

*hands-on*  
**science**  
*An Inquiry Approach*

**Grade 6**

*Series Editor*

Jennifer Lawson

*Writer*

Jennifer Lawson



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**An Inquiry Approach**

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**Assistant Editors:**

Leigh Hambly  
Leslie Malkin  
Desirae Warkentin

**Book and Cover Design:**

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**Cover Photos:**

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**Illustrations:**

Jess Dixon; 26 Projects; ArtPlus Ltd.

**Teacher Reviewer:**

Susan Atcheson



**PORTAGE & MAIN PRESS**

100-318 McDermot Avenue  
Winnipeg, MB, Canada R3A 0A2  
Tel: 204-987-3500 • Toll free: 1-800-667-9673  
Toll-free fax: 1-866-734-8477  
Email: [books@portageandmainpress.com](mailto:books@portageandmainpress.com)  
[www.hands-on.ca](http://www.hands-on.ca)

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# **Introduction to** ***Hands-On Science, Grade 6***

# Introduction to *Hands-On Science*

## Program Introduction

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

## The Foundations of Scientific Literacy

*Hands-On Science* focuses on the four foundation statements for scientific literacy in Canada, as outlined in the Pan-Canadian Protocol.<sup>1</sup> These foundation statements are the bases for the learning outcomes identified in *Hands-On Science*.

### Foundation 1: Science, Technology, Society, and the Environment (STSE)

Students will develop an understanding of the nature of science and technology, of the relationships between science and technology, and of the social and environmental contexts of science and technology.

### Foundation 2: Skills

Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions.

### Foundation 3: Knowledge

Students will construct knowledge and understandings of concepts in life science, physical science, and earth and space science, and apply these understandings to interpret, integrate, and extend their knowledge.

### Foundation 4: Attitudes

Students will be encouraged to develop attitudes that support responsible acquisition and application of scientific and technological knowledge to the mutual benefit of self, society, and the environment.

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**NOTE:** While these foundation statements form the bases for the science program, it is important for teachers to recognize and honour that some students might identify with science from a cultural knowledge base. For example, Indigenous students might not respond to in-class questioning, as they might view this as opposing traditional protocol of respectful listening; therefore, the teacher may have to clarify the intent of questioning in the classroom and acknowledge the different ways students may demonstrate knowledge, basic skills, values, and attitudes.

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## Program Principles

1. Effective science programs involve hands-on inquiry, problem solving, and decision making.
2. The development of students' skills, attitudes, knowledge, and understanding of STSE issues form the foundation of the science program.
3. Children have a natural curiosity about science and the world around them. This curiosity must be maintained, fostered, and enhanced through active learning.
4. Science activities must be meaningful, worthwhile, and relate to real-life experiences.

<sup>1</sup> *Common Framework of Science Learning Outcomes: Pan-Canadian Protocol for Collaboration on School Curriculum*, 1997

5. The teacher's role in science education is to facilitate activities and encourage critical thinking and reflection. Children learn best by doing, rather than by just listening. The teacher, therefore, should focus on formulating and asking questions rather than simply telling.
6. Science should be taught in correlation with other school subjects. Themes and topics of study should integrate ideas and skills from several core areas whenever possible.
7. The science program should encompass, and draw on, a wide range of educational resources, including literature, nonfiction research material, audio-visual resources, technology, as well as people and places in the local community.
8. The science program should be infused with knowledge and world-views of the Indigenous Peoples of North America, as well as other diverse multicultural perspectives.
9. Assessment of student learning in science should be designed to focus on performance and understanding, and should be conducted through meaningful assessment techniques carried on throughout the unit of study.

## Program Implementation

### Program Resources

**Hands-On Science** is organized in a format that makes it easy for teachers to plan and implement. The book is divided into four units, which are the selected topics of study for the grade level, as well as a main introduction at the beginning of the book. The units relate directly to the learning outcomes, which complement those established in the Pan-Canadian Protocol and related provincial/territorial documents.

Each unit also has its own introduction, which summarizes the general goals for the unit. This

introduction provides background information for teachers, planning tips, lists of vocabulary related to the unit, as well as other pertinent information such as how to embed technology, sustainability, and Indigenous and multicultural perspectives into units of study.

Also included at the beginning of each unit is a Curriculum Correlation Chart for Knowledge and Understanding Outcomes, and another for Scientific Inquiry and Design Process Skills Outcomes. These are based on the Pan-Canadian Protocol for Science outcomes, as well as on provincial/territorial science curriculum documents.

Additionally, the introduction to each unit includes a list of related books suitable for students and a list of annotated websites. References for Teachers is located at the end of the book.

Each unit is organized into numbered lessons comprised of topics and activities based on the learning outcomes. Lessons are arranged in the following format:

**Lesson Title:** The title of each lesson is posed as a guided inquiry question, which identifies the outcomes students will be addressing or the question they will be answering.

**Information for Teachers:** Some lessons provide teachers with the basic scientific knowledge they will need to present the activities. This information is offered in a clear, concise format, and focuses specifically on the topic of study.

**Materials:** A complete list of materials required to conduct the main activities is provided. 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. Many of the identified items are for the teacher to use for display purposes, or for making charts for recording students' ideas. In some cases, visual materials (large pictures, sample charts, and diagrams) have been included with the activity to assist the teacher in presenting ideas and questions, and to encourage discussion. You may wish to reproduce these visuals, mount them on sturdy cardstock, and laminate them so they can be used for years to come.

**Engage:** This activity is intended to activate prior knowledge, review previous lessons, and engage students in the lesson. The guided inquiry question for the lesson is also introduced in this section. Teachers may choose to record the question for display throughout related investigations. For example, the guided inquiry question might be recorded on a sentence strip and displayed.

**Explore:** This section details a step-by-step procedure, including higher-level questioning techniques, and suggestions for encouraging the acquisition of new knowledge and skills. In some cases, one lesson may involve several Explore activities, which are identified as Explore: Part One, Explore: Part Two, and so on.

**Learning Centre:** Included with most lessons are independent student learning opportunities that focus on the learning outcomes. They are designed as learning centres, and to promote differentiated instruction, the centres are based upon multiple intelligences research.<sup>2</sup> Each centre focuses on a different multiple intelligence, to provide opportunities for students to use areas of strength and also to expose them to new ways of learning. The following

intelligences, identified by the accompanying icons, are focused on in **Hands-On Science**:

- **Verbal-Linguistic:** These learners think in words and enjoy reading, writing, word puzzles, and oral storytelling. When a learning centre focuses on Verbal-Linguistic intelligence, the following icon is used:



- **Logical-Mathematical:** These learners think by reasoning and enjoy problem-solving, puzzles, and working with data. When a learning centre focuses on Logical-Mathematical intelligence, the following icon is used:



- **Visual-Spatial:** These learners think in visual pictures and enjoy drawing and creating visual designs. When a learning centre focuses on Visual-Spatial intelligence, the following icon is used:



- **Bodily-Kinesthetic:** These learners think using their physical bodies, and enjoy movement, sports, dance, and hands-on activities. When a learning centre focuses on Bodily-Kinesthetic intelligence, the following icon is used:



- **Musical-Rhythmic:** These learners think in melodies and rhythms and enjoy singing, listening to music, and creating music. When a learning centre focuses on Musical-Rhythmic intelligence, the following icon is used:



2 Conklin, Wendy. *Differentiation Strategies for Science*. Huntington Beach, CA: Shell Education, 2004.

Katz, Jennifer. *Teaching to Diversity: The Three-Block Model of Universal Design*. Winnipeg: Portage and Main Press, 2012.

- **Interpersonal:** These learners think by talking to others about their ideas and enjoy group work, planning social events, and taking a leadership role with friends or classmates. When a learning centre focuses on Interpersonal intelligence, the following icon is used:



- **Intrapersonal:** These learners think within themselves and enjoy quietly thinking, reflecting, and working individually. When a learning centre focuses on Intrapersonal intelligence, the following icon is used:



- **Naturalistic:** These learners learn by classifying objects and events and enjoy anything to do with nature and scientific exploration of natural phenomena. When a learning centre focuses on Naturalistic intelligence, the following icon is used:



- **Existential:** These learners learn by probing deep philosophical questions and enjoy examining the bigger picture as to why ideas are important. When a learning centre focuses on Existential intelligence, the following icon is used:



Teachers are encouraged to explore the topic of multiple intelligences with their students and to have students identify ways they learn best, and ways that are challenging for them. Guidelines for this process are included in the book *Teaching to Diversity* (cited in the footnote on the previous page).

Each learning centre is described on a task card that remains at the centre, along with any required supplies and materials. When implementing the learning centres, it is important to review the task card prior to having students work at the centre, to ensure they are familiar with the content and the expectations.

**NOTE:** Many of the learning centre tasks also offer excellent assessment opportunities – both formative and summative – that teachers can take advantage of through student conferences/interviews. Teachers can then use the Individual Student Observations sheet, on page 19, to record assessment data. See the next section of *Hands-On Science, Assessment Plan*, for more information on assessment.

**Embed: Part One:** The activities in this section are intended to review the main ideas of the lesson, focusing on specific learning outcomes. The guided inquiry question for the lesson is also reviewed in this section, and students are encouraged to share their knowledge, provide examples, and ask further inquiry questions. This section also includes directions for any reproducible activity sheets found in the lesson, which are designed to correlate with the learning outcomes of the main activity. Activity sheets are included to be used during the main activity in a lesson, often to record results of investigations. In some lessons, the same activity sheets are used as follow-up to the main activities.

Students may work independently on the sheets, in small groups, or you may read over the sheets together and complete them in a large group setting. Activity sheets can also be made into overheads or large experience charts. Since it is important for students to learn to construct their own charts and recording formats, teachers may decide to use the activity sheets as examples of ways to record and communicate ideas about an activity. Students can then create their own sheets rather than use the ones provided.

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**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 lesson in itself or the sole assessment for the lesson.

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**Embed: Part Two:** With each lesson, teachers are also encouraged to embed learning by adding to graphic organizers; having students record, describe, and illustrate new vocabulary; and adding new vocabulary to the classroom word wall (a bulletin board or piece of poster paper for displaying new science terminology. Both teachers and students can then add to the word wall throughout the unit, or even all year.) New vocabulary may include terminology in Indigenous and other languages that reflect the cultural diversity of the classroom and the community.

**Enhance:** This section includes optional activities to extend, enrich, and reinforce the learning outcomes.

**Assessment for, as, and of Learning:** Based on current research about the value of quality classroom assessment (Davies 2011), suggestions are provided for authentic assessment, which includes assessment *for* learning, assessment *as* learning, and assessment *of* learning. These assessment strategies focus specifically on the learning outcomes that are related to a particular lesson.

Keep in mind that these suggestions are merely ideas to consider; teachers are also encouraged to use their own assessment techniques and to refer to the other assessment strategies outlined in detail in the Assessment section of *Hands-On Science*, on pages 15 to 28.

## Classroom Environment

The classroom setting is an important aspect of any learning process. An active environment, one that gently hums with the purposeful conversations and activities of students, indicates that meaningful learning is taking place. When studying a specific topic, teachers are encouraged to display related objects and materials, student work, pictures and posters, graphs and charts made during activities, and summary charts of important concepts taught and learned. An active environment reinforces concepts and skills that have been stressed during science activities.

## Timelines

No two groups of students will cover topics and material at the same rate, and so planning the duration of units is an important responsibility of the teacher. In some cases, students will not complete the lesson's activities during one block of time, and students may be especially interested in one topic and want to expand upon it. The individual needs of the class should be considered; there are no strict timelines involved in *Hands-On Science*. It is important, however, to spend time on every unit in the program so that students focus on all the curriculum outcomes established for the grade level.

## Classroom Management

Although hands-on activities are emphasized throughout this program, how these experiences are handled is up to the individual teacher. In some cases, teachers may have all students manipulating materials individually; in others, teachers may choose to organize the class into small group settings. Small groups encourage the development of social skills, enable all students to be active in the learning process, and mean less cost in terms of materials and equipment.

## Classroom Safety

Occasionally, especially when safety concerns are an issue, teachers may decide to demonstrate an activity, while still encouraging as much student interaction as possible. Again, classroom management is up to the individual teacher, since it is the teacher who ultimately determines how the students in his or her care function best in the learning environment.

The nature of science and of scientific experimentation means that safety concerns do arise from time to time. Throughout ***Hands-On Science***, when there is a potential safety issue that teachers need to be aware of, the concern is flagged with the following safety icon:



## Scientific Inquiry Skills: Guidelines for Teachers

The ***Hands-On Science*** program is based upon a scientific inquiry approach. While involved in the activities of ***Hands-On Science***, students use a variety of scientific inquiry skills as they answer questions, solve problems, and make decisions. These skills are not unique to science, but they are integral to students' acquisition of scientific literacy. The skills include initiating and planning, performing and recording, analyzing and interpreting, as well as communicating and the ability to work in teams.

The following guidelines provide a framework that can be used to encourage students' skill development in specific areas.

## Observing

Students learn to perceive characteristics and changes through the use of all five senses. Students are encouraged to use sight, smell, touch, hearing, and taste safely, in order to gain information about objects and events. Observations may be qualitative (by describing properties such as texture or colour), or quantitative (such as size or number), or both. Observing includes:

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

It is important to encourage students to communicate their observations in a variety of ways, including orally, in writing, and by sketching labelled diagrams.

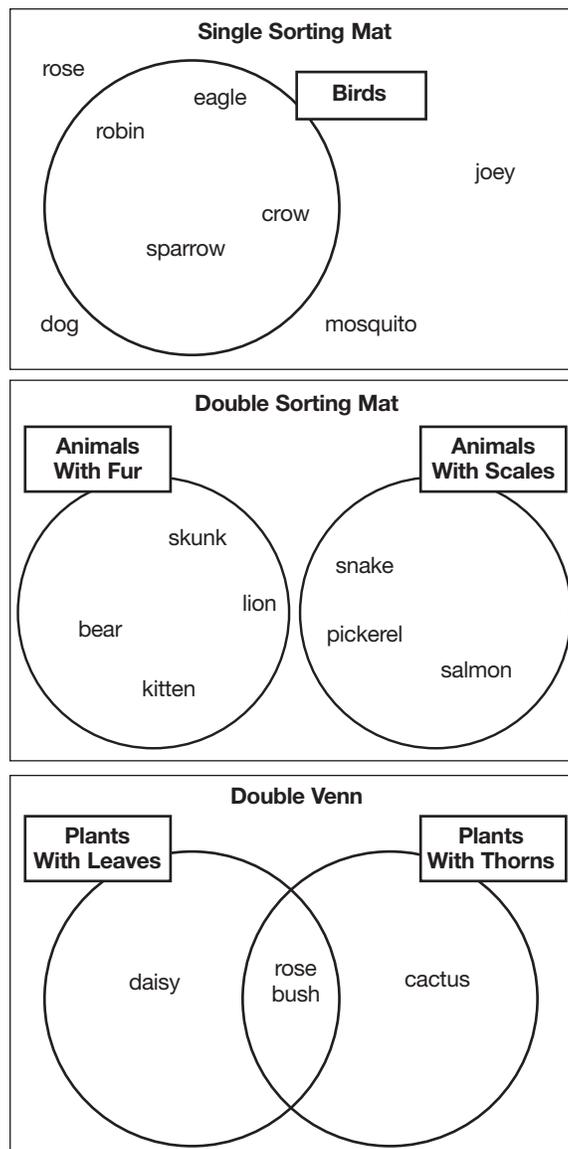
## Exploring

Students need ample opportunities to manipulate materials and equipment in order to discover and learn new ideas and concepts. During exploration, students need to be encouraged 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.

## Classifying

Classification is used to group or sort objects and events and is based on observable properties. For example, electrical circuits can be classified as series or parallel. One strategy for sorting involves the use of a sorting mat or a Venn diagram. Sorting mats show distinct groups, while Venn diagrams intersect to show similar characteristics among sets.

For example:



## Measuring

Measuring is a process of discovering the dimensions or the quantity of objects or events. In the early years, measuring activities first involve the use of nonstandard units of measure, such as interlocking cubes or paper clips to determine length. This allows students to build understanding of how to observe, compare, and

communicate dimensions and quantity. This is a critical preface to measuring with standard units. By grade 6, students use standard measuring tools. For example, they will measure mass/weight, length, volume, and temperature using standard units. They will also measure the passage of time using seconds, minutes, and hours. In addition, they will use specialized measuring devices to measure electrical power.

An essential skill of measurement is estimating. Students should be encouraged regularly to estimate before they measure, whether in nonstandard or standard units. Estimation allows students opportunities to take risks, use background knowledge, and learn from the process.

## Communicating, Analyzing, and Interpreting

In science, one communicates by means of diagrams, graphs, charts, maps, models, and symbols, as well as with written and spoken languages. Communicating includes:

- reading and interpreting data from tables and charts
- making tables and charts
- reading and interpreting data from pictographs, bar graphs, double bar graphs, frequency tallies, line plots, and broken line graphs
- making pictographs, bar graphs, double bar graphs, frequency tallies, line plots, and broken line graphs
- making labelled diagrams
- making 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 as part of a specific activity, there are guidelines that should be followed:

- A **tally chart** is a means of recording data as an organized count. The count is grouped in 5s for ease of determining the total by counting by 5s.

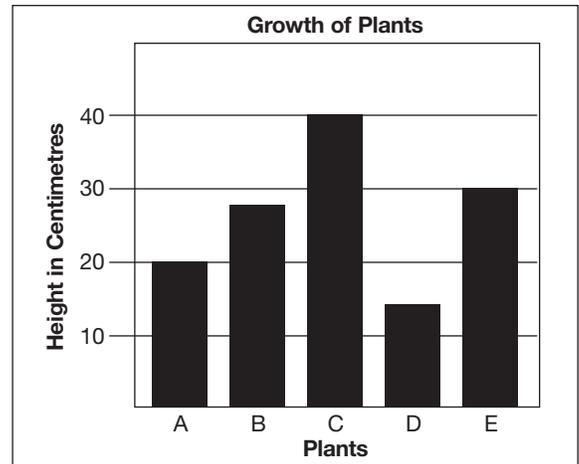
Favourite Sport		
Sport	Tally	Total
Baseball		6
Hockey		10
Soccer		12

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

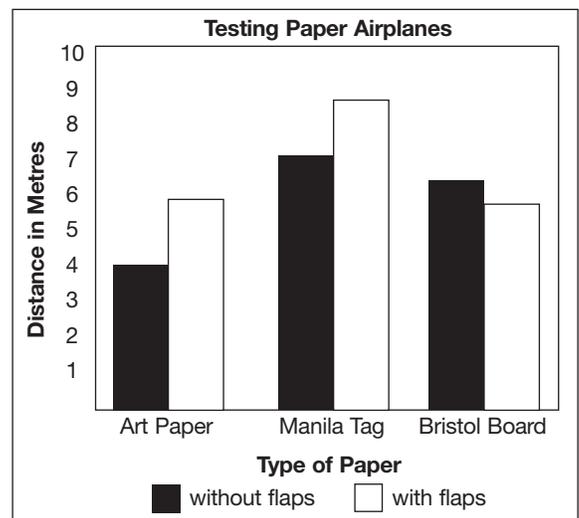
Favourite Dessert				
				
				
				
				
Cake	Pie	Ice Cream		

- A **bar graph** is another common form of scientific communication. Bar graphs should always be titled so the information communicated is easily understood. These titles should be capitalized in the same manner as one would title a story. Both axes of the graph should also be titled and capitalized in the same way. In most cases, graduated markings are noted on one axis and the objects or events being compared

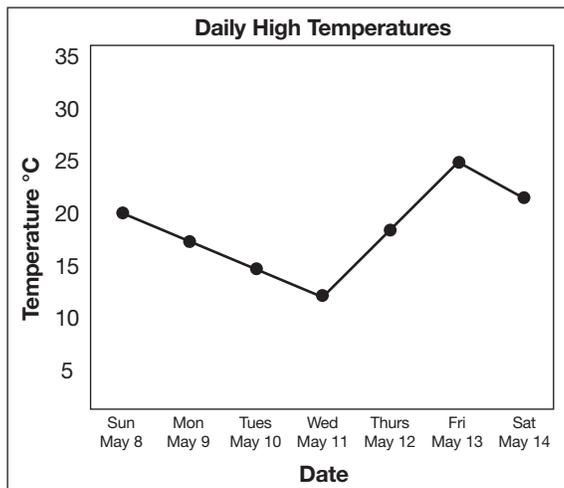
are noted on the other. On a bar graph, the bars must be separate, as each bar represents a distinct piece of data.



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



- A **broken line graph** is used to communicate data when measuring an object or event over a period of time. For example, a broken line graph may be used to present daily outdoor high temperatures over a period of one week.



By grade 6, students should also be constructing pictographs and bar graphs using many-to-one correspondence, as in the example below:

Number of Birds Observed	
Jeremy	
Judy	
David	
Kelly	
Emily	

Each stands for 5 birds.

- A **chart (table)** requires an appropriate title, and both columns and rows need specific headings. Again, all titles and headings require capitalization of the first letter as in the title of a story. In some cases, pictures can be used 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**

What Substances Dissolve in Water?		
Substance	Dissolves in Water	Does Not Dissolve in Water
Beads		✓
Sugar	✓	
Drink mix	✓	
Rice		✓
Pepper		✓

**Data Chart**

Local Snowfall		
Month	2015–16 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. Teachers should encourage students to use the appropriate vocabulary related to their investigations (e.g., *lift*, *drag*, *thrust*, and *gravity*). The language of science also includes terms such as *predict*, *infer*, *estimate*, *measure*, *experiment*, and *hypothesize*. Teachers should use this vocabulary regularly throughout all activities and encourage their students to do the same. As students become proficient at reading and writing, they can also be encouraged to use the vocabulary in written form. Consider developing whole-class or individual student glossaries in which students can record the terms they have learned and define them in their own words.

## Predicting

Predicting refers to the question, “What do you think will happen?” For example, ask students to predict what they think will happen to the flight path of a paper airplane when they bend the rudder. 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 the paper airplane turned when they bent the rudder and flew it. Again, it is important to encourage students to take risks when making such inferences. Before explaining scientific phenomena to them, they should be given opportunities to infer for themselves, using a variety of perspectives.

## Inquiry Through Investigating and Experimenting

When investigations and experiments are conducted in the classroom, planning and recording both the process and the results are essential. There are standard guidelines for leading these hands-on inquiries:

- 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

Both the purpose and the hypothesis should be in present tense, as these are determined by students prior to the hands-on experiment.

In *Hands-On Science* lessons, there are often investigations that can be explored using this version of the standard experimental design.

Throughout the inquiry process, it is important that students be guided through these steps, and be given the opportunity to communicate their questions, predictions, observations, and conclusions. This may be done in a variety of ways: orally as a class, recording findings as a class, having students use drawings and writings, or a combination of these.

## Inquiry Through Research

Research is another aspect of inquiry that involves finding, organizing, and presenting information related to a specific topic or question. Scientific inquiry involves making observations, exploring, asking questions, and looking for answers to those questions. Even at a young age, students can begin to research topics studied in class if they are provided with support and guidelines. Accordingly, guided research is a teaching/learning strategy that is encouraged throughout *Hands-On Science*. Guided research provides an opportunity for students to seek further information about subjects of inquiry, personal interest, or topics of their choice. As such, students are empowered and engaged in the process. Guided research encourages students to:

- 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.

Guided research encourages teachers to:

- Provide opportunities for students to ask questions of personal interest.
- Provide accessibility 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*, the approach for scientific inquiry is one of gradual release. 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*.

### Online Considerations

As our technological world continues to expand at an accelerating rate, and increasing information is available online, students will turn to the Internet more and more to expand their learning. Accordingly, *Hands-On Science, Grade 6* is replete with opportunities for students to research and investigate using online resources.

Teachers are encouraged to talk often with students about safety protocols when online. Particularly when students are using the Internet to make connections with other people (for example, in search of information about a topic they are exploring), it is important they are fully aware of how to keep themselves safe when connecting with strangers. At all times, teachers should be vigilant in supervising student use of the Internet.

Teachers are also encouraged to discuss copyright and plagiarism with regards to the Internet, reminding students that copying information word for word is wrong. If they are quoting information from the Internet, quotation marks are required, along with appropriate citation of the source. Otherwise, information should always be paraphrased. Photos, drawings, figures, and other images found online should also be used only 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 which] 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://creativecommons.ca>>.)

### Addressing Students’ Literacy Needs

The inquiry process involves having students ask questions and conduct investigations and research to answer these questions. At the grade-6 level, students may benefit from support for research, reading, and writing. Consider having volunteers, student mentors, or educational-assistants support students during these processes to help students with reading, research, and writing.

### Using the Design Process

Throughout *Hands-On Science*, students have opportunities to use the design process to plan (design) and construct objects. For example, in Unit 1, students design and create a new animal or plant that would survive well in a specific habitat.

The design process involves having students seek solutions to practical problems. There are specific steps to the process:

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: 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 design process also involves research and experimentation.

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



### Developing Attitudes Related to Science, Technology, and Society

According to the *Manitoba Curriculum Framework of Outcomes: Grades 5 to 8 Science (2000)*:

Attitudes refer to generalized aspects of behaviour that are modelled for students and reinforced by selective approval. Attitudes are not acquired in the same way as skills and knowledge. They cannot be observed at any particular moment, but are evidenced by regular, unprompted manifestations over time. Development of attitudes is a lifelong process that involves the home, the school, the community, and society at large. The development of positive attitudes plays an important role in students' growth by interacting with their intellectual development and by creating a readiness for responsible application of what they learn (p. 2.10).

The science-, technology-, and society-related attitudes focused on at the grade-6 level and which are fostered and encouraged throughout **Hands-On Science** lessons include:

- Appreciate that women and men of diverse cultural backgrounds can contribute equally to science.
- Show interest in the activities of individuals working in scientific and technological fields.
- Demonstrate confidence in their ability to carry out investigations.

- Appreciate the importance of creativity, accuracy, honesty, and perseverance as scientific and technological habits of mind.
- Be sensitive to and develop a sense of responsibility for the welfare of other humans, other living things, and the environment.
- Frequently and thoughtfully evaluate the potential consequences of their actions.

### Cultural Connections

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

### Indigenous Connections

As the original human inhabitants of Canada, Indigenous peoples are central to the Canadian context. As such, it is important to infuse the knowledge of our Indigenous forebears and their descendants into the learning experiences of all students. There are three groups of Indigenous peoples in Canada: First Nations, Métis, and Inuit.

Throughout the **Hands-On Science** program, there are many opportunities to incorporate culturally appropriate teaching methodologies from an Indigenous world-view. As one example, Indigenous Elders offer a wealth of knowledge that can be shared with students. Consider

inviting an Elder as a guest into the classroom in connection with specific topics being studied (as identified within the given lessons throughout the unit). An Elder can guide a nature walk, share stories and legends, and help students understand an Indigenous perspective of the natural world. An Elder will provide guidance for learners and opportunities to build bridges between the school and the community.

It is important to acknowledge any visiting (or visited) Elder, as Elders have traditionally been recognized within Indigenous communities as highly esteemed individuals. There are certain protocols that should be followed when inviting an Elder into your classroom; “TPAC Elder Protocol – Policies and Procedures” is a document from the University of Manitoba Student Affairs Aboriginal Student Centre that includes helpful information in this regard. See: <[www.umanitoba.ca/student/asc/tpac/protocol.html](http://www.umanitoba.ca/student/asc/tpac/protocol.html)>.

**NOTE:** Although both cultural connections and Indigenous connections are generally included in the Enhance section of a lesson of *Hands-On Science*, teachers should not regard this content as supplementary. First and foremost, the central science outcomes are focused on in the Engage and Explore sections of each lesson, while other curricular connections – such as literature, art, Indigenous connections, and other cultural connections – are usually featured in the Enhance section.

## Technology

Digital learning, or learning with information and communication technology (LwICT), is an important component of any classroom. As such, technological supports available in schools – including digital cameras, computers/tablets, interactive whiteboards (IWB), projectors, document cameras, and even calculators – can be used with and by students to enhance

their learning experiences. When technology connections are made in *Hands-On Science* lessons, the following icon is used:



## Sustainability

*Hands-On Science* 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 the Indigenous world-view about respecting and caring for the earth.

The three pillars of sustainability are the environment, society, and the economy. When sustainability links are made in *Hands-On Science* lessons, any or all of the sustainability pillars may be the focus of this connection, and are identified by the following icon:



# The Hands-On Science Assessment Plan

**Hands-On Science** provides a variety of assessment tools that enables teachers to build a comprehensive and authentic daily assessment plan for their students. Based on current research about the value of quality classroom assessment (Davies 2011), suggestions are provided for authentic assessment *for* learning, assessment *as* learning, and assessment *of* learning:

## Assessment for Learning

It is important to assess student understanding before, during, and after a science lesson. The information gathered helps teachers determine students' needs and then plan the next steps in instruction. Students may come into class with misconceptions about science concepts. By identifying what they already know, you can help them make connections and address any problem areas.

To assess students as they work, use the assessment for learning suggestions and questions provided with many of the activities. Questions focus on the lesson outcomes and are intended to promote higher-level thinking skills, active inquiry, and decision making.

While observing and conversing with students, use the **Anecdotal Record** sheet, as well as the **Individual Student Observations** sheet to record assessment for learning data:

- **Anecdotal Record:** To gain an authentic view of a student's progress, it is critical to record observations *during* science activities. The **Anecdotal Record** sheet, presented on page 18, provides the teacher with a format for recording individual or group observations.
- **Individual Student Observations:** When teachers wish to focus more on individual students for a longer period of time, consider using the **Individual Student**

**Observations** sheet, found on page 19.

This reproducible provides more space for comments and is especially useful during conferencing, interviews, or individual student performance tasks.

When assessment *for* learning is suggested in a lesson, the icon shown at left is used.

## Assessment as Learning

It is also important for students to reflect on their own learning about science. For this purpose, teachers will find a **Student Self-Assessment** sheet on page 25.

**NOTE:** This reproducible requires students to describe a science skill on which they are working. This offers a valuable opportunity to discuss with students the scientific inquiry skills emphasized in grade 6, and to encourage a focus on these skills during all science activities. Refer to the description of these skills in the subsection of the introduction, **Scientific Inquiry Skills: Guidelines for Teachers** (pages 7–11), as well as to the **Curriculum Correlation Chart: Scientific Inquiry and Design Process Outcomes**, at the beginning of each unit.

In addition, a **Science Journal** sheet, found on page 20, will encourage students to reflect on their own learning. Teachers can copy several sheets for each student, cut them in half, add a cover, and bind the sheets together. Students can then create title pages for their own journals. For variety, you may also have students use the blank reverse sides of each page for other reflections. For example, have students draw or write about:

- new science challenges
- favourite science activities
- real-life experiences with science
- new science terminology

Students should also be encouraged to reflect on their cooperative group work skills. For this purpose, a **Cooperative Skills Self-Assessment** rubric is included on page 26.

Student reflections can also be done in many ways other than in writing. For example, students can:

- Interview one another to share their reflections on science.
- Write an outline or brief script, and make a video reflection.
- Create an electronic slide show with an audio recording of their reflections.

When assessment as learning is suggested in a lesson, the icon shown on the preceding page is used.

### Assessment of Learning

Assessment of learning provides a summary of student progress related to the accomplishment of the outcomes at a particular point in time. It is important to gather a variety of assessment data to draw conclusions about what a student knows and can do. As such, consider collecting student products, observing processes, and having conversations with students. Teachers should also consider which student work is formative and which is summative in their deliberations. Only the most recent and consistent evidence should be used.

Assessment of learning suggestions are provided throughout the **Hands-On Science** program. Use the **Anecdotal Record** sheet, found on page 18, and the **Individual Student Observations** sheet, found on page 19, to record student results.

Always assess the individual student's accomplishments, not group work. However, you may also assess how the individual student

works within a group. Such skill development includes the ability to “respond respectfully to the ideas and actions of others ... assume roles and share responsibilities as group members ... listen to and consider differing opinions.”<sup>3</sup> For this purpose, a **Cooperative Skills Teacher Assessment** form is included on page 24.

When assessment of learning is suggested in a lesson, the icon shown in the preceding column is used.

### Performance Assessment

Assessment of learning also includes performance assessment, which is planned, systematic observation and assessment based on students actually doing a specific science activity. Teacher- or teacher/student-created rubrics can be used to assess student performance.

A **Sample Rubric** and a **Rubric** for teacher use are included on pages 21 and 22. For any specific activity, the teacher and students discuss criteria for completing a task successfully before the work is done. The teacher then selects four criteria that relate directly to the learning outcomes, and records these criteria on the **Rubric**. Students receive a check mark point 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** form found on page 23.

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**NOTE:** Performance tasks can be used for both assessment *for* learning and assessment *of* learning.

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Consider using four levels of achievement for your rubrics, to determine performance levels:

<sup>3</sup> Manitoba Education and Training, 1999, p.3.37

4. Thorough understanding and in-depth application of concepts and skills
3. Very good understanding and application of concepts and skills
2. Basic understanding and some application of concepts and skills
1. Limited understanding and minimal application of concepts and skills<sup>4</sup>

**Hands-On Science** provides numerous opportunities for students to apply their skills. By considering the same levels throughout the year, you should be able to track skill development and determine when students have a thorough understanding and 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 the students' work, with students involved in the selection of pieces and justification for choices. Progress portfolios reflect the students' progress as they improve, and aim to demonstrate an in-depth understanding of the material over time.

Select, with student input, work to include in a science portfolio or in a science section of a multi-subject portfolio. This should include representative samples of student work in all types of science activities. Reproducibles are included to organize the portfolio (**Portfolio Table of Contents** sheet is on page 27, and **Portfolio Entry Record** sheets are on page 28).

**NOTE:** In an Indigenous context, portfolio creation may differ in that the student and teacher may select completed work from a coming-to-know perspective that reflects participatory learning. Students reflect on their own understanding of the world around them or a sense of negotiating another point of view.

<sup>4</sup> Manitoba Education, 2012, p. 22

## An Important Note to Teachers

Throughout the **Hands-On Science** program, suggestions are provided for assessment *for* learning, assessment *as* learning, and assessment *of* learning. It is important to keep in mind that these are merely suggestions. Teachers are encouraged to use the assessment strategies presented in a wide variety of ways, and to ensure that they build an effective assessment plan using these assessment ideas, as well as their own valuable experience as educators.

**NOTE:** 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, community members, and educators. An assessment that includes all these perspectives provides a balanced understanding of what represents success for Indigenous students and their families/community. A strong partnership between parents/guardians/communities and school improves student achievement. Teachers should be aware some Indigenous students may feel apprehensive about a formal process of assessment; others may find Western achievement goals do not fit their Indigenous world-view.

# Unit 1

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## **Diversity of Living Things**

# Introduction

In this unit, students explore the diversity of living things and the ways that species are classified into kingdoms, including animal, plant, moneran, fungi, and protists. Students will begin to understand how these kingdoms are organized according to structural characteristics of living things, with a focus on the phyla (branches) of the various kingdoms.

A note on the classification system for living things: There has been great debate among scientists regarding how best to classify living things into distinguishable kingdoms. For example, before the invention of the microscope, organisms were classified only as plant or animal. With the discovery of microscopic forms of life, it became apparent that many of these microorganisms (e.g., fungi, bacteria, algae, viruses, and single-cell organisms like the paramecium and the amoeba) held both animal and plant characteristics and could not be simply classified into either kingdom.

The debate on this issue continues, and no single agreed-upon system for classifying living things exists. You will hear about various numbers of kingdoms and domains when studying taxonomy. One of the most popular systems today, however, is the five-kingdom classification of living organisms: animal, plant, fungus, protist, and moneran (viruses have yet to be identified within this classification system).

Remember that this controversy persists, and it should not be a surprise to find reference materials with contradictory information. Teachers are encouraged to discuss this classification debate with their students. This can provide a venue for understanding science is an ever-evolving field of study and it does not always provide black-and-white answers. New information about DNA continues to influence our understanding of how to classify organisms.

When teaching the content found in this unit, it is important to keep in mind that classifying is very much a scientific process skill. Since the classification systems used to organize living things are quite complex, give students repeated opportunities to explore and extend their thinking. Encourage them to compare and contrast animals, plants, and even nonliving things; this will help students develop critical-thinking skills. This unit also provides a variety of suggestions for graphic organizers and strategies to aid students in their study.

## Planning Tips for Teachers

- Many of the activities in this unit rely on the availability of a wide variety of pictures of living things. Collect these pictures from magazines and old calendars before beginning the unit, and consider having students participate in their collection as a way to stimulate interest in the topic of study.
- Teachers are encouraged to have on hand at least one good-quality, high-powered microscope, which will be of great benefit for students' investigations during this unit, especially when they are studying microorganisms like protists and bacteria. Local middle and senior schools may consider a loan. Also, consider accessing other related tools such as prepared slides or Microslide Viewers and Microslides.
- Develop a Makerspace centre, where students learn together and collaborate on do-it-yourself projects. Give students opportunities to work with a variety of tools at the centre, as well as with both everyday and recycled materials. Makerspace centres also integrate well with arts-and-crafts activities. For this unit, set up a Makerspace centre that encourages informal learning about organisms. Include a variety of living-

thing artifacts (e.g., shells, seeds, leaves, fruits, vegetables, grains, and other unique examples such as a bird's nest, a starfish, a shark's tooth, a bear claw, fur). Encourage students to collect artifacts, as well. Also, collect specimens in jars, tracks, moulds and casts of living things, fossils, field guides, identification keys, photos of organisms, preserved plants, microscopes and relevant prepared slides, micro-viewers and appropriate slide strips, and so on to provide at the centre. Access to cameras, computers/tablets, and art supplies is also encouraged.

Work with students to develop a collaborative culture at the Makerspace centre, where they can tinker, invent, and improve on their creations as they work through the unit. As teachers pose questions within lessons, students can determine solutions through creating. It is important not to direct the learning here; rather, create the conditions for learning to happen.

Many Indigenous peoples believe all life – plants, animals, and humans – are equal, and all living things are dependent upon one another for survival. Traditionally, Indigenous peoples lived off the land, so they were keenly aware of their surroundings – such as the breadth of plants and animals found in their ecosystem. This close relationship to the land helped foster an Indigenous world-view of connection to all living things.

Indigenous belief is that an animal gives up its soul to provide humans with what they need for survival; therefore and out of respect, no portion of the sacrificed (hunted) animal should go to waste, with every part being used for food, clothing, tools, or shelter. With a true appreciation of where their food comes from, Indigenous peoples have in-depth knowledge

about hunting, about the animals they hunt, and about the plants they forage. Traditionally, animals were seen as teachers, guides, and companions, in addition to being integral to survival – Indigenous peoples' existence depended on animals and plants for everything from transportation to signalling seasonal changes to assisting with agricultural pursuits (notwithstanding the already mentioned shelter, clothing, and, of course, food).

Through oral stories and accounts, Indigenous peoples pass down their knowledge and observations of the natural world to new generations. It is important to realize, historically, Indigenous peoples likely classified the natural world differently than European explorers and scientists did, based on both their needs and their natural environment.

## Science Vocabulary

Throughout this unit, teachers should use, and encourage students to use, vocabulary related to living things, such as:

- *animals, arthropod, classification key, classification system, endoskeleton, exoskeleton, fossil record, fungus, invertebrate, kingdom, moneran, naturalist, organism, paleontologist, plants, protist, species, structure, vertebrate.*

Extension vocabulary is also presented in specific lessons.

Also, consider including vocabulary related to scientific inquiry skills. These might be displayed in the classroom throughout the year, as they relate to all units. Teachers and students could then brainstorm which skills they are being asked to use as they work in particular lessons. They could also discuss what that skill looks and sounds like as they explore and investigate.

Vocabulary related to scientific inquiry skills includes:

- *access, ask, brainstorm, classify, collect, communicate, compare, connect, consider, construct, control, cooperate, create, demonstrate, describe, develop, diversity, draw conclusion, estimate, evaluate, explain, explore, find, follow, formulate, graph, handle, identify, improve, infer, investigate, justify, measure, observe, order, organize, plan, predict, propose, recognize, record, reflect, repeat, rephrase, research, respond, review, select, sequence, share, suggest, test.*

Throughout the unit, a Science Glossary is referred to, as well as a class word wall, which can be created on a bulletin board or simply on poster paper, to conserve space. On the bulletin board or poster paper, record new vocabulary as it is introduced throughout the unit. Ensure that the word wall is placed in a location of the classroom where all students can see and access the vocabulary. Refer to the words frequently, and encourage students to use them in their writing and conversation.

## Promoting Scientific Inquiry

Throughout the inquiry process, it is essential for both teachers and students to generate thoughtful questions about the scientific information and issues presented. There are many questioning systems that can be implemented; the point is to apply them to the scientific material within the unit. Often simply changing a question can turn the intent from a focus on knowledge and understanding to an emphasis on scientific inquiry, which can then lead to use of the design process.

The chart below shows how questions related to topics of study in this unit and which address specific curriculum outcomes can focus either on knowledge and understanding (as in column two) or can encourage more in-depth inquiry and higher-level thinking (as in column three) and then lead to the design process (column four).

A questioning system such as this can be used by both teachers and students to reach beyond factual content toward rich, inquiry-based investigations.

<b>Unit Topic</b>	<b>Knowledge and Understanding</b> (Content questions that range in complexity)	<b>Scientific Inquiry</b> (Testable questions by students or by scientists)	<b>Design Process</b> (Prototype questions designed or critiqued by students)
Classification and identification	What are the five kingdoms of organisms?	What similarities and differences can you observe between protists and bacteria?	What are the limitations of a compound light microscope (found in high-school labs) in observing bacteria?
Invertebrates and vertebrates	Is there an advantage to having a backbone?	What diversity of invertebrates can be found in a rotting log?	What conditions are necessary to keep a terrarium healthy?

# 3 How Is the Animal Kingdom Divided Up?

## Information for Teachers

There is no one agreed-upon way of classifying organisms among scientists. One of the more common classification systems for living things includes five kingdoms of organisms: monerans (helpful and harmful bacteria), protists (small, single-celled organisms, generally seen only under microscope), fungi (mushrooms and moulds), plants (from moss to tall, redwood trees), and animals. Within the latter, we often place organisms into one of two groupings: vertebrates (animals with backbones) and invertebrates (animals without backbones).

Key to classifying organisms are their physical characteristics, which allow us to break down the kingdoms into multiple levels, each level more specialized than the one above it. Terms often used to classify living things include *kingdom*, *phylum/phyla*, *class*, *order*, *family*, *genus*, and *species*. In higher grades, students focus on the detailed study of these levels of taxonomy.

Animals with backbones are called “vertebrates.” These include:

- amphibians: cold-blooded animals that begin life with gills to breathe in water, then develop lungs to breathe air. Examples are the frog, toad, newt, and salamander.
- birds: warm-blooded animals with wings and feathers. Examples are the penguin, hummingbird, flamingo, and sparrow.
- fish: cold-blooded animals with gills to breathe in water. Examples are the shark, goldfish, catfish, and tuna.
- mammals: warm-blooded animals with hair or fur that nurse their young. Examples are the cat, bat, human, and whale.
- reptiles: cold-blooded animals with scales. Examples are the snake, lizard, turtle, alligator, and crocodile.

Animals without backbones are called “invertebrates.” These include:

- sponges: animals with large pores that live in water. Examples are calcareous sponges, glass sponges, homoscleromorpha, and demosponges.
- coelenterates: water animals with stinging tentacles, such as jellyfish, man-of-war, and coral.
- flatworms: animals that are flat, and not really worms that we recognize, such as Turbellaria, Trematoda, Monogenea, and Cestoda.
- nematodes: threadlike animals such as roundworms, pinworms, and threadworms found in soil and as parasites in other animals.
- molluscs: soft-bodied animals often protected by an outer shell, such as snails, oysters, and clams. Squid and octopus are also considered to be molluscs.
- annelids: segmented worms such as earthworms, ragworms, and leeches.
- arthropods: animals with jointed legs and segmented bodies, such as centipedes (two legs per body section), millipedes (four legs per body section), spiders (eight legs and two body parts), insects (six legs and three body parts: head, thorax, and abdomen), and crustaceans (such as crabs, lobster, and shrimp). Eighty percent of all animals on Earth are arthropods.
- echinoderms: spiny animals, such as starfish, sea urchins, sand dollars, and sea cucumbers.

The term *species* is used to identify specific animals within each branch of the kingdom.

# 3

**NOTE:** A diagram of the animal kingdom is included in this lesson (1.3.1, see Materials section below). Teachers are encouraged to display the diagram as a classroom reference throughout this unit by copying it, enlarged, onto chart paper or projecting it. This will help students become familiar with this method of classifying living things.

## Materials

- large collection of animal pictures (from calendars and magazines. Try to source pictures from as many phyla as possible. Make sure to include both vertebrates and invertebrates.)
- chart paper
- markers
- Diagram: The Animal Kingdom (1.3.1)
- projector (if not available, use another available method of displaying images for students. For example, see note above.)
- student dictionaries
- mural paper (optional)
- tape
- scissors
- poster paper
- art supplies
- glue sticks
- string or thread
- references and bookmarked websites with appropriate resources about the animal kingdom
- Activity Sheet A: Invertebrates and Vertebrates of the Animal Kingdom (1.3.2)
- Activity Sheet B: Cubing Sheet: Animal Research (1.3.3)
- Learning-Centre Task Card: Illustrating an Animal Group (1.3.4)
- List: Animal Groups (1.3.5)
- sticky notes
- KWHL chart (from lesson 1)
- Science Glossary (1.1.3)

## Engage

As a class, review the meaning of a classification system. Ask:

- What does the term *classify* mean?
- How do you classify objects?
- What is a *classification system*?
- What are some ways you can classify living things?
- How are plants and animals different?
- What are some ways you can classify animals?

Together with students, brainstorm a list of ways to classify animals. Record these on chart paper.

**NOTE:** Students may be familiar with animal group classifications from earlier grades (mammals, amphibians, reptiles, birds, fish, insects). Teachers are encouraged to discuss these in addition to other ways of classifying, such as number of legs, size, covering, behaviour, and other specific features like beaks and claws.

Organize the class into working groups, and distribute an assortment of animal pictures to each group. Have the groups classify their pictures according to their own determined criteria.

Then, have each group present its classification system to the class. As each system is presented, discuss the rules or criteria the group used. Add any new rules or criteria to the list brainstormed earlier (during the Engage section of the lesson). Ask:

- What do you think is the most scientific way to classify animals? Why?

Introduce the guided inquiry question: **How is the animal kingdom divided up?**

## 3

**Explore: Part One**

Display enlarged Diagram: Animal Kingdom (1.3.1). Discuss the diagram, focusing on how animals are classified according to structural features (e.g., backbones, jointed legs, lungs, gills).

On chart paper, record the term *species*. Ask students to share their understanding of the term, and record their ideas on chart paper. Have students check dictionaries, and co-construct a class definition for the term.

During this discussion, encourage students to provide examples of animals that could be included on each branch. Have them observe and describe structural features of animals they can see on the diagram – for example, discuss the characteristics of the centipede. Make clear that some structural features cannot be easily seen from the outside or in a picture (e.g. number of chambers in the heart).

For example, ask:

- Which species would fit into the insect branch?
- What do all insects have in common?
- How are insects different from spiders?
- What are examples of species of fish?
- What do all fish have in common?
- Are whales [or dolphins/porpoises] fish? Why not? (They are warm blooded, they have lungs, and they nurse their young, so they are mammals.)
- What are examples of species of amphibians [or reptiles/birds/mammals]?

Now have the same groups of students as before work to sort their animal pictures according to the diagram of the animal kingdom. Have students determine how many “branches” are represented in their pictures and which “branches” are missing.

Next, provide students with copies of Activity Sheet A: Invertebrates and Vertebrates of the Animal Kingdom (1.3.2), along with a variety of reference materials about animals. Have students work together in their groups to gather information about some branches of the animal kingdom.

**NOTE:** Not all branches of the animal kingdom are featured on the activity sheet. This research activity is meant to give students background knowledge on how animals are classified by structural features.

**Activity Sheet A**

Directions to students:

Record your research about various animals of the animal kingdom on the chart (1.3.2).

**Explore: Part Two** 

Have each student select a specific animal species from the kingdom for more detailed research (encourage students to select species from a variety of branches of the animal kingdom). Provide students with copies of Activity Sheet B: Cubing Sheet: Animal Research (1.3.3) and reference materials about animals. Have students create information cubes on their selected species.

Once students have completed their cubes, have the class come together as a larger group to sort the cubes according to the branches of the animal kingdom represented. Students may wish to draw a large tree on mural paper and hang the cubes from appropriate branches to replicate the diagram of the animal kingdom.

**Activity Sheet B**

Directions to students:

Record researched information about your selected animal on the individual sections of the cube. Cut out the cube outline, fold it, and glue it to form a cube (1.3.3).

## 3

**Assessment for Learning** 

Observe students as they conduct individual research for their cube. Focus specifically on their ability to gather information, organize ideas, and present findings on the cubing sheet. Use the Individual Student Observations sheet, on page 19, to record results.

**Learning Centre** 

At the learning centre, provide art supplies, poster paper, a copy of the Learning-Centre Task Card: Illustrating an Animal Group (1.3.4), and a copy of List: Animal Groups (1.3.5). The English language is rich with colourful nouns that describe groups of the same animal (e.g., colony of ants, bed of snakes, murder of crows).

Have students select one animal, record its name and the group name on a sheet of poster paper, and make a drawing or cartoon to fit the description (e.g., a *crash* of rhinoceros, an *army* of frogs).

**Embed: Part One**

Revisit the guided inquiry question: **How is the animal kingdom divided up?** Have students share their knowledge, provide examples, and ask further inquiry questions.

**Embed: Part Two**

- Have students add to the KWHL chart as they learn new concepts, answer some of their own inquiry questions, and ask new inquiry questions.
- Add new terms and illustrations to the class word wall. Also, include the words in other languages, as appropriate.
- Have students add new terms, illustrations, and sentences to their Science Glossary (1.1.3). When possible, encourage them to add the words in other languages, including Indigenous languages, reflective of the classroom population.

**Enhance** 

- Have students research to determine if the animal they researched (for the cube activity) is abundant, endangered, at risk, or extinct.
- Distribute a copy of Enhance Information Sheet: Classification: The Scientist Behind the Scene (1.3.6) to each student. Read and discuss the contributions Carolus Linnaeus made to the classification of living things.
- Explain to students that the animal kingdom diagram used in this lesson is just one type of graphic organizer that can be used to classify animals. As a class, reconstruct the animal kingdom using a concept web format, as shown in Figure: The Animal Kingdom (1.3.7).
- At the beginning of the day or following recess or lunch break, give each student a picture of an animal as he or she enters the classroom. Ask students to find the “branch” of the animal kingdom diagram (1.3.1) displayed or projected in the classroom on which their animal belongs (see note at end of the Information for Teachers section, above, as well as note below).

**NOTE:** If animal pictures used for this activity are small enough, teachers can then use tape or sticky tack to affix each one to the diagram once it has been correctly placed on the tree by a student.

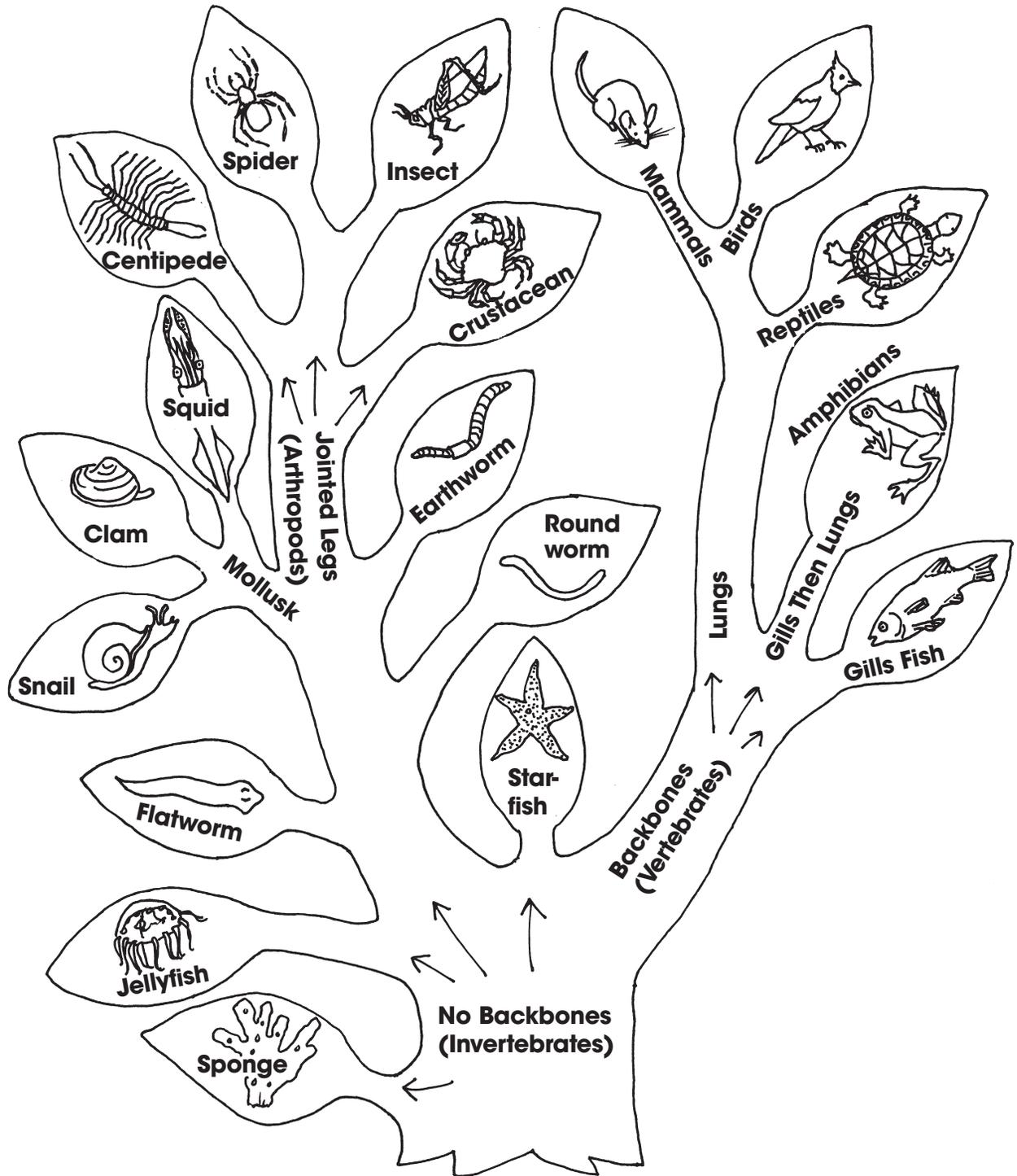
- Give students an opportunity to experiment with using classification keys. Provide a variety of pictures of birds or butterflies, along with field guides that have classification keys. Challenge students to use the keys to classify the animals.
- Have students review earlier work they have completed on the use of different classification systems. Then, ask them to reflect on how Indigenous peoples might have used different systems of classification, because their local environment, needs, and traditions/customs were different from those

**3**

of the European immigrants. Ask students to create a new system of classification that takes into consideration the Indigenous relationship with nature and their survival needs (e.g., plants – taste, appearance, texture, smell, poisonous; animals – fur, feathers, four legs, wings).

- Plan a bird-watching expedition in your community to identify birds in their natural habitat, using classification keys. Have students research local birding venues to determine a good location for the field trip. Consider having a birder guest speak to the class prior to the expedition, to share background knowledge and best practices for bird-watching.
- Sea shells are molluscs. Display a collection of shells (craft shops and dollar stores often sell bags of shells) along with a guidebook on shells and molluscs. Have students examine, identify, and classify the shells. Have them construct their own charts to record their findings.
- Have students continue their do-it-yourself projects at the Makerspace centre.

# The Animal Kingdom



Date: \_\_\_\_\_

Name: \_\_\_\_\_

# Invertebrates and Vertebrates of the Animal Kingdom

## Invertebrates of the Animal Kingdom:

Branches	Characteristics	Examples
<b>Molluscs</b>		
<b>Crustaceans</b>		
<b>Earthworms</b>		
<b>Centipedes</b>		



Date: \_\_\_\_\_

Name: \_\_\_\_\_

## Invertebrates and Vertebrates of the Animal Kingdom (continued)

### Vertebrates of the Animal Kingdom:

Branches	Characteristics	Examples
<b>Fish</b>		
<b>Amphibians</b>		
<b>Reptiles</b>		
<b>Birds</b>		
<b>Mammals</b>		

# Cubing Sheet: Animal Research

 **Food:**

**Animal:**

**Relatives:**

**Habitat:**

**Physical Characteristics:**

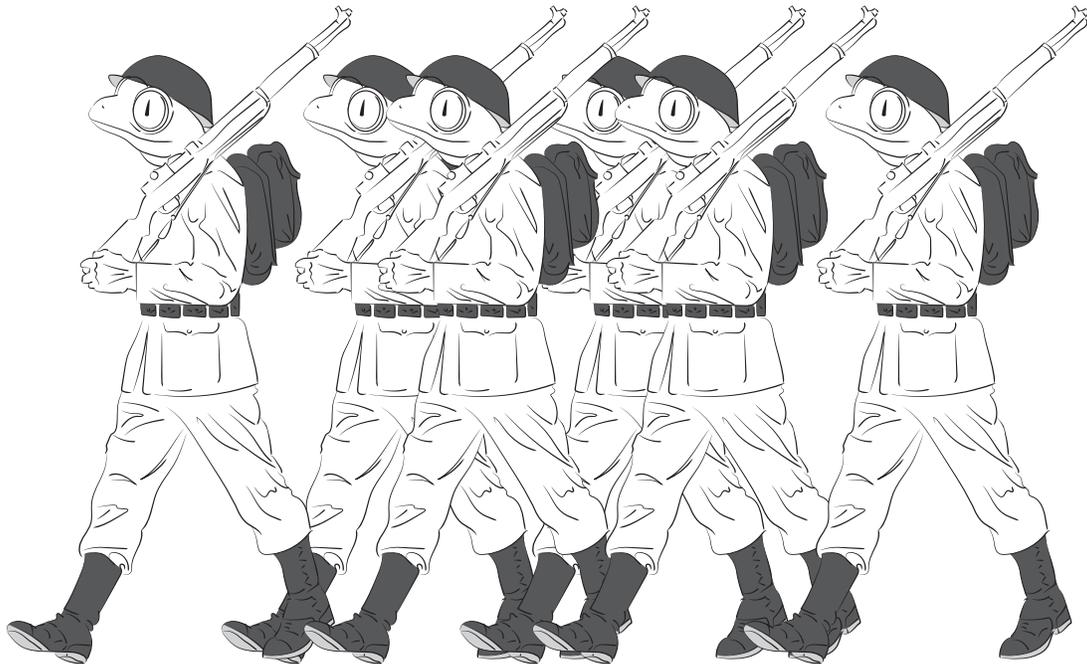
**Diagram:**



## Illustrating an Animal Group

The English language is rich with colourful nouns that describe groups of the same animal.

1. Review the Animal Groups list.
2. Select one animal, and record the animal name and group name.
3. On poster paper, create a drawing or cartoon to fit the description
4. On the backside of the poster paper, write a paragraph describing the features of this animal, and explain how you would classify this animal within the animal kingdom.



# Animal Groups

<b>Animal Name</b>	<b>Group Name</b>	<b>Animal Name</b>	<b>Group Name</b>
<b>Ants</b>	<b>Colony</b>	<b>Eels</b>	<b>Swarm</b>
<b>Apes</b>	<b>Shrewdness</b>	<b>Elephants</b>	<b>Herd</b>
<b>Bears</b>	<b>Sloth or sleuth</b>	<b>Elk</b>	<b>Gang</b>
<b>Beavers</b>	<b>Colony</b>	<b>Ferrets</b>	<b>Business</b>
<b>Bees</b>	<b>Swarm</b>	<b>Finches</b>	<b>Charm</b>
<b>Boars</b>	<b>Sounder</b>	<b>Fish</b>	<b>School</b>
<b>Butterflies</b>	<b>Flight or flutter</b>	<b>Flies</b>	<b>Business</b>
<b>Caterpillars</b>	<b>Army</b>	<b>Foxes</b>	<b>Skulk or troop</b>
<b>Cats</b>	<b>Clouder, clowder, clutter, cluster (tame), kindle, or litter (young)</b>	<b>Frogs</b>	<b>Army</b>
<b>Cattle</b>	<b>Drove</b>	<b>Geese</b>	<b>Gaggle (standing), skein (flying)</b>
<b>Chickens</b>	<b>Brood, peep</b>	<b>Goats</b>	<b>Tribe</b>
<b>Colts</b>	<b>Rag</b>	<b>Gorillas</b>	<b>Band</b>
<b>Crows</b>	<b>Murder</b>	<b>Grasshoppers</b>	<b>Cluster</b>
<b>Deer</b>	<b>Herd</b>	<b>Hens</b>	<b>Brood</b>
<b>Dogs</b>	<b>Kennel, litter (young)</b>	<b>Herons</b>	<b>Siege</b>
<b>Donkeys</b>	<b>Pace or herd</b>	<b>Horses</b>	<b>Team (while pulling)</b>
<b>Ducks</b>	<b>Brace, flock, or paddling (swimming), raft or team (in flight)</b>	<b>Jackrabbits</b>	<b>Husk</b>
<b>Eagles</b>	<b>Convocation</b>	<b>Jays</b>	<b>Band</b>
		<b>Jellyfish</b>	<b>Smack</b>
		<b>Kangaroos</b>	<b>Troop</b>



## Animal Groups (continued)

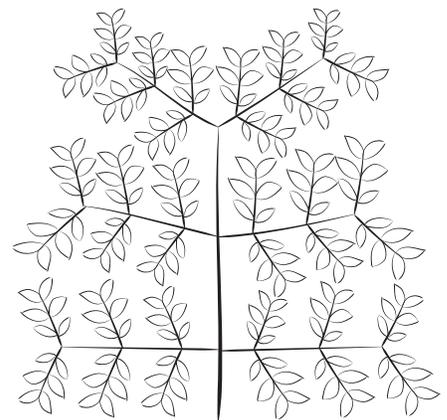
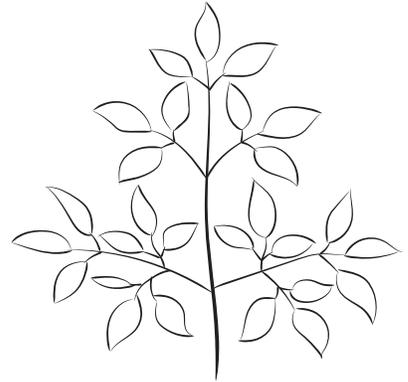
<b>Animal Name</b>	<b>Group Name</b>	<b>Animal Name</b>	<b>Group Name</b>
<b>Larks</b>	<b>Exaltation, ascension, or bevy</b>	<b>Ravens</b>	<b>Unkindness</b>
<b>Leopards</b>	<b>Leap</b>	<b>Rhinoceroses</b>	<b>Crash</b>
<b>Lions</b>	<b>Pride</b>	<b>Roaches</b>	<b>Shoal</b>
<b>Locusts</b>	<b>Plague</b>	<b>Salmon</b>	<b>Run</b>
<b>Martens</b>	<b>Richness</b>	<b>Sandpipers</b>	<b>Murmuration</b>
<b>Mice</b>	<b>Nest</b>	<b>Sheep</b>	<b>Flock</b>
<b>Moles</b>	<b>Labour</b>	<b>Snakes</b>	<b>Bed</b>
<b>Monkeys</b>	<b>Troop</b>	<b>Sparrows</b>	<b>Host</b>
<b>Owls</b>	<b>Parliament</b>	<b>Squirrels</b>	<b>Drag (dray)</b>
<b>Parrots</b>	<b>Company</b>	<b>Storks</b>	<b>Mustering</b>
<b>Peacocks</b>	<b>Muster</b>	<b>Swallows</b>	<b>Flight</b>
<b>Penguins</b>	<b>Colony</b>	<b>Swans</b>	<b>Wedge or flight</b>
<b>Pheasants</b>	<b>Nide, bouquet, nest, covery, brood (a family), nye (large group on the ground)</b>	<b>Toads</b>	<b>Knot</b>
<b>Pigs</b>	<b>Drove or litter</b>	<b>Trout</b>	<b>Hover</b>
<b>Ponies</b>	<b>String</b>	<b>Turkeys</b>	<b>Rafter</b>
<b>Porpoises</b>	<b>School</b>	<b>Turtles</b>	<b>Bale or nest</b>
<b>Poultry</b>	<b>Run</b>	<b>Vipers</b>	<b>Nest</b>
<b>Prairie dogs</b>	<b>Coterie</b>	<b>Wasps</b>	<b>Nest</b>
<b>Rabbits</b>	<b>Warren</b>	<b>Whales</b>	<b>Gam or pod, herd (sperm)</b>
		<b>Woodpeckers</b>	<b>Descent</b>
		<b>Wrens</b>	<b>Herd</b>

## The Scientist Behind the Scene

**Carolus Linnaeus was born in Sweden in 1707, the same year the British settled Acadia in Nova Scotia. Carolus first showed an interest in plants when he played in the family garden. However, his father, who was a minister, wanted his son to be a minister, as well. Carolus was not interested in the ministry and did not do well in his studies. His dad warned him that if attending school was just going to be a waste of money, he might as well learn to be a shoemaker. Fortunately, one teacher realized that Carolus loved learning about nature. He persuaded Reverend Linnaeus to send Carolus to medical school. Here, in his spare time, Carolus helped the botany (plant) professor do demonstrations for students. His passion for plants was rekindled!**

**Carolus became a medical doctor to support his horticultural habit, and in his spare time he studied plants and animals in great detail. He also wrote some books (*Systema Naturae*, 1735; *Philosophia Botanica*, 1751; and *Species Platorum*, 1753). These books helped develop our modern-day classification (taxonomy) system for both plants and animals.**

**Before he died in 1778, Carolus Linnaeus established a botanical garden in Uppsala, Sweden. You can still visit the garden today. In 1788, in England, a group of famous scientists formed a club called "The Linnaean Society" in honour of Carolus Linnaeus. It is said that Linnaeus did for plants and animals what geographer Gerardus Mercator (1512-1594) did for the Earth's surface when he designed a map of the world for navigators in 1569.**



# The Animal Kingdom

