hands-on science

An Inquiry Approach

Grade 1

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An Inquiry Approach

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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.[1] 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.

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.

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.

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

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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 are located at the end of every unit.

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

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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 17, 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 18. 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 24.

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 1, 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 7–10), 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 19, 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

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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 25.

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 17, and the **Individual Student Observations** sheet, found on page 18, 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".[3] For this purpose, a **Cooperative Skills Teacher Assessment** form is included on page 23.

When assessment of learning is suggested in a lesson, the icon shown on 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 20 and 21. 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 22.

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

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

3 Manitoba Education and Training, 1999, p.3.37

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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[4]

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 26, and **Portfolio Entry Record** sheets are on page 27).

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.

4 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 that some Indigenous students may feel apprehensive about a formal process of assessment; others may find that Western achievement goals do not fit their Indigenous world-view.

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Unit 1

Characteristics and Needs of Living Things

Introduction

This unit of ***Hands-On Science, Grade 1*** focuses on the characteristics and basic needs of living things. Throughout the unit, students will demonstrate an understanding of the basic needs of animals and plants (e.g., the need for food, oxygen, and water). Students will investigate the characteristics of animals and plants, and they will gain growing awareness that both animals and plants depend on their environment to meet their basic needs. In addition, students will learn to describe the requirements for good health for humans.

Planning Tips for Teachers

Since it is not possible to bring all types of plants and animals into the classroom, teachers will need to collect a wide variety of pictures of living things. Teachers may consider sending a letter home to students' families to request help with this project. Some good sources for pictures of animals are:

- wall calendars (the same calendar will work, year after year)
- magazines (e.g., *Canadian Geographic, National Geographic, Chickadee, Owl, Chirp*)
- Google Images (prescreen any Google Image searches you expect students to carry out)

Also, contact local nature centres, zoos, garden clubs, pet shelters, and other similar government or nongovernmental organizations. These organizations can be a great way to obtain materials (and other services) about animals and plants in your community. Teachers are also encouraged to put feelers out into the broader school community, to find any "resident experts" within the school community in one of these areas. This is a great way to expand resources and make connections in the community.

Put together a variety of reading materials at a range of reading levels appropriate for your class. Include fiction and nonfiction resources. If possible, also arrange time for students to visit animal and plant websites. Always preview any website you expect students to use.

Finally, begin collecting old shoeboxes, which will be required in lesson 5, for students to create dioramas of animal habitats. Teachers may wish to send home a letter to students' families in advance to ask for help collecting the boxes.

Throughout the unit, as you conclude a lesson and move on to the next one, be sure to keep all charts and displays created during the lesson, as well as activity sheets and other work done. Sometimes, these are referred to again in subsequent lessons, and all charts and other materials created throughout the unit are used in the concluding lesson, which is a final inquiry project.

Teachers are reminded of the value of incorporating Indigenous perspectives and world-views into lessons whenever possible. These include having the following:

- a respectful relationship with nature, with an intention to sustain natural resources for generations to come
- the belief that all life – plants, animals, and humans – is equal and that all living things depend upon one another for survival
- the idea that humans have special relationships with animals, which are seen as teachers, guides, and companions and are key to human survival

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Science Vocabulary

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

- *alive, animal, bones, brain, characteristic, heart, human, lungs, muscles, offspring, plant, reproduce, stomach.*

Teachers should also consider infusing vocabulary related to scientific inquiry skills into daily lessons. This vocabulary might be displayed in the classroom throughout the year, as it relates to all science clusters. Students could then brainstorm which skills they are being asked to use as they work in particular lessons. They could also discuss what the skill looks and sounds like as they explore and investigate. Vocabulary related to scientific inquiry skills includes terms such as:

- *ask, brainstorm, collect, compare, construct, create, describe, estimate, explain, explore, find, follow, graph, identify, improve, match, measure, observe, order, plan, predict, record, research, select, test.*

Early on in the unit, students are encouraged to create a "pictionary" – a picture dictionary – in which to record new vocabulary they learn throughout the unit. Also, teachers are encouraged to create a science word wall for the unit. It can be created on a bulletin board or simply on a piece of poster paper, so as not to take up too much space. Record new vocabulary on the bulletin board or poster as it is introduced during the unit. Ensure that the word wall is placed in a location of the classroom where all students can see and access the words.

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2 How Are Living and Nonliving Things Different?

Information for Teachers

All living things can do the following:

- Use energy, water, and oxygen
- Grow
- Reproduce*
- Die

*With young students, it is acceptable to use the term *have babies* to explain the meaning of the word *reproduce,* when talking about animals (not plants).

Materials

- variety of living things such as plants, pets (e.g., hamster, fish), if possible
- variety of nonliving things such as a rock, a ruler, a shoe, a cellphone
- variety of pictures of living things, including humans, other animals, and plants (use both classroom resources and student photos from nature walk from the preceding lesson)
- variety of pictures of nonliving things, such as toys, cars, and household items
- projector (optional)
- chart paper, markers, scissors, glue
- drawing paper, crayons
- KWHL chart (from lesson 1)
- Pictionary (1.1.1)
- Learning-Centre Task Card: What Have I Learned About Living and Nonliving Things? (1.2.1)
- Activity Sheet: Living Things (1.2.2)

Engage

Display a variety of living and nonliving things and a variety of pictures of living and nonliving things for students to observe, sort, manipulate, and discuss. Ask students:

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

Have students sort the objects and pictures into "living" and "nonliving" groups.

Now, remove the nonliving objects and pictures, and have students examine the living things. Challenge students to sort them into groups. Model this approach with a few pictures first, and then have students determine a rule for sorting the objects. If they are having difficulty thinking of sorting rules, you may suggest:

- Animals and plants
- Humans, other animals, and plants
- Things with legs and things with no legs
- Things that move and things that do not move
- Things with hair and things with no hair
- Things with eyes and things with no eyes

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

Assessment for Learning 
While students are classifying objects in the Engage activity cited above, observe their abilities to group and explain sorting rules. This is a skill used throughout the unit and applies to other subjects, as well. Record observations on the Anecdotal Record sheet, on page 17.

Explore

Have students share the ways that they have sorted their pictures. Now, encourage them to discuss what they know about living things. Ask:

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

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- What will happen to all living things some day?
- Where does a chicken come from?
- Where does a tree come from?
- What does this tell you about living things? (e.g., they can reproduce or have babies)

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

During the activity and subsequent discussion, record students' responses, and add to the "What do we know" column of the KWHL chart created in lesson 1, using a different colour of marker than you used in lesson 1. Take this opportunity to expand discussion about what students "want to know" and "how" they will discover this information.

Introduce the term *reproduce* to students, and discuss the word in broader terms. Mention, for example, that animals (including humans) have babies; birds and most reptiles lay eggs, which hatch into young; plants produce seeds, which grow into new plants. Use the term *reproduce* often in subsequent lessons so that the word becomes part of the students' vocabulary. As mentioned earlier, it is also acceptable for young students to refer to the reproduction of living things (other than plants) as "having babies" or "having young."

Learning Centre

At the learning centre, display a wide variety of nonliving objects, living things, and pictures of both. Also, include the Learning-Centre Task Card: What Have I Learned About Living and Nonliving Things? (1.2.1), chart paper, and markers. Have students classify the objects and pictures and discuss their sorting rules.

Embed: Part One

Revisit the guided inquiry question: **How are living and nonliving things different?** Have students share their knowledge, provide examples, and ask further inquiry questions.

Give each student a copy of Activity Sheet: Living Things (1.2.2), and have students complete it.

Activity Sheet

Directions to students:

Think of one thing you know about all living things, and print it on your activity sheet. Check the list on chart paper for ideas. Draw a picture to go with what you write (1.2.2).

NOTE: Consider completing a copy of the activity sheet ahead of time to project as a model for students as they complete their own activity sheets.

Embed: Part Two

- Add to the KWHL chart as students learn new concepts, answer some of their own inquiry questions, and ask new inquiry questions.
- Add new words, including the term *reproduce*, and illustrations and examples to the class word wall. Also, include the words in other languages, as appropriate.
- Have students add new terms and pictures to their Pictionary (1.1.1), including the word *reproduce* (e.g., a mother animal and her young). When possible, encourage students to add words and examples in other languages, including Indigenous languages, reflective of the classroom population.

Enhance

- Have students cut out pictures (from magazines, or printed from the Internet) of living and nonliving things to glue onto a sorting mat.

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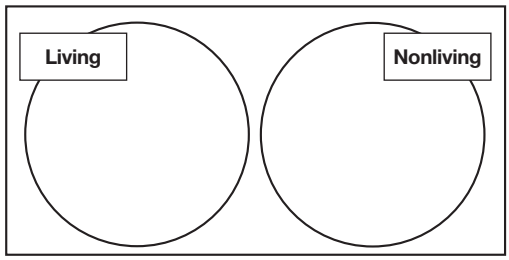
NOTE: If students have not used sorting mats before, introduce this graphic organizer and model the process with a few pictures of living and nonliving things. For example:

Sorting Living and Nonliving Things



- Students can also use a program such as Kidspiration to make the sorting mat.
- In pairs, have students play What Is My Rule? Distribute a copy of Enhance Activity Sheet: What Is My Rule? (1.2.3) to each student. Display a set of pictures of living things. Have one student in the pair select (but not reveal) a rule for sorting pictures (e.g., has fur/has no fur). Once he or she has sorted the pictures, ask the other student to guess what rule was used to sort the pictures.
- Visit a local zoo, bird sanctuary, nature centre, pet store, or wildlife reserve with students. Many of these places offer winter programs, so the field trip need not be limited to the spring. Encourage students to use a combination of their senses, as appropriate, to make observations of living things, and have them record their observations using new terminology and add illustrations.
- Invite a guest speaker from a local zoo, bird sanctuary, nature centre, pet store, or wildlife reserve to visit the class with slide show presentations or live animals.
- Plan a nature walk with students. Give each student two paper bags. Have students label one bag "Living Things" and the other bag "Nonliving Things." Then, have students collect objects that represent living and nonliving things for each bag. Remind students that they must not remove most living things from the environment; however, they can collect items such as fallen leaves, grass, feathers, and seeds. After the nature hunt, encourage students to explain the rationale behind their choices (justification for what they collected and why they think the objects are examples of living and nonliving things).

SAFETY NOTE: Prior to the nature walk, review safety issues with students, such as not picking up dangerous items (and what some of these dangerous items might be). You may wish to have students use gloves for this activity. Also, discuss what they can and cannot remove from the natural environment.

- Select several pictures of living things, and cut them into puzzle pieces. Challenge students to identify each living thing by observing just one puzzle piece. Then have students gather the other pieces for that living thing and put the puzzle together.
- Have students create animals from play dough or clay. Encourage them to mix colours to get appropriate animal colours.
- Encourage students to take pictures of living or nonliving things and bring them to school.
- Encourage students to interview family members and ask them to share stories about living and nonliving things. Storytelling is an integral learning technique in Indigenous cultures, as well as in many other cultures.
- Access the interactive activity, Lesson 2: Sorting Living and Nonliving Things, in the Unit 1 folder at: <portageandmainpress.com/HOS-MB/gr1>.

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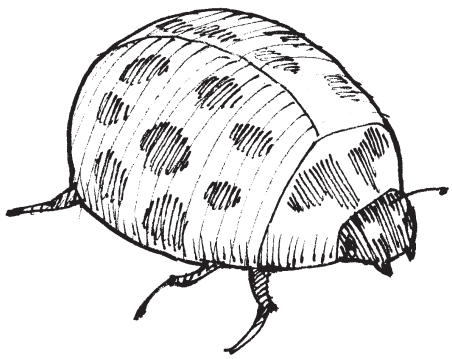
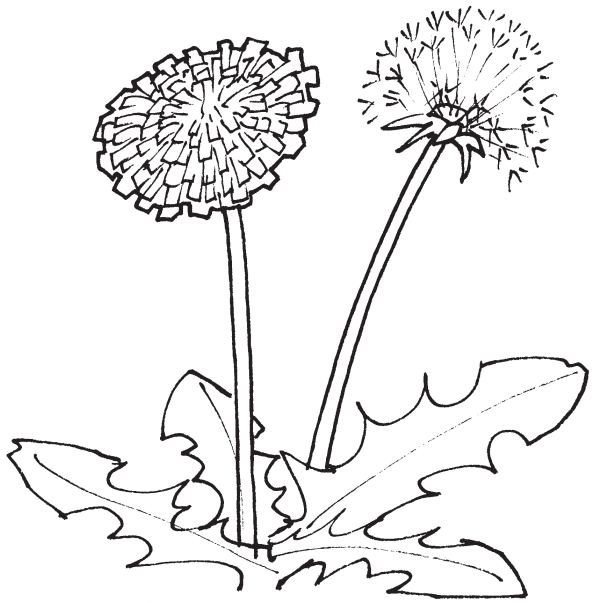
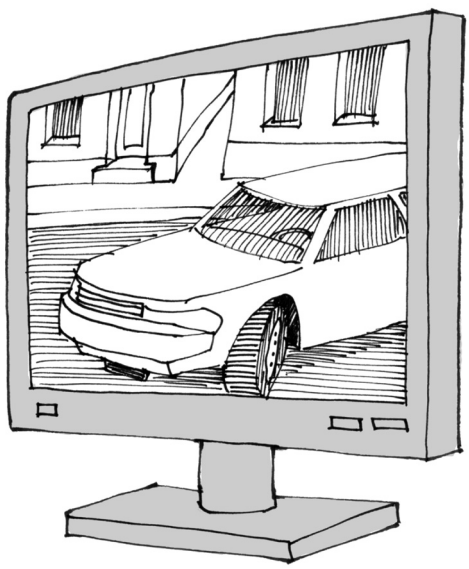
What Have I Learned About Living and Nonliving Things?

1. **Observe and examine the objects and pictures of objects.**
2. **Sort the objects and pictures, and classify them into living and nonliving groups.**
   - **What is the same about the objects in each group?**
3. **Find a way to record and label your sorting.**







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Date: _____ **Name:** _____

Living Things

One thing I know about all living things:

_____

_____

_____

_____

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Date: _____ **Name:** _____ **Partner:** _____

What Is My Rule?