4th ed.). Courtenay, BC: Connections Publishing, 2020.

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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 Animals

About This Unit

This unit of ***Hands-On Science and Technology for Ontario, Grade 2*** focuses on the study of animals, specifically patterns of growth and change. Students will investigate the growth patterns of different animals and compare these with their own growth. They will also learn about the conditions necessary to foster healthy development in animals.

Students will learn about similarities and differences among various types of animals and the ways in which animals adapt to different environmental conditions. They will investigate physical and behavioural characteristics and the process of growth of different types of animals. Students will learn about ways humans can affect other animals.

Planning Tips for Teachers

- Collect pictures of both adult and baby animals. Be sure to represent a range of animals from all six animal groups: mammals, birds, insects, fish, amphibians, and reptiles. If possible, laminate the pictures so they can be used throughout the unit. Good resources for pictures include the following:
  - old calendars
  - magazines (e.g., *Ranger Rick*, *Owl*, *Chickadee*, *Highlights for Children*, *Canadian Geographic*)
  - departments of agriculture and forestry
  - agricultural and forestry associations (e.g., Forests Ontario)
  - environmental associations (e.g., Greenpeace, World Wildlife Fund, Canadian Environmental Network [RCEN])
  - zoological, humane, and naturalist societies (e.g., Toronto Zoo, Ontario Nature)
  - websites (e.g., National Geographic Kids—Animals: <https://kids.nationalgeographic.com/animals>, Toronto Zoo—Animals and Plants: <https://www.torontozoo.com/animals>)

  Some organizations may provide booklets, posters, reference materials, or even kits or classroom presentations.
- Collect a variety of reading materials about animals at a range of reading levels appropriate for your students. Include fiction and nonfiction resources in as many different genres as possible (e.g., poetry, comic books, riddle books, weird-fact books). Use these reading materials at the Animal Library (set up in lesson 1, Action: Part Three) and for reference throughout the unit.
- If possible, arrange time for students to visit specific animal websites. Always preview any website students may use.
- Review Resources for Students, on page 44, and check to see which books are available in your school library. If necessary, order relevant books for the unit from your local library or education library.
- Decide if you are going to have a class pet—or bring in caterpillars (to watch transform into butterflies) or mealworms for studying life cycles. Including live animals enhances the concepts students are learning and provides them with first-hand observation experiences.

  Many animals are suitable for the classroom and are relatively easy to look after. Fish, for example, are easily cared for, and a fish tank provides an excellent observation centre. To introduce a greater variety of animals to students, consider having guest pets (e.g., bird, rabbit, guinea pig, snake) visit the classroom for a month at a time.

SAFETY NOTE: Consider any student allergies when selecting a classroom animal.

- In this unit, mealworms are used for experiments as they are easy to acquire and can usually be purchased from local pet stores. Mealworm experiments (see lesson 6) require about 30 days to complete.

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To house the mealworms and perform the experiments, collect the following materials:

- 50–60 mealworms
- 5–10 plastic containers
- mesh screen
- aluminum pie plate
- paper towels
- stopwatch
- scissors
- sharp knife
- strong tape
- oatmeal
- cornmeal
- wheat flour
- bran
- potato slices

- A great way to conclude this unit is to have students work in groups, pairs, or individually on an animal project of their choice.
- Keep charts, displays, and other work completed during each lesson. These are often referenced in subsequent lessons.
- Consider recording each lesson's guided inquiry question (e.g., on a sentence strip) for display throughout related investigations.
- Have students make land-based learning journals for use throughout the unit. Use notebooks with sturdy covers or paper and clipboards. Provide a zipper-lock bag for each student to carry their journal and supplies (e.g., pencils, sharpeners, pencil crayons [rather than markers, which will bleed if wet], stretch gloves [for journaling on cooler days]).

STEM Makerspace

Add unit-specific materials to the STEM Makerspace that encourage learning about growth and changes in animals, in addition to the general materials listed in the Introduction to ***Hands-On Science and Technology for Ontario, Grade 2*** (see page 15). Include items such as artifacts from animals (feathers, bones, teeth, fossils, shells); models of animals including skeleton models; as well as equipment such as magnifiers, tweezers, and measuring devices.

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

Coding

Familiarize yourself with some coding programs that can be used in the classroom, such as ScratchJr, a free app 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 the unit 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.

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

Prepare unplugged coding kits for students to use with the Coding Connections activities throughout the unit. Unplugged coding kits are easy to make using common classroom materials. Include some of the following items:

- **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,

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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. A printable template of images is included with this unit (see page 42). Have students draw additional images on the blank cards provided (see page 42). Both the image cards and blank cards can be printed 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, carpets, or floors using masking tape or painter's tape. To create a foldable grid that is easy to store, 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 with this unit (see page 42). The grid template can be printed on 11 x 17 paper.

NOTE: In the labelled grid, letters (x-axis) and numbers (y-axis) are used to refer to specific locations on the grid. Students may initially require support in understanding 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 card images included with this unit (see page 42) or have students 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, consider allowing 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. Free printable sets of coding cards are available online; for example, ScratchJr offers printable images of coding blocks for download: <https://www.scratchjr.org/teach/resources>.

Indigenous Knowledge and Perspectives

Incorporate Indigenous knowledge and perspectives into lessons whenever possible. Traditional teachings for many Indigenous Peoples that connect to growth and changes in animals include the following:

- It is important to have a respectful relationship with nature, and to sustain natural resources for generations to come.
- All life—plant, animal, and human—lives in harmony and all living things depend on one another for survival.
- Humans have special relationships with other animals, which are seen as teachers, guides, and companions that are key to human survival.
- Life is interconnected and cyclical.

This unit of ***Hands-On Science and Technology for Ontario, Grade 2*** provides an opportunity for students to learn more about having respectful relationships with other animals. Students will also learn that humans, and all other animals, grow and change or metamorphose as part of their life cycle.

Traditionally, people depended on other animals for many reasons, including to signal seasonal changes, assist with agricultural pursuits, and provide necessities. When an animal was hunted, every part of it was used for food, clothing, tools, transportation, and shelter. Some Indigenous

Peoples believe that the animal offers its life to provide humans with what they need for survival; therefore, out of respect to the animal, no part of it should go to waste.

Many Indigenous Peoples have a true appreciation of where their food comes from, as well as an in-depth knowledge of hunting and of the animals they hunt. Through this interaction, people develop relationships with other animals and the natural world. Indigenous knowledge considers the natural renewal cycles of animals, and care is taken to harvest sustainably. For example, Indigenous people are always cautious about harvesting during the spring, when animals have offspring they need to care for.

When an animal or fish is harvested, the priority is distributing it to feed multiple families, rather than storing or freezing it for later use. The harvest is shared with Elders who can no longer hunt and harvest for themselves. Food and tools are shared within the community so that everyone benefits from the healing strength and nourishment contained in the meat or fish.

For more information about incorporating Indigenous knowledge and perspectives in your lessons, refer to the Introduction to ***Hands-On Science and Technology for Ontario, Grade 2***, on page 6.

Science and Technology Vocabulary

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

- *adaptation, adult, behaviour, caterpillar, characteristic, chrysalis, cocoon, development, ecosystem, egg, food group, growth, habitat, larva, life cycle, metamorphosis, nymph, offspring, pupa, spine, stage, trait*

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, estimate, explain, explore, find, follow, graph, identify, improve, investigate, measure, observe, order, plan, predict, recognize, record, repeat, research, respond, select, sequence, test*

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

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

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

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

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

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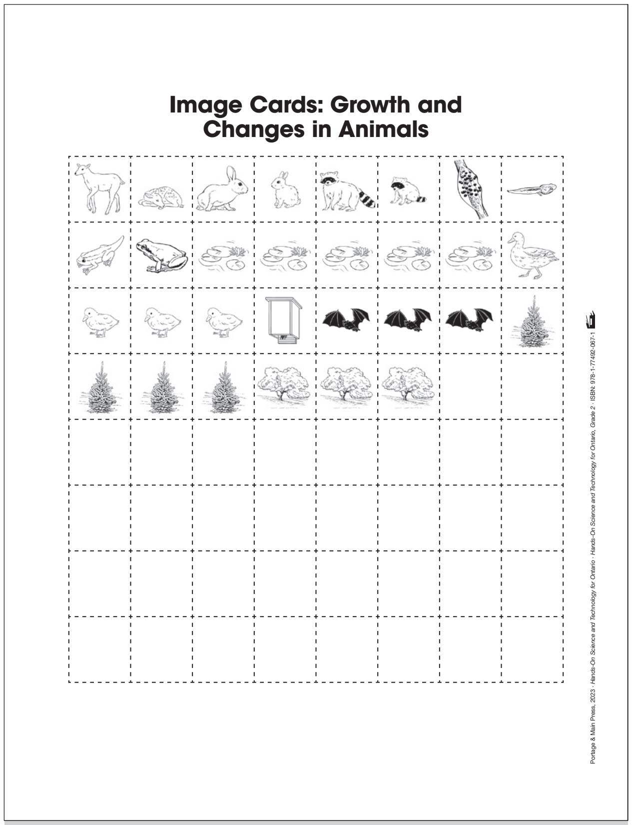
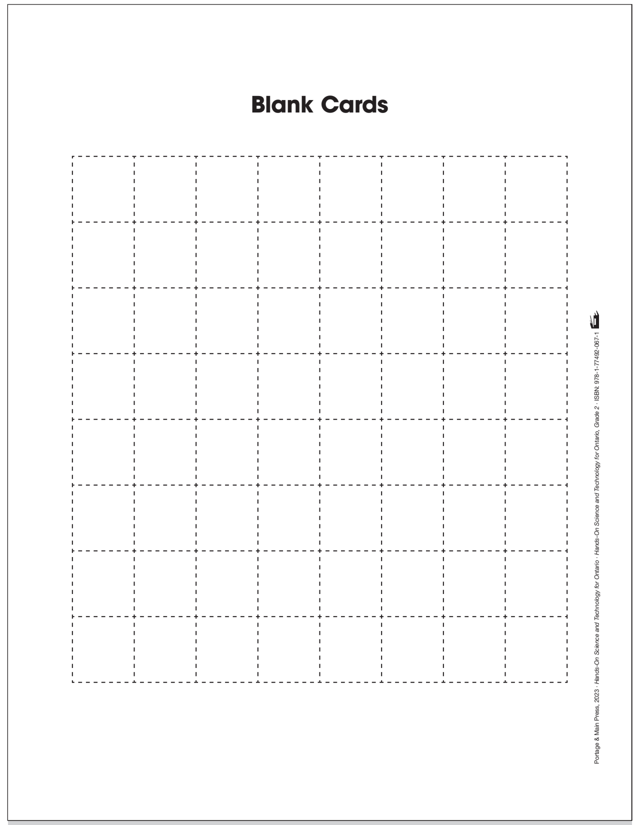
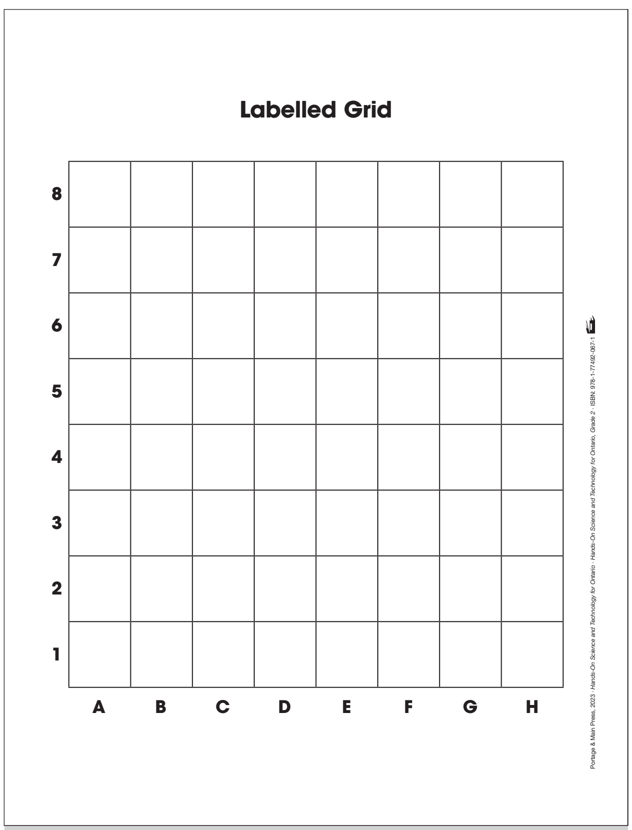
Image Cards: Growth and Changes in Animals



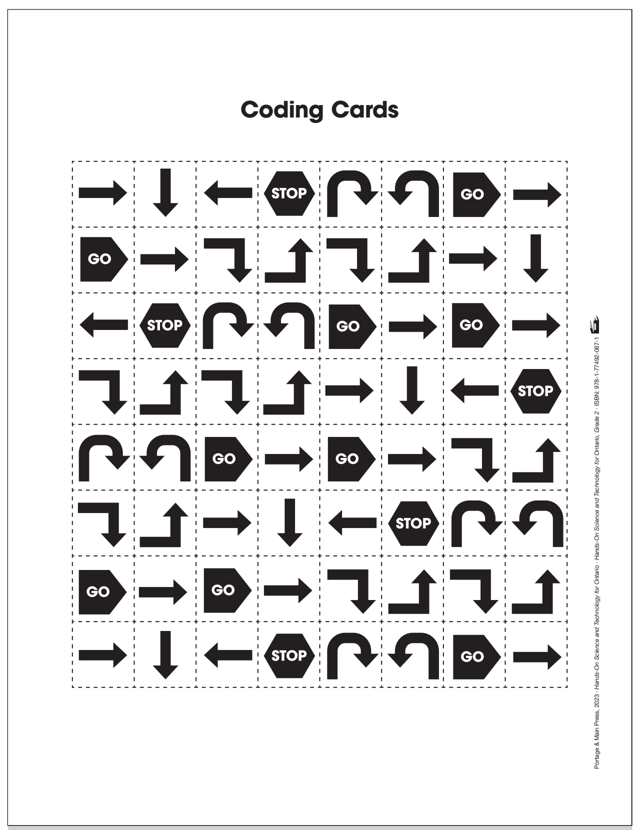
Blank Cards



Labelled Grid



Coding Cards



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 animals have an impact on society and the environment, and ways in which human activities have an impact on animals and the places where they live	**B1.1** examine impacts that animals can have on society and the environment, and describe some ways in which any negative impacts can be minimized										√	√	√
	B1.2 assess impacts of various human activities on animals and the places where they live, and describe practices that can minimize negative impacts					√				√		√	√
B2. Exploring and Understanding Concepts: demonstrate an understanding that animals grow and change and have distinct characteristics	**B2.1** compare physical characteristics of various animals, including characteristics that are constant and those that change	√	√	√	√				√	√			
	B2.2 describe the locomotion of various animals			√	√				√				
	B2.3 describe the life cycle of a variety of animals, including insects, amphibians, birds, and mammals	√	√			√	√	√					
	B2.4 compare changes in the appearance and behaviour of various animals as they go through a complete life cycle	√	√			√	√	√					
	B2.5 describe adaptations, including physical and/or behavioural characteristics, that allow various animals to survive in their natural environment								√	√	√	√	√

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Resources for Students

NOTE: **Resources marked with an asterisk are considered to be 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

Ojibway Animals, Jason Adair (Native Northwest, 2011).*

Mwâkwa Talks to the Loon: A Cree Story for Children, Dale Auger (Heritage House, 2015).*

If You Were Born a Kitten (ebook), Marion Dane Bauer (Simon & Schuster Books for Young Readers, 2015).

Baby on Board: How Animals Carry Their Young, Marianne Berkes (Dawn, 2017).

Run Salmon Run, Bobs & Lolo (Page Two Books, 2020).

Seven Grandfathers, Marigold Brown (Fallen Leaves, 2020).

The Very Impatient Caterpillar, Ross Burach (Scholastic, 2019).

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

The Very Hungry Caterpillar, Eric Carle (Philomel Books, 2021).

The Great Kapok Tree: A Tale of the Amazon Rain Forest, Lynne Cherry (Houghton Mifflin Harcourt, 2020).

Métis Camp Circle: A Bison Culture Way of Life, Leah Marie Dorion (Gabriel Dumont Institute Press, 2019).*

Extremely Gross Animals: Stinky, Slimy and Strange Animal Adaptations, Claire Eamer (Kids Can, 2021).

Are You My Mother? P. D. Eastman (Random House, 2020).

Muncha! Muncha! Muncha! Candace Fleming (Atheneum Books for Young Readers, 2002).

The Frog Mother, Hetxw'ms Gyetxw (Brett D. Huson) (HighWater, 2021).*

The Raven Mother, Hetxw'ms Gyetxw (Brett D. Huson) (HighWater, 2022).*

How Animals Care for Their Young: Parenting Styles in the Animal World, Pavla Hanácková (Windmill Books, 2022).

Arctic Animal Life Cycles: Mammals, Jordan Hoffman (Inhabit Education Books, 2022).

Look Again: Secrets of Animal Camouflage, Steve Jenkins and Robin Page (Houghton Mifflin Harcourt, 2019).

Living in Harmony, Basil Johnston (Kegedonce, 2011).*

Sweetest Kulu (5th Anniversary Edition), Celina Kalluk (Inhabit Media, 2019).*

How and What Do Animals Eat? Bobbie Kalman (Crabtree, 2015).

You're Just Right, Victor Lethbridge (Tatanka Productions, 2014).*

What If You Had Animal…? Series, Sandra Markle (Scholastic, 2013–2021).

Panda Bear, Panda Bear, What Do You See? Bill Martin Jr. (Henry Holt, 2014).

Jellies in the Belly: A Sea Turtle's Atlantic Adventure, Carol McDougall (Boulder Books, 2022).

Nanabosho and the Woodpecker, Joe McLellan (Pemmican, 1995).*

Nanabosho, Soaring Eagle and the Great Sturgeon, Joe McLellan (Pemmican, 1993).*

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

Going Wild: Helping Nature Thrive in Cities, Michelle Mulder (Orca Book Publishers, 2018).

Wild Eggs: A Tale of Arctic Egg Collecting, Suzie Napayok-Short (Inhabit Media, 2018).*

Animal Life Cycles series, Elizabeth Neuenfeldt and Rebecca Sabelko (Bellwether Media, 2021).

Have You Seen Birds? Joanne Oppenheim (Scholastic Canada, 2017).

Antifreeze, Leaf Costumes, and Other Fabulous Fish Adaptations, Laura Perdew (Nomad, 2020).

Stink Fights, Earwax, and Other Marvelous Mammal Adaptations, Laura Perdew (Nomad, 2020).

Spit Nests, Puke Power, and Other Brilliant Bird Adaptations, Laura Perdew (Nomad, 2020).

Sunscreen, Frogsicles, and Other Amazing Amphibian Adaptations, Laura Perdew (Nomad, 2020).

Water-Walking, Sidewinding, and Other Remarkable Reptile Adaptations, Laura Perdew (Nomad, 2020).

Watch It Grow: Backyard Life Cycles, Barbara Reid (North Winds, 2020).

Amara and the Bats, Emma Reynolds (Atheneum Books for Young Readers, 2021).

Follow That Bee! A First Book of Bees in the City, Scot Ritchie (Kids Can, 2019).

Animals! Here We Grow! Shelley Rotner (Holiday House, 2022).

Mealworms, Kari Schuetz (Bellwether Media, 2017).

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

Follow the Life Cycle series, Rachel Tonkin (Crabtree, 2020).

Just a Dream (25th Anniversary Edition), Chris Van Allsburg (Houghton Mifflin Harcourt, 2015).

Websites

- **https://www.sheppardsoftware.com/science/animals/games/animal-characteristics/**
  Animal Characteristics Game—Sheppard Software: Game in which students sort types of animals by characteristic.
- **https://www.torontozoo.com/animals**
  Animal Fact Sheets—Toronto Zoo: Click on the world region, then the animal to discover facts about habitat, diet, adaptations, and reproduction, as well as threats to survival.
- **https://kids.nationalgeographic.com/animals**
  Animals—National Geographic Kids: Information about and photographs of animals organized by animal type (classes).
- **www.defenders.org**
  Defenders of Wildlife: High-resolution photographs and information on endangered species and biodiversity.
- **https://www.tvokids.com/school-age/games/dino-exhibit-dino-dana**
  Dino Dana Dino Exhibit Game—TVO Kids: Learn facts about the characteristics/adaptations demonstrated by each dinosaur body part.

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1 What Do We Know About Growth and Changes in Animals?

Information for Teachers

Growth is the process of developing and maturing.

Materials

- Image Bank: Animals (See Appendix, page 325) (Print copies of these images, at least one photograph for each student in the class. Be sure to hand out the baby and adult photographs of each animal.)
- envelopes or file folders (each large enough to hold one animal picture) (one for each student)
- sticky notes (large)
- chart paper
- markers
- Activity Sheet: Science and Technology Glossary (1.1.1) (enough for each student to have several copies)
- Task Card: What Can I Learn About Animals? (1.1.2) (several copies to leave at the Animal Library)
- Animal Library Sample Slips (several copies to leave at the Animal Library; cut apart) (1.1.3)
- Animal Library Activity Slips (enough for each student to use at the Animal Library; cut apart) (1.1.4)

Activate

Ask students to imagine they are a group of scientists who are experts at identifying animals. Provide each student with an envelope or file folder containing one of the animal pictures (adult or baby) from the Image Bank: Animals and one large sticky note. (Be sure to hand out both the baby and adult pictures for each animal.) Ensure that students keep their pictures to themselves at this stage of the activity. Have students open their envelopes or file folders and examine their pictures. Ask students to record the following information on their sticky note:

1. the name of the animal shown in the picture
2. the word *adult* or *baby* to indicate if the picture shows a mature or baby animal

Explain that one way to tell if an animal is an adult or a baby is by its fur (if it is an animal that has fur). If the animal in the photograph has no fur but normally would, it is a baby.

Tell students there are two pictures of each type of animal in the collection: one as a baby and one as a mature (adult) animal. One student in the class will have a picture of the animal as an adult and another will have a picture showing the same animal as a baby. Challenge students to find their animal partners. Have students hold their pictures so their animal is visible to others and walk around the room. Encourage students to find their partner without speaking. When all students are in pairs, have them discuss the following with each other:

1. the name of their animal (Encourage students to use both the adult animal name and the baby animal name, if possible [e.g., frog/tadpole, dog/puppy].)
2. as many differences as they can observe between the baby and adult animal

When pairs have finished discussing with each other, have each pair share the differences they observed between the adult and baby animals with the class. Then, ask students:

- What do the picture pairs have in common? (they are all animals)
- What do you think you are going to learn about in science now? (animals, and how baby animals grow and change into adults)

Introduce the guided inquiry question: **What do we know about growth and changes in animals?**

NOTE: Save the collected adult and baby animal pictures; they are used again in lesson 5.

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Action: Part One

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

Growth and Changes in Animals			
What We Know	What We Want to Know	How We Can Find Out	What We Learned

Discuss the title of the chart with students. Ask:

- What do you already know about growth and changes in animals?
- What is an example of growth in an animal? (e.g., animal gets bigger, longer, taller)
- What is an example of change in an animal? (e.g., baby bird, which hatches with few or no feathers, later grows feathers)

Have students share their ideas. Record this information in the first column of the chart.

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

- As you begin to study animals and their changes from baby to adult, what questions do you have?
- What would you like to learn about baby and adult animals?

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.

As students share questions and concepts they want to know more about, discuss ways they might find the answers to these questions. Encourage students to think of a variety of ways they could learn new ideas or find answers to scientific questions. For example:

- read classroom resources (e.g., books, magazines, websites/blogs)
- watch videos of nature programs or documentaries
- read library resources (e.g., books, magazines, websites/blogs)
- use resources from home (e.g., books, artifacts, interviews with family members or other experts)
- invite guest speakers to the classroom (e.g., Elders or Knowledge Keepers or other community members)
- go on field trips or nature walks
- write a letter or email to an expert, requesting information
- make observations
- take or examine photographs

Record students' ideas in the third column of the KWHL chart.

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

Explain that new information they learn about growth and changes in animals will be recorded in the fourth column of the KWHL chart.

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

Action: Part Two

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

At the end of the unit, students can cut apart the rows on their sheets, alphabetize their words, and create booklets of terminology related to growth and changes in animals.

NOTE: The Science and Technology Glossary presents an excellent opportunity to celebrate cultural diversity by having students include

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words in languages other than English. Students may include terms in Indigenous languages, and English-language learners may include terminology in languages spoken at home.

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

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

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

Provide students with the following directions:

Record the term *growth* on the blank line in the left-hand column. Draw an illustration in the right-hand column to describe that term.

NOTE: Suggest to students that they use the animal in their envelope or file folder (from the activity in Action: Part One) to help them illustrate the term *growth*.

Action: Part Three

Set up an Animal Library in the classroom. Provide books (fiction and nonfiction), magazines, posters, weird-fact books, riddles, and any other animal materials, along with a copy of the Task Card: What Can I Learn About Animals? (1.1.2) and the Animal Library Sample Slips (1.1.3), and numerous copies of the Animal Library Activity Slips (1.1.4) for student use.

NOTE: Ensure the resources offered in the Animal Library are at a variety of reading levels to engage all learners.

Encourage students visiting the Animal Library to choose anything they want to read, then complete one of the following written tasks, using one of the Animal Library Activity Slips (1.1.4):

1. Recommend a book. For example:
   Title: *If You Were Born a Kitten*
   Author: Marion Dane Bauer

   I recommend this book because you learn about animals that you might not know anything about, like seahorses and opossums.
2. Complete a "Did You Know?" fact slip. For example:
   Did you know a baby seahorse is born from its father? It pops out from its father's pouch.
3. Write an animal riddle using information read or discovered at the Animal Library. For example:

   I have two large back legs and two smaller front legs. I travel by hopping. I keep my joey in my pouch. What am I?

Encourage students to complete a different slip each time they visit the library.

STEM Makerspace

- Using the materials available at the Makerspace, challenge students to build a model that shows the differences between a baby animal and its mother.
- Encourage students to use their prior knowledge of growth and changes in animals to help them design their model. Focusing on the difference in size is a good starting point for students.
- When students complete their models, ask:
  - How did you build the model of the baby animal differently from the model of its mother?
  - What changes does your model show?

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Coding Connections

NOTE: See pages 4 to 5 for more detailed information on coding, including plugged and unplugged coding.

PLUGGED: Create an Animation With a Baby Animal and Its Mother in ScratchJr

- Provide students with Chromebooks or tablets.
- Read aloud the CBC Kids' article "Meet 9 Amazing Animal Moms" <https://www.cbc.ca/kids/articles/meet-some-amazing-animal-moms>, which is about a variety of animal mothers and how they protect and care for their young.
- Challenge students to create an animation that includes a baby animal and its mother using the free coding app ScratchJr (available on the App Store or Google Play Store for iPads, Android devices, and Chromebooks: <https://www.scratchjr.org/>). Students can choose one of the animal characters or draw their own using the Paint Editor tool. They can then select the same character a second time and explore how to resize it using the Grow or Shrink block. Students can then create a code for each of their animals (baby and mother).

NOTE: Check out the Learn page on the ScratchJr website to read about the program's features, as well as tips and hints: <https://www.scratchjr.org/learn/interface>.

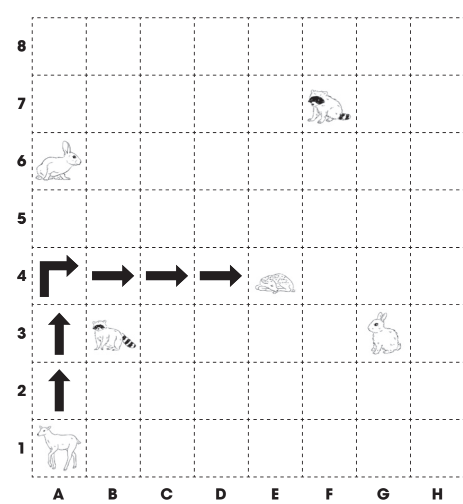
UNPLUGGED: Help the Animal Parents Find Their Babies

- Provide students with blank labelled coding grids and coding cards.
- Challenge students to code concurrent events that take three different parent animals (deer, rabbit, and raccoon) to their babies. Note that in coding, multiple sequences happening at the same time are called *concurrent events*. Students will use coding cards to create three different sequences of arrows that, when followed, will guide each parent animal to travel along the grid to its baby. For example (see the illustration below), the deer mother (doe) starts at A1, moves up three squares, turns right, and moves right four squares to E4, where its baby (fawn) is located. The raccoon mother (sow) starts at B3, moves right four squares, turns left, and moves up four squares, where its baby (kit) is located.

NOTE: Students may initially require support in understanding 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.

- As an additional challenge, ask:
  - Will any of the animals cross paths? How do you know?
- Remind students that if there are any problems with their code they will need to debug their code (find errors and fix them) and try again.

NOTE: This activity can also be completed using materials from an unplugged coding kit or real objects with students playing the roles of the animals.



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Talking Circle

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

Consolidate and Debrief

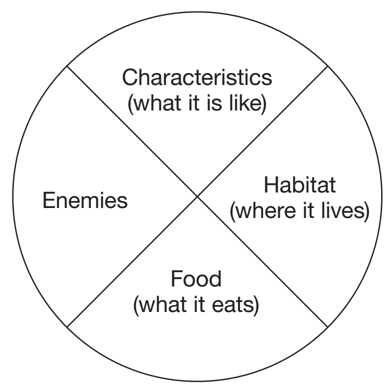
- Add to the KWHL chart as students learn new concepts, answer some of their own inquiry questions, and ask new inquiry questions.
- Begin a class word wall to display new terminology and illustrations that students learn throughout the unit.

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.

Enhance

- **Family Connection:** Provide students with the following sentence starter:
  - A favourite animal in our home or neighbourhood is _____.

  Have students record the sentence starter in their Science and Technology 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.
- Have students research the provincial/territorial flags of Canada, as well as flags of other places that feature animals. Have each student select a flag to draw and research the significance of the animal on the flag.
- Have students research which animals were traditionally important to the survival of local Indigenous Peoples (e.g., bison, deer, rabbits, fish, caribou, elk, moose, beaver, ducks, geese).
- Have students use clip art and pictures from various websites to add to the set of adult and baby animal pictures used in the lesson, including endangered species. This could lead to discussion about animals that are more common and those that are less common—and why!
- Celebrate cultural diversity by having students research the names of animals in different languages, especially those reflective of the classroom population.
- Have students use a graphic organizer to record information and research about animals studied, as in the example below:



- Have students research animals that are found in different countries. Students can then display pictures of the animals along with their names on a world map.

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1.1.1

Date: ______________ **Name:** ______________________

Science and Technology Glossary

Word	Diagram
Word ______	Diagram
Word ______	Diagram
Word ______	Diagram
Word ______	Diagram

1.1.1

1.1.2

What Can I Learn About Animals?

Welcome to the Animal Library!

1. Choose something you want to read, and then relax at the centre and read!
2. Decide how you want to share something you have read with your classmates. You can:
   - Recommend a book.
   - Write a "Did You Know?" fact about one animal.
   - Write a riddle about one animal.

1.1.2

1.1.3

Animal Library Sample Slips

Book Recommendation

Title: If You Were Born a Kitten

Author: Marion Dane Bauer

I recommend this book because you learn about animals that you might not know anything about, like seahorses and opossums.

This book is recommended by: Susan

Did You Know?

Did you know a baby seahorse is born from its father? It pops out from its father's pouch!

Fact written by: Theo

Animal Riddle

I have two large back legs and two smaller front legs. I travel by hopping. I keep my joey in a pouch. What am I?

Answer: look on the back of this card.

Riddle writer: Fatima

1.1.3

1.1.4

Animal Library Activity Slips

Book Recommendation

Title: ______________________

Author: ______________________

I recommend this book because ______________________

____

This book is recommended by: ______________________

Did You Know?

Did you know ______________________

____

____

____

Fact written by: ______________________

Animal Riddle

____

____

____

Answer: ______________________

Riddle writer: ______________________

1.1.4

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/9781774920671>**.

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 **xxxxxxxxxx** 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 Animals

Lesson 1: What Do We Know About Growth and Changes in Animals?

Animals

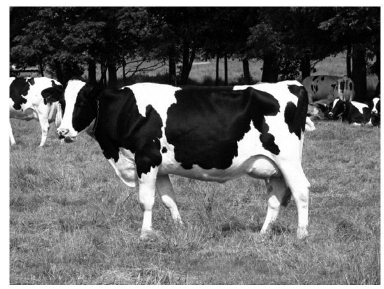

1. American Robin Chicks (Baby)


2. American Robin (Adult)


3. Monarch Caterpillar or Larva (Baby)

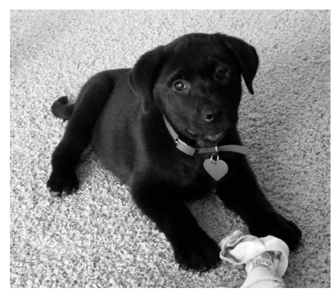

4. Monarch Butterfly (Adult)


5. Holstein Dairy Calves (Baby)

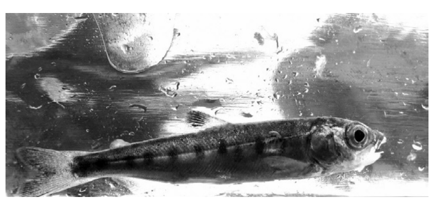

6. Holstein Dairy Cow (Adult)


7. Tabby Kittens (Baby)


8. Tabby Cat (Adult)


9. Labrador Retriever Puppy (Baby)


10. Labrador Retriever Dog (Adult)


11. Sockeye Salmon Fry (Baby)


12. Sockeye Salmon (Adult)

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13. Frog Tadpoles (Baby)

14. American Bullfrog (Adult)

15. Human Child (Baby)

16. Human (Adult)

17. Canada Goose Goslings (Baby)

18. Canada Geese (Adult)

19. Polar Bear Cub (Baby)

20. Polar Bear (Adult)

21. Eastern Cottontail Kit (Baby)

22. Eastern Cottontail Rabbit (Adult)

23. Green Sea Turtle Hatchling (Baby)

24. Green Sea Turtle (Adult)

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25. Shiras Moose Calf (Baby)

26. Shiras Moose (Adult)

27. Bald Eagle Eaglet (Baby)

28. Bald Eagle (Adult)

29. Grey Squirrel Pup (Baby)

30. Grey Squirrel (Adult)

Image Credits:

1 – “Two Chicks” by Flickr user Mark Turnauckas. Used under CC BY 2.0 licence.

2 – “American Robin” by Flickr user Becky Matsubara. Used under CC BY 2.0 licence.

3 – “on leaf” by Flickr user Patty O’Hearn Kickham. Used under CC BY 2.0 licence.

4 – “Monarch” by Flickr user Rick&Brenda Beerhorst. Used under CC BY 2.0 licence.

5 – “Dairy calves” by Flickr user Farm Watch. Used under CC BY 2.0 licence.

6 – “Big girl” by Flickr user Bill Tyler (fishhawk). Used under CC BY 2.0 licence.

7 – “Tabby Kittens” by Flickr user Jennifer C. Used under CC BY 2.0 licence.

8 – “Gracie the Almighty” by Flickr user Frostdragon. Used under CC BY 2.0 licence.

9 – “cutie” by Flickr user Tori VanTimmeren. Used under CC BY 2.0 licence.

10 – “Sweet lil’ hunting dog” by Flickr user m01229. Used under CC BY 2.0 licence.

11 – “SFU doctoral biology student Sean Godwin has found evidence that sea lice weaken juvenile Fraser River sockeye salmon’s ability to forage for food. (Photo credit: Lauren Portner)” by Flickr user Simon Fraser University – Communications & Marketing. Used under CC BY 2.0 licence.

12 – “sockeye spawners” by Flickr user Alaska Region U.S. Fish & Wildlife Service. Used under Public Domain licence.

13 – “Tadpoles” by Flickr user Thomas Wood. Used under CC BY 2.0 licence.

14 – “Frog” by Flickr user Brian Desrosiers Photography. Used under CC BY 2.0 licence.

15 – “Untitled image” by Flickr user Eelco Cramer. Used under CC BY 2.0 licence.

16 – “homecare-assistance Marietta GA” by Flickr user agilemktg1. Used under Public Domain licence.

17 – “Spring Geese and Goslings at Shoreline Park” by Flickr user Don DeBold. Used under CC BY 2.0 licence.

18 – “Canada Geese” by Flickr user Kevin M Klerks. Used under CC BY 2.0 licence.

19 – “Polar Bear Cub” by Flickr user tableatny. Used under CC BY 2.0 licence.

20 – “Dungarees” by Flickr user em_j_bishop. Used under CC BY 2.0 licence.

21 – “Untitled image” by Flickr user David Fant. Used under CC BY 2.0 licence.

22 – “Eastern Cottontail Rabbit (Sylvilagus floridanus)” by Flickr user Jim, the Photographer. Used under CC BY 2.0 licence.

23 – “Baby Green Sea Turtle” by Flickr user Tyler Karaszewski. Used under CC BY 2.0 licence.

24 – “Sea Turtle” by Flickr user City.and.Color. Used under CC BY 2.0 licence.

25 – “baby moose” by yiddishcowboy. Used under CC BY 2.0 licence.

26 – “Shiras Moose Bull Crossing the Green River on Seedskadee NWR 1” by Flickr user USFWS Mountain-Prairie, photographer: Tom Koerner. Used under Public Domain licence.

27 – “Bald eagle in nest, May 2013 Photo By USFWS Jeremy N. Moore” by Flickr user USFWS Midwest Region. Used under Public Domain licence.

28 – “Bald Eagle” by Flickr user Brent Kimber. Used under CC BY 2.0 licence.

29 – “Baby Gray Squirrel” by Flickr user audreyjm529. Used under CC BY 2.0 licence.

30 – “Écureuil gris – Gray squirrel” by Flickr user Denis Fournier. Used under CC BY 2.0 licence.

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About the Contributors

Jennifer E. Lawson, PhD, is the creator of the Hands-On series published by Portage & Main Press. As senior writer and editor for the series, she has contributed to more than 50 publications for teachers and students. Jennifer provides professional development workshops for educators locally, nationally, and virtually, and is a Workplace Wellness Advisor. Her most recent book is a collective effort called *Teacher, Take Care: A Guide to Well-Being and Workplace Wellness for Educators*. She is also one of the founders of Mission to Mexico, an organization that supports schools in some of the most impoverished communities in Puerto Vallarta, Mexico. Throughout her extensive career in education, Jennifer has worked as a classroom teacher, resource and special education teacher, consultant, principal, university instructor, and school trustee. She lives with her family in Winnipeg, Manitoba.

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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