Science and Technology Resource Pack

Grade 6: Life Systems

Diversity of Living Things

Discrete
(Inclusive of All S&T Strand Expectations)

Pilot Edition

A RESOURCE PACKAGE FOR TEACHERS BY TEACHERS
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This document has been reviewed for equity. In implementing this resource, individual teachers will model and encourage respect for racial, cultural, and language diversity. Teachers will foster inclusion by modifying activities, procedures, and materials as necessary to promote equal access and safety for all students.
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<td></td>
<td>Worksheet 8-2</td>
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Science and Technology Expectation Sheets

Overview:
The study of living things in Grade 6 focuses on the use of classification systems as ways of learning about the great diversity of species and as ways of organizing the study of species. Particular attention is given to the classification of organisms in the animal kingdom. Classifying animals not only will enable students to learn about many different types of animals, from mammals to microscopic organisms, but will help them to observe and describe similarities and differences among species more precisely. To acquire first-hand experience in studying the diversity of living things, students will examine and classify organisms in a specific habitat — a pond, for example.

Overall Expectations
By the end of Grade 6, students will:
- demonstrate an understanding of ways in which classification systems are used to understand the diversity of living things and the interrelationships among living things
- investigate classification systems and some of the processes of life common to all animals
- describe ways in which classification systems can be used in everyday life

Expectations in the Ontario Curriculum Correlated with the Unit Activities

<table>
<thead>
<tr>
<th>Ministry Code</th>
<th>Expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>6s4</td>
<td>explain why formal classification systems are usually based on structural characteristics rather than on physical appearance or behavioural characteristics</td>
</tr>
<tr>
<td>6s5</td>
<td>recognize that the essential difference between cold- and warm-blooded animals lies in different means of regulating body temperature</td>
</tr>
<tr>
<td>6s6</td>
<td>identify and describe the characteristics of vertebrates, and use these characteristics to classify vertebrates as mammals, birds, amphibians, reptiles, and fish</td>
</tr>
<tr>
<td>Ministry Code</td>
<td>Expectations</td>
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<tr>
<td>---------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>6s7</td>
<td>identify and describe the characteristics of invertebrates, and classify invertebrates into phyla</td>
</tr>
<tr>
<td>6s8</td>
<td>compare the characteristics of vertebrates and invertebrates</td>
</tr>
<tr>
<td>6s9</td>
<td>compare the characteristics of different kinds of arthropods</td>
</tr>
<tr>
<td>6s10</td>
<td>describe microscopic living things using appropriate tools to assist them with their observations</td>
</tr>
<tr>
<td>6s11</td>
<td>describe ways in which micro-organisms meet their basic needs</td>
</tr>
<tr>
<td></td>
<td><strong>Developing Skills of Inquiry, Design, and Communication</strong></td>
</tr>
<tr>
<td></td>
<td><strong>By the end of Grade 6, students will:</strong></td>
</tr>
<tr>
<td>6s12</td>
<td>formulate questions about and identify the needs of different types of animals, and explore possible answers to these questions and ways of meeting these needs</td>
</tr>
<tr>
<td>6s13</td>
<td>plan investigations for some of these answers and solutions, identifying variables that need to be held constant to ensure a fair test and identifying criteria for assessing solutions</td>
</tr>
<tr>
<td>6s14</td>
<td>use appropriate vocabulary, including correct science and technology terminology, in describing their investigations and observations</td>
</tr>
<tr>
<td>Ministry Code</td>
<td>Expectations</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------</td>
</tr>
<tr>
<td>6s15</td>
<td>compile data gathered through investigation in order to record and present results, using charts, tables, labelled graphs, and scatter plots produced by hand or with a computer</td>
</tr>
<tr>
<td>6s16</td>
<td>communicate the procedures and results of investigations for specific purposes and to specific audiences, using media works, oral presentations, written notes and descriptions, charts, graphs, and drawings</td>
</tr>
<tr>
<td>6s17</td>
<td>identify various kinds of classification systems that are based on specific criteria and used to organize information</td>
</tr>
<tr>
<td>6s18</td>
<td>identify inherited characteristics</td>
</tr>
<tr>
<td>6s19</td>
<td>explain why characteristics related to physical appearance</td>
</tr>
<tr>
<td>6s20</td>
<td>identify various kinds of plant or animal organisms in a given plot using commercially produced biological or classification keys</td>
</tr>
<tr>
<td>6s21</td>
<td>describe specific characteristics or adaptations that enable each group of vertebrates to live in its particular habitat</td>
</tr>
<tr>
<td>Ministry Code</td>
<td>Expectations</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------</td>
</tr>
<tr>
<td>6s22</td>
<td>explain how fossils provide evidence of changes in animals over geological time</td>
</tr>
<tr>
<td>6s23</td>
<td>compare similarities and differences between fossils and animals of the present</td>
</tr>
</tbody>
</table>
## UNIT OUTLINE

<table>
<thead>
<tr>
<th>Activity</th>
<th>Type</th>
<th>Title</th>
<th>Description</th>
<th>Specific Expectations Addressed</th>
<th>Suggested Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Nature Walk</td>
<td>A nature walk can occur anywhere near the school. Students will observe their surroundings and note their observations of the life forms that they encounter (both plant and animal).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Why Classify?</td>
<td>Students are given a collection of 20 pieces of cardboard that differ only in colour, shape, and size. They are challenged to group the cardboard pieces in as many different ways as possible, recording their method as a tree classification system.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Let’s Classify Living Things!</td>
<td>The class will examine three specimens: a rock, a plant, and an animal. Through observation and discussion, students will generate a list of characteristics for living things, then classify the living things on the worksheet using their own criteria.</td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td></td>
<td>Reliable Characteristics</td>
<td>Students will use some behavioural, physical, and structural characteristics to classify themselves. They will then consider the reliability and appropriateness of each of these characteristics for use in a formal biological classification system.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Kingdoms Are Not Just For Kings!</td>
<td>Students will be introduced to formal biological classification based on structural characteristics. They will learn the vocabulary that is associated with the classification system, originated by Carl Linnaeus.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>So You Think You’re a Vertebrate?</td>
<td>Students will learn about the five classes of vertebrate and their characteristics.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Adaptation: How Can I Fit In?</td>
<td>The teacher will discuss with the class some adaptations that allow animals to survive in their particular habitats, then students will have an opportunity to create an imaginary bird to live in a specialized habitat.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**

- RA = reflective activities
- CA = content activities
- OE = open-ended activities
- AO = assessment opportunities
<table>
<thead>
<tr>
<th>Activity</th>
<th>Type</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td></td>
<td>8 Arthropods and Other Invertebrates</td>
<td>Bottled specimens are provided in the Resource Pack so that students can compare the body parts of various invertebrates. Live specimens are also very interesting to observe, so students can set up simple habitats and collect specimens. In groups, students will choose one invertebrate to research in detail.</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Who Am I?</td>
<td>The students will use the knowledge that they have gained about vertebrates and the many phyla that are grouped together and generally referred to as 'invertebrates' to create a game that they can challenge their classmates to play.</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Take a Closer Look!</td>
<td>Students will learn to use a microscope so that they will be able to examine microscopic living things in the next activity. They will learn the parts of a microscope, how to set up a slide with a cover slip, what the magnification means, and how the slide is moved under the lens.</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Tiny Living Things</td>
<td>Students will use their microscope skills to observe and draw some microscopic living things. By observing the actions of the microscopic organisms, students will describe the ways in which these organisms meet their needs for food, water, air, and movement.</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>A Scientific Inventory</td>
<td>Students will identify as many plants and animals as possible in a given plot of land 1m² in size. They will describe the habitat, prepare sketches of the specimens, and then use field guides to identify their specimens.</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>How Can I Tell a Pine From a Spruce?</td>
<td>Students will learn to use a key to identify coniferous trees. They will examine several types of coniferous trees or branches. This can be done as an outdoor activity or as an in-class activity.</td>
</tr>
</tbody>
</table>

RA = reflective activities  CA = content activities  OE = open-ended activities  AO = assessment opportunities
<table>
<thead>
<tr>
<th>Activity</th>
<th>Type</th>
<th>Title</th>
<th>Description</th>
<th>Specific Expectations Addressed</th>
<th>Suggested Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td></td>
<td>Dig Into the Past!</td>
<td>Students will complete an individual research project on the topic of fossils. They will compare fossils from the past with present-day animals.</td>
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<tr>
<td>15</td>
<td></td>
<td>Design Your Own Investigation</td>
<td>Students will design an experiment to determine whether certain insects or other animals will grow larger if given large quantities of food. They will ensure that they have designed a fair test. The results will be communicated to the class in the form of a presentation.</td>
<td></td>
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<tr>
<td>16</td>
<td></td>
<td>Let’s Go to the ROM!</td>
<td>The ROM has an excellent insect gallery that is available for classroom use. The Discovery Centre can also be booked for hands-on investigation. Students will compare the arthropods they have already examined with preserved and fossil specimens in the museum collection, looking at adaptation and natural interrelationships.</td>
<td></td>
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<tr>
<td>17</td>
<td></td>
<td>Think About What You’ve Learned</td>
<td>By now, students will have a better understanding of what “diversity of living things” really means. This activity asks students to reflect on their learning and identify some of the most interesting things that they have learned.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RA = reflective activities  CA = content activities  OE = open-ended activities  AO = assessment opportunities

Activities which encompass Understanding Basic Concepts, Developing Skills of Inquiry, Design, and Communication and Relating Science and Technology to the World Outside the School using the following headings:

**Reflective Activity (RA)**
- to find out and record what the students already know at the beginning of the process,
- to determine what the students have learned through the unit, allows opportunities for meta-cognitive studies and should mirror (in some way) the initial Reflective Activity

**Content Activities (CA)**
- to relate, in unambiguous but not authoritarian ways, alternative conceptions of the concepts under study
Open-Ended Activities (OE)
• to allow the students to design their own technological solutions to problems (SPICE methodologies) or to devise their own scientific investigations of phenomena (OLDER methodologies)

Assessment Opportunities (AO)
• should be embedded throughout the unit
UNIT OVERVIEW/SAFETY PAGE

Unit Overview
The unit progresses logically through the classification systems of the animal kingdom, considering the interrelationships among living things. Based on a nature walk, the unit begins with a review of the Grade 2 unit *Growth and Changes in Animals*. Students move to a comparison of animal classification systems and other classification systems in everyday life (i.e., school, government). The unit continues with the classification of vertebrates. Students participate in a brief research project on one of the animal classes, then progress to the classification of invertebrates. They are involved in a more in-depth research project studying a particular invertebrate animal. Live specimen study is included in this activity. This is followed by an examination of arthropods (including a microscopic study), as well as a field trip to explore fossils and the adaptation of animals over time. Their last investigation is based on the fair test principal. The unit concludes with a review of what students have learned over the unit.

Safety Considerations

Pond Study
Please consult most recent policies and procedures of the Toronto District School Board for activities involving water.
If you wish to take students to the local stream, pond etc., make sure that you have:
• adequate supervision
• first aid kit
• parental supervision
• students prepared with appropriate clothing

If you have any questions or concerns, please contact the District Wide Co-ordinator of Outdoor Education.

Animal/Plant Life
Please refer to most recent policies and procedures for outdoor excursions when respect for life.
• Handle living and non-living things gently and with care.
• Make sure captured living creatures have appropriate food, water, light, darkness, moisture, fresh air, space, etc.
• When observing plant and animal life, watch out for poison ivy and other poisonous plants.
• Have students wash their hands before and after handling any living things, either in the classroom or out of doors. Provide soap and water for this purpose.

Exacto Knives
Exacto knives should only be used by teachers.
## MATERIALS LIST

### Non-Consumable Materials Included in the Resource Pack

#### Books
- *The Beginner’s Guide to Animal Autopsy* (Scholastic)
- *Focus on Science* (D.C. Heath Canada Ltd.)
- *Science* by Burdett (Scholastic)
- various animal reference books

#### Videos
*(Note to teacher: These videos are optional, so they may or may not be included in your Resource Pack.)*
- Amphibians (Eyewitness)
- Amphibians (Wonder Why)
- Animal Predators and the Balance of Nature (Magic Lantern)
- Animals #9 (Wonder Why)
- Animals with Backbones (Magic Lantern)
- Birds (Eyewitness)
- Fish (Wonder Why)
- Insects #16 (Wonder Why)
- Insects (Eyewitness)
- Mammals (Wonder Why)
- Plants and Animals Depend on Each Other (Magic Lantern)
- Reptiles (Wonder Why)

#### Other Materials
- bottled specimens (invertebrates)
- cover slips
- dropper bottles (12)
- feathers
- gelatin
- glass slides
- magnifying glasses (12)
- microscope slide set (pond life, insects)
- microscopes
- *Studying Insects* (transparencies)
- thread
- tweezers (6)

### Consumable Materials Included in the Resource Pack
- Mealworm Kit (including 12 mealworms, mealworm food, earth, 6 plastic observation dishes)
- petri dishes (30)
- Popsicle sticks
- string
Materials Supplied by the School, Teacher, and Students (Found Materials)

- branches from coniferous trees
- Bristol board
- camcorder and videotape
- camera
- chart paper
- clipboards (or any other hard boards)
- collection trays and bottles
- construction paper
- gloves
- glue
- large rock
- live specimens (mealworms, worms, sow bugs, snails, etc.)
- metre stick or measuring tape
- pencils, coloured pencils, markers, chalk, pens
- plastic spoons or trowels
- potted plant
- resource material for research projects (i.e. encyclopedias, Internet, texts, etc.)
- rulers
- scissors
- stapler
- student notebooks
- video about vertebrates
Activity 1
Nature Walk

[CATCH box with expectation codes: ]

Overview
A nature walk can occur anywhere near the school. It can be a walk through the neighbourhood, a walk to a nearby park or green space, or a walk around the schoolyard. The purpose of this activity is to have students start thinking about the diversity that exists around them. Students will observe their surroundings and note their observations of the life forms that they encounter (both plant and animal). (time)

Background Information
• **habitat:** the environment in which a plant or animal lives (or is naturally found)

Materials
• clipboards
• pencils
• camera (optional)
• hand lens* (optional)
• plastic spoons or trowels
• collection trays and bottles
• petri dishes*
• probes (e.g., Popsicle sticks*)
• tweezers*
• Worksheets 1-1 to 1-3
*included in Resource Pack

Teacher Preparation
• Photocopy Worksheets 1-1 to 1-3. You will need one per student or per pair. Bring extra paper on the nature walk in case students run out of room for their observations. Keep Worksheet 1-3 for wrapping up in the classroom afterwards.
• Collect clean jars for pond water
• Collect permission forms. If you will be leaving school property, arrange for parent supervision for the nature walk.

Instructional Strategies

Reflections
• Review the expectations for student behaviour while out on the walk. Discuss safety considerations for crossing roads in a large group.
• Discuss the type of observations that students should make. Students should use their senses to observe (sight, sound, smell, and touch, **not** including taste). Remind students to focus on the plant and animal species that they see.
• Students may tend to think of animals in terms of mammals, so discuss how birds, ants, fish, snails, snakes, etc. are also animals.
• Remind students that trees are plants too, and that different types of trees have differently shaped leaves.
• Encourage students to look for plants and animals of different sizes, both tiny and big, and to look both high and low in their surroundings (i.e., study the grass closely, then look up into the tree branches).

Activity Time
• Have students get into pairs. Hand out and explain the worksheets.
• Encourage students to sketch **and** describe the life forms they observe.
• If students know the names of some living things, they should record them, but names are not essential.
• Depart for the trip with clipboards, pencils, and worksheets. At intervals, stop and allow students to discuss and record their observations.
• Upon your return to the classroom, have students wash their hands.
Wrapping Up
- Back in the classroom, have a class discussion. Students should describe what they have observed and compare their observations with their classmates’ notes. Students will begin to have an appreciation for the diversity of life around them in their own community.
- Use the questions on Worksheet 1-3 to guide the discussion and/or guide students in a written reflection for their science journal.
- Review the meaning of the term *habitat*.

Building on the Experience
Some students may wish to further their investigations by consulting field guides to identify the plants or animals that they observed.

Remediation/Extension
- Pair ESL/Learning Disabled Students with peer mentors.
- Refer to the Grade 2 Life Systems strand (Growth and Changes in Animals).
- Use additional visual/text sources (see Related Resources, p. 00).

Curriculum Links
**The Arts:** Visual Art - Have students make rubbings of bark and sketches of the plants and animals observed.
**Language:** Writing - Have students use descriptive language while noting their observations.

Assessment Suggestions/Strategies
As this is a reflective activity, no assessment will be made. However, save individual student observations in science journals to serve as a base-line of student knowledge for the unit.
Worksheet 1-1
Observation Sheet

[CATCH Name and Date lines]

<table>
<thead>
<tr>
<th>Sketch</th>
<th>Description/Location/Name (if known)</th>
</tr>
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</tbody>
</table>
Worksheet 1-2
Animal Descriptions

[CATCH Name and Date lines]

Use these words (and your own words too!) to describe the living things you observe.

Words for Describing Animals:

<table>
<thead>
<tr>
<th>MOVEMENT</th>
<th>COLOUR</th>
<th>BODY</th>
</tr>
</thead>
<tbody>
<tr>
<td>walk</td>
<td>dark</td>
<td>dry</td>
</tr>
<tr>
<td>crawl</td>
<td>light</td>
<td>slimy</td>
</tr>
<tr>
<td>run</td>
<td>solid</td>
<td>scales</td>
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<td>hop</td>
<td>patterned</td>
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<td>fly</td>
<td>striped</td>
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<td>slither</td>
<td>spots</td>
<td>how many eyes?</td>
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<td>swim</td>
<td>describe unusual</td>
<td>how many legs?</td>
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<td>markings you see</td>
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<td></td>
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Words for Describing Plants:

<table>
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<tr>
<th>PLANT DESCRIPTIONS</th>
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<tbody>
<tr>
<td>woody stems</td>
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<td>soft stems</td>
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<td>rough</td>
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<td>hairy</td>
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<td>thorns</td>
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<td>shiny</td>
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<td>dull</td>
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<td>branched</td>
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<tr>
<td>flowers</td>
</tr>
<tr>
<td>scented</td>
</tr>
<tr>
<td>seeds</td>
</tr>
<tr>
<td>fruit</td>
</tr>
<tr>
<td>leaves (toothed, smooth, lobed, single, compound)</td>
</tr>
</tbody>
</table>
Worksheet 1-3
Nature Walk Reflection

[CATCH Name and Date lines]

These questions will help you frame your thoughts about what you have observed. You may have other observations or Reflections you would like to add.

Answer these questions in your notebook:

1. What plants or animals did you observe the most frequently?
2. a) What size were most of the animals you observed?
   b) What was the smallest plant?
   c) What was the smallest animal?
   d) What was the biggest plant?
   e) What was the biggest animal?
3. What surprised you about what you saw?
4. When you observed the same plant or animal twice, was it in the same type of place (habitat) both times?
5. a) Name a plant and describe where you saw it. Why do you think this plant was found in that particular spot?
   b) Name an animal and describe where you saw it. Why do you think this animal was found in that particular spot?
6. Do you think there is a relationship between certain plants and animals and their habitat? Explain.
Activity 2
Why Classify?

[CATCH box with expectation codes: ]

Overview
Students are given a collection of 20 pieces of cardboard that differ only in colour, shape, and size. They are challenged to group the cardboard pieces in as many different ways as possible, recording their method as a tree classification system. Through class discussion, students can compare some of the systems of classification that arise from their choices.

Background Information
Whenever objects are grouped together on the basis of some set of characteristics, they are said to be classified. People classify just about everything around them. It might have started out by simply calling certain things “good” and other things “bad,” depending upon how they were perceived. As the world grew more complicated, the need for a better system of identifying and classifying objects became necessary. Classification systems are one way to make sense of our surroundings.

Classification Systems
A classification system is one in which a set of objects is sorted or classified according to the particular characteristics found in the members of the set. The levels of classification continue until it is decided that any further division of subsets would serve little purpose.

- **tree diagram:** a hierarchy classification scheme named for its resemblance to an inverted tree; each category becomes more specific and more exclusive the further one proceeds.
- **dichotomous key:** a classification system that divides a set of objects into two groups at every level until they can no longer be separated into two groups; often used in identification keys

Materials
For each pair:
- 3 large red circles
- 1 large red square
- 4 small red circles
- 4 large black squares
- 2 large black circles
- 2 small red squares
- 1 small black circle
- 3 small black squares
- Worksheet 2-1 (one per student)

Teacher Preparation
- Cut out the shapes, one set per each group of 2. A master for circles and squares is given at the end of this activity as a guide. Use coloured poster board; after the class is over, store the shapes for future use.
- Photocopy Worksheet 2-1 (one per student). Although students will work in pairs, each student should fill out his or her own worksheet. You may want to have extra copies on hand for students who devise more than one classification system.

Instructional Strategies

Reflections
- To introduce the topic of classification, have students think about a recent visit to a supermarket, department store, or public library.
- Ask, “How is food arranged in a supermarket?” Expect to hear that different types of food are placed in different sections of the store (i.e., frozen goods, non-frozen foods, fresh vegetables and fruit, canned goods, dairy products, meats, and baked goods).
- Ask, “How are things arranged in a department store?” Expect to hear that different types of products are located on different floors (i.e., clothing, appliances, toiletries). On these floors, the products are divided up into more categories (i.e., women’s clothing, men’s clothing, girls’ and boys’ clothing, baby clothing).
• Ask, “How are books arranged in a public library?” Expect to hear that books are arranged by topic (i.e., fiction, science, gardening, cooking). Within these categories, books are placed alphabetically by author.
• Ask, “Why are classification systems needed?” Students should realize that classification systems are used in these places to help people find what they are looking for, to make it easier to compare similar items, or to put things back where they belong.

Activity Time
• Instruct student pairs to sort their 20 shapes into two groups using one characteristic (i.e., colour).
• Have students regroup all the materials, and then sort the shapes into two groups using a different characteristic.
• Challenge students to find as many characteristics as possible to sort their materials into groups. They should consider the attributes of size, colour, and shape.
• Once students are familiar with sorting their materials, introduce the student activity. Distribute one copy of the tree diagram (Worksheet 2-1) to every student. Each student should record her or his own notes.
• Have students start by choosing a characteristic to divide the material into groups. Next, leaving the material divided up, students should subdivide each group into smaller groups based on a different characteristic.
• Remind students to record the characteristic and numbers in each group on Worksheet 2-1 as soon they make each division.
• After they have divided the material as far as possible, challenge students to come up with a different method of sorting that is different from the first. Have the students name the resulting groups (see the example given at the end of this activity).

Wrapping Up
Have students share their different sorting methods and discuss the results they obtained for their tree diagrams. There are six possible ways to sort the materials depending on the order of the sort (colour/size/shape or shape/size/colour or size/shape/colour, etc.).

Building on the Experience
• Students may wish to record all six possibilities on tree diagrams for themselves or for display. A display of the possibilities would benefit other students who are having difficulty visualizing them.
• Students may also be interested in investigating the Dewey Decimal System to see how libraries make use of a classification system.

Curriculum Links
Mathematics: Data Management - Students will display data on a chart (tree diagram).

Assessment Suggestions/Strategies
• Observe the students as they work in pairs. Look for co-operation and sharing of information and ideas.
• Evaluate the students’ tree diagrams for accurate organization.
Master for Circles and Squares
Sample Tree Diagram

- **20 pieces**
  - **10 large shapes**
    - **5 circles**
      - 3 red (X)
      - 2 black
    - **5 squares**
      - 1 red
      - 4 black
  - **10 small shapes**
    - **5 circles**
      - 4 red (Y)
      - 1 black
    - **5 squares**
      - 2 red
      - 3 black

**Note:** For example, X is called “large circle red” and there are three of them. Y is called “small circle red” and there are four of them.
Worksheet 2-1
Tree Diagram

[CATCH Name and Date lines]

1. Arrange the 20 pieces of cardboard into two groups.
2. Subdivide each group into two more groups.
3. Continue to subdivide each group until further subdivisions don’t make sense.
4. Record your groupings on this sheet.
5. In each blank, also write the **number** of objects placed there.

20 pieces

Answer these questions on the back of the page:
1. What characteristics did you use in grouping?
2. How do supermarkets use a classification system?
3. How do libraries use a classification system?
4. Why are classification systems important or useful?
5. How many different ways can you sort these shapes?
Activity 3
Let's Classify Living Things!

[CATCH box with expectation codes: ]

Overview
The class will examine three specimens: a rock, a plant, and an animal. Through observation and discussion, students will generate a list of characteristics for living things. They will be asked to create their own informal classification system for the items pictured on the worksheet.

Materials
- large rock
- plant in a pot
- a living animal (e.g., small rodent, reptile, fish, insect)
- blank paper
- scissors
- rulers, pencils
- Worksheet 3-1

Teacher Preparation
- Gather specimens for demonstration.
- Photocopy the worksheet (one per pair of students).

Instructional Strategies
Reflections
- Have students look at the three specimens. Ask, “Which ones are alive?” Students should realize that the plant and the animal are both alive.
- Ask, “How can you tell that they are alive?” Guide the discussion so that students generate a list of characteristics that living things have and non-living things do not. Here is an example:

<table>
<thead>
<tr>
<th>Characteristics of Living Things</th>
</tr>
</thead>
<tbody>
<tr>
<td>grow</td>
</tr>
<tr>
<td>reproduce</td>
</tr>
<tr>
<td>die</td>
</tr>
<tr>
<td>take in food and liquids</td>
</tr>
<tr>
<td>take in oxygen</td>
</tr>
<tr>
<td>eliminate wastes</td>
</tr>
<tr>
<td>move and respond to stimuli (plants will turn towards the light)</td>
</tr>
</tbody>
</table>

- Write the list on the chalk board, and/or have students record it in their notebooks.
- Explain that things can be divided into two main groups: living and non-living things. Have students suggest a few examples that fit into each group.
- Discuss ways to divide the heading “living things” into smaller groups. For example, living things can be divided into plants and animals. Plants can be divided into those with woody stems (i.e., trees) and those with soft stems, while animals can be divided into those with legs versus those without legs, or those with fur versus those without fur. There are many possibilities!

Activity Time
- Hand out the worksheets, one to each pair. Instruct students to cut out each item on the page. It will be easier for them to sort the items if they can physically move them around.
- Have students start by classifying the items into two main groups. Student pairs should discuss the reasons for the groups they have chosen.
• As they sort the items, tell students to record the information as a key on a blank piece of paper. (The key can be patterned after the tree diagram used in the last activity.) Students should write the names of the items in each group in the boxes. Do not have them glue the pictures in place.

• Here are some characteristics that can be used to classify living things (let students come up with their own characteristics):

- plants/animals
- trees/other plants
- flowers/other plants
- keeps leaves all year round/loses leaves in the fall
- produces food for humans/does not produce food for humans
- green/coloured
- big/small
- fly/doesn’t fly
- swims/doesn’t swim
- walks/doesn’t walk
- legs/no legs
- # of legs
- fur or hair/no fur or hair
- scales/no scales

• Remind students that the key they are creating will be evaluated, so it should be drawn with a ruler, and all labelling should be neat and legible.

Wrapping Up
Have students submit their keys for evaluation.

Building on the Experience
Students can extend their understanding of this topic by creating a chart or a Venn Diagram that represents the similarities and differences between a live dog and a stuffed dog.

Curriculum Links
Mathematics: Data Management - representing information in charts and graphs

Assessment Suggestions/Strategies
• During the activity, question students about their criteria for selecting characteristics to form the groups that they have chosen.
• When evaluating this activity, take into account the care taken in drawing the tree diagram, and the reasoning put into selecting the characteristics used to create the classification system. Accept any reasonable classification.
Worksheet 3-1
Let’s Classify Living Things!

1. Cut out each of the items on this page.
2. First, sort the items into two groups.
3. Now subdivide each group into smaller groups.
4. Continue to classify. Record your classification as a tree diagram on a blank piece of paper.

Be careful not to lose any pieces!

[ROLAND: I ADDED ALL THESE to replace the drawings given by the author; I don’t think we really need diagrams, do you? Or maybe after the field testing…]

[CATCH very simple but recognizable line drawing of each of the following living things: they should be as small as possible, to fit into this chart]

<table>
<thead>
<tr>
<th>dandelion</th>
<th>mosquito</th>
<th>lettuce</th>
<th>eagle</th>
<th>grass</th>
</tr>
</thead>
<tbody>
<tr>
<td>frog</td>
<td>salmon</td>
<td>dragonfly</td>
<td>pine tree</td>
<td>ant</td>
</tr>
<tr>
<td>goldfish</td>
<td>mouse</td>
<td>rabbit</td>
<td>lion</td>
<td>spider</td>
</tr>
<tr>
<td>snake</td>
<td>maple tree</td>
<td>apple tree</td>
<td>rose</td>
<td>human</td>
</tr>
</tbody>
</table>
Activity 4
Reliable Characteristics

[CATCH box with expectation codes: ]

Overview
Students will use some behavioural, physical, and structural characteristics to classify themselves. They will then consider the reliability and appropriateness of each of these characteristics for use in a formal biological classification system (as opposed to the informal system they employed in the last activity).

Background Information
- **behavioural characteristics**: the way that a person or organism acts or responds to events or stimuli; including likes, dislikes, fears
- **physical characteristics**: the way a person or organism looks; its appearance; including colour, height, weight
- **structural characteristics**: the way a person or organism is structured; the way the parts are put together; including the number of legs, body parts, eyes

Materials
- chart paper and markers; or chalk and chalk board
- student notebooks
- Worksheet 4-1

Teacher Preparation
Photocopy the worksheets (one per pair or small group).

Instructional Strategies

Reflections
- Introduce the idea that everyone in the class is unique, an individual. Question the students about whether they think that each of them is totally unique or whether they think there might some similarities among some of them.
- Ask students to raise one hand. How many raise their right hand?
- Ask students to cross their arms. Which arm is on top?
- Ask students if they can roll the end of their tongue up. Now ask them to try rolling the sides of their tongue up. How many can do it?
- Ask the students who have blue eyes to stand up. Now have the students with brown hair stand up, and then the tall students (how will you decide who is tall?). How many of each are there in the class?
- Ask students about their fears. Who is frightened by spiders? by heights? by the dark? by horror stories? How does this divide up the class?
- Ask those students who like pizza to put their hands up. Now ask for students who like carrots, then for those who like apples. Students will see that they have different tastes.
- Ask the students who have two ears to stand up; then those with two legs; then those with three eyes; then those with a backbone. These characteristics should not divide the class. They are all *Homo Sapiens* (human)!
- Students should recognize that they share some characteristics.

Activity Time
- Introduce the terms *behavioural characteristics, physical characteristics, and structural characteristics*. Have students develop their own definition for each term.
- Have students consider the exercise in which they have just taken part. Ask students to work in pairs or small groups to brainstorm a list of characteristics that fit each of the three main categories. They can record this on Worksheet 4-1 in the form of a chart or a web diagram.

Wrapping Up
- When everyone has finished brainstorming, pose some questions to the class:
- Which type of characteristic is the most reliable for identifying plant or animal species?
- When might it be useful to use other types of characteristics to classify organisms?

* Students should realize that structural characteristics are the most reliable, because these characteristics do not change from one member of a species to another. Physical and behavioural characteristics can vary from one individual to another within a species. These characteristics are useful when surveying people’s likes and dislikes, or when designing products for people to purchase.

* Remind students to record the information they have learned in their notebooks.

**Building on the Experience**
Students can choose an organism (i.e., cat, dog, squirrel, bird) and record as many behavioural, physical, and structural characteristics as they can in the form of a chart or a web diagram. Post these around the room so other students can benefit from the reinforcement of these concepts.

**Curriculum Links**
**Mathematics:** Data Management – use of graphic organizers to display information  
**Language:** Writing - description of characteristics; comparison of the different characteristics and their importance for formal and informal classification systems

**Assessment Suggestions/Strategies**
Students’ understanding of why structural characteristics are important in formal classification can be assessed from their notes written during Wrapping Up. These notes could also be used for Language Arts evaluation. Use the ASAP Communication Rubric (see the Appendices, p. 00).
Worksheet 4-1
Reliable Characteristics

[CATCH Name and Date lines]

Use this space to draw a chart or web diagram of different types of characteristics. Here are a few characteristics to start you off:

- colour of hair
- afraid of spiders
- two legs
Activity 5
Kingdoms Are Not Just For Kings!

[CATCH box with expectation codes: ]

Overview
Students will be introduced to formal biological classification based on structural characteristics. They will learn the vocabulary that is associated with the classification system, originated by Carl Linnaeus.

Background Information
The Swedish biologist Carl Linnaeus developed the formal classification system that is now accepted in modern biology. The classification system is in Latin. All living things are divided into five kingdoms, which are listed below:

- **Protista**: living things that can be seen only with a microscope, and contain a nucleus
- **Monera**: living things that can be seen only with a microscope, and do not contain a nucleus
- **Plantae**: living things that produce their own food through photosynthesis, and contain chlorophyll (a green pigment used during photosynthesis)
- **Animalia**: living things that eat and move around, and do not contain chlorophyll
- **Fungi**: living things that do not move around, absorb nutrients from dead or living organisms, and do not contain chlorophyll

In each kingdom, there are eight levels of division. In order from most general to most specific, they are: kingdom, phylum, class, order, family, genus, species, and variety. This system is used for all kingdoms.

Because the Linnaeus system is quite complicated, students will learn a simplified version of it. The animal kingdom, **Animalia**, can be divided into the following nine phyla:

- **Porifera** (e.g., sponges)
- **Coelenterata** (e.g., jellyfish)
- **Nematoda** (e.g., roundworms)
- **Annelida** (e.g., earthworms)
- **Platyhelminthes** (e.g., tapeworms)
- **Mollusca** (e.g., snails)
- **Echinodermata** (e.g., starfish)
- **Arthropoda** (e.g., insects)
- **Chordata** (includes all vertebrates)

All these phyla except for Chordata can be grouped together under the heading **Invertebrates**. Students should be able to classify an animal as either a vertebrate or an invertebrate.

- **vertebrate**: an animal with a backbone (e.g., human, dog, snake, bird)
- **invertebrate**: an animal without a backbone (e.g., worm, snail, ant, bee); many invertebrates have hard shells or outer body coverings called **exoskeletons** (e.g., beetle, ladybug)

Materials
- Worksheets 5-1 and 5-2

Teacher Preparation
Photocopy the worksheets (one per student). A sample copy of Worksheet 5-1, with the answers filled in, is located at the end of this activity.
Note: Students will be familiar with some of the terms, but may not know how they are related to each other. During this lesson, students should learn the five kingdoms and learn to distinguish between *vertebrates* and *invertebrates*.

- Start by surveying the class to see which of these terms (i.e., the various kingdoms, *vertebrates*, and *invertebrates*) are familiar. Write the familiar terms on the chalk board.
- Tell students that they will now be introduced to the formal classification of living things. Explain that scientists use this type of classification to describe living things.

### Activity Time

- Hand out Worksheets 5-1 and 5-2 (one of each per student). Students will fill in the worksheets during the class discussion.
- Introduce the five kingdoms. Describe the characteristics for each kingdom, then have students suggest and record examples for each kingdom. You may need to give the examples for kingdoms *Protista* and *Monera*.
- Introduce the terms *vertebrate* and *invertebrate*. Ask students to suggest and record as many examples as possible for each.

### Wrapping Up

- Have students write a short paragraph in their journals reflecting what they have learned about the diversity of living things.
- Make sure students recognize that the heading *Invertebrates* contains many very different organisms.

### Building on the Experience

- Provide books containing pictures of organisms belonging to the various kingdoms and phyla that you have discussed for those students who have never seen many of these creatures.
- Some students from tropical countries may be able to share their knowledge of reptiles or parasites.
- Interested students can read about some of the lesser known phyla.

### Curriculum Links

**Mathematics:** Data Management - charts, graphic organizers

### Assessment Suggestions/Strategies

Monitor students’ ability to complete the worksheets.
All living organisms are divided into five kingdoms.

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Structural Characteristics</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protista</td>
<td>• single-celled animal • nucleus • no chlorophyll • seen with microscope</td>
<td>• amoeba • paramecium • stentor • vorticella</td>
</tr>
<tr>
<td>Monera</td>
<td>• single-celled animal • no nucleus • no chlorophyll • seen with microscope</td>
<td>• bacteria</td>
</tr>
<tr>
<td>Animalia*</td>
<td>• multi-celled organism • no chlorophyll • able to move around • eats other living things</td>
<td>• worms • insects • reptiles • amphibians • snails • mammals • birds • fish</td>
</tr>
<tr>
<td>Plantae</td>
<td>• multi-celled organism • chlorophyll • unable to move around</td>
<td>• mosses • ferns • trees • grasses</td>
</tr>
<tr>
<td>Fungi</td>
<td>• multi-celled organism • no chlorophyll • unable to move around</td>
<td>• mushroom • toadstool • bracket fungi (on trees) • moulds</td>
</tr>
</tbody>
</table>

*We will focus on kingdom Animalia.
**Worksheet 5-1**  
The Five Kingdoms

[CATCH Name and Date lines]

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Structural Characteristics</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protista</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monera</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animalia*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plantae</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fungi</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*We will focus on kingdom Animalia."
Worksheet 5-2
Vertebrates and Invertebrates

[CATCH Name and Date lines]

The kingdom Animalia (animals) can be divided into *vertebrates* and *invertebrates*.

A *vertebrate* is: ____________________________________________________________

An *invertebrate* is: _________________________________________________________

<table>
<thead>
<tr>
<th>Examples of Vertebrates</th>
<th>Examples of Invertebrates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Activity 6
So You Think You’re a Vertebrate?

[catch box containing expectation codes: ]

Overview
Students will learn about the five classes of vertebrate and their characteristics. They will have an opportunity to view these animals live or on a video and, from their observations, use a chart to sort the characteristics that distinguish each class.

Background Information
Vertebrates can be divided into the following classes:
• reptiles
• fish
• birds
• amphibians
• mammals

Warm blooded animals maintain their body temperature within a very narrow temperature range. Each species has its own distinct normal temperature that must be maintained. For humans, normal body temperature is 37°C. When our body temperature goes above this, we say we have a fever. If the body temperature goes lower, hypothermia can result. Both situations can be life-threatening. Mammals and birds are both warm blooded.

Cold blooded animals take on the temperature of their surroundings. On a cold day, these animals are cold and usually move slowly. On a hot day, they are warm and move more quickly. Cold blooded animals can tolerate a wider temperature range than warm blooded animals. However, they cannot tolerate extremely high or extremely low temperatures, and must hibernate to escape freezing temperatures. Cold blooded animals’ life processes (metabolic rate) speed up when their bodies are warmer. They often seek warm places to rest after feeding, since warmth speeds up their digestion. Some frogs can even tolerate temperatures slightly below freezing for short periods of time.

<table>
<thead>
<tr>
<th><strong>Mammals</strong></th>
<th><strong>Birds</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Distinguishing Characteristics</td>
<td>Distinguishing Characteristics</td>
</tr>
<tr>
<td>- warm blooded</td>
<td>- body covered with feathers</td>
</tr>
<tr>
<td>- born with lungs for breathing</td>
<td>- warm blooded</td>
</tr>
<tr>
<td>- hair or fur on their bodies at some point in their lives</td>
<td>- lay eggs</td>
</tr>
<tr>
<td>- females nurse young from milk glands called mammary glands</td>
<td>- 2 wings, 2 legs</td>
</tr>
<tr>
<td>- young are born live (exceptions platypus &amp; echidna, which lay eggs)</td>
<td>- mouthparts form a beak or bill</td>
</tr>
<tr>
<td>- most have four limbs</td>
<td>- hatched with lungs for breathing</td>
</tr>
</tbody>
</table>
### Amphibians
**Distinguishing characteristics:**
- cold blooded
- most adults live on land, eggs laid in water, some spend almost entire life in water
- skin moist or slimy (except toads)
- bony skeleton
- never found in salt water
- undergo metamorphosis, i.e. egg, tadpole, frog
- young breathe with gills, adults develop lungs with permit them to live on land

**Groups:**
- with tail (salamander and newts)
- without tail (frogs and toads)

### Reptiles
**Distinguishing characteristics:**
- cold blooded
- hatched with lungs for breathing
- dry skin, usually with scales
- eggs laid on land, young hatch from eggs, resemble parents
- usually 2 pairs of limbs, except for snake
- bony skeleton

**Groups:**
- alligators and crocodiles
- snakes
- lizards
- turtles

### Fish
**Distinguishing characteristics:**
- cold blooded
- simple skeleton of bone or cartilage
- breathe through gills
- most have scales and a mucous covering
- fins for locomotion
- no neck
- 2-chambered heart
- live in water entire life (except for lungfish and some species of catfish)

**Groups:**
- bony fish skeleton
- cartilaginous fish skeleton (sharks and rays)

### Materials
- one or more videos on vertebrates showing the five classes; preferably showing movement, reproduction, and interesting members of each class
- if possible, live examples of the five classes (students’ pets from home)
- reference books (encyclopedias, animal books, etc.)
- Worksheets 6-1 and 6-2

### Teacher Preparation
- Order and preview the video(s).
- Photocopy the worksheets (one of each per student).
Instructional Strategies

Reflections

• Instruct students to reach behind them and run their hands along the ridge in the middle of their back.
• Ask them what they are feeling. They should recognize that they feel bones. It is their backbone, part of their skeleton.
• Ask students if they know what these bones are called. Introduce the term *vertebrae*.
• Ask students if they know what runs along inside the row of vertebrae. Inform students that a *spinal cord* of nerves runs along inside the backbone, and is protected by the bone. Ask, “What might happen if the backbone or spinal cord is damaged?” (Answer: The spinal cord is extremely important. Damage can cause paralysis.)
• Humans are not the only animals with backbones. Review that animals with backbones are called *vertebrates* (because they have vertebrae).
• As a review, ask students to name some of the animals they know that have backbones. If you do not have a video available, take some time over this and write the list on the chalk board.

Activity Time

With a Video
If you have been able to find an appropriate video, continue as follows:
• Hand out the worksheet to each student. Review the headings on the chart so that they know what to look for on the video. In particular, review the concepts of warm blooded and cold blooded animals.
• Give students time after the video(s) to discuss their observations in a small group and complete their charts.

Without a Video
If you do not have a video available, teach the lesson as follows:
• Introduce the terms *mammal*, *amphibian*, *reptile*, *bird*, and *fish*.
• Use the list of vertebrates you wrote on the chalk board during Reflections time. (Try to include some different animals than were discussed for Worksheet 5-2, since students will classify these later.) Ask students to help you classify the list of vertebrates into the five classes. Record your groupings on the chalk board.
• Introduce/review the terms *cold blooded* and *warm blooded*. Discuss which of the five classes are warm blooded and which are cold blooded.
• Hand out Worksheet 6-1. Working as a class, go through the worksheet identifying structural characteristics for each group. Alternatively, have students work in small groups to fill out the worksheet, then come together as a class to discuss it. If you cannot decide on the answer to a question, have students use the reference books to find out.

Wrapping Up
• If you watched the video, have a class discussion after students have completed their worksheets. Ask some questions:
  - What was the most unusual thing you learned from the video(s)?
  - What was the most interesting animal that you saw? What made it so interesting?
  - What part of the chart was difficult to fill in? Who/what can help you with that?
  - Do you see any similarities among any of the classes?
• Have students look at their completed Worksheet 5-2 from the previous activity. Using the list of vertebrates they recorded, have them classify these animals into the five classes and record their answers on Worksheet 6-2.

Building on the Experience
Interested students can learn more about spinal injuries and the research that is being done to try to repair spinal cord damage.

Assessment Suggestions/Strategies
Collect the worksheets and assess for completion and accuracy.
Worksheet 6-1  
So You Think You’re a Vertebrate?  

[CATCH Name and Date lines]

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mammals</th>
<th>Birds</th>
<th>Reptiles</th>
<th>Amphibians</th>
<th>Fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do they have a backbone?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are they warm or cold blooded?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How do they move?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is their body covered with?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How do they breathe?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How do they reproduce/take care of young?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Give some examples</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you know any exceptions? (explain why)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAMMALS</td>
<td>BIRDS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>-------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REPTILES</td>
<td>AMPHIBIANS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FISH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Activity 7
Adaptation: How Can I Fit In?

[CATCH box with expectation codes: ]

[ROLAND: This activity seems familiar—are we ok with copyright?]

Overview
The teacher will discuss with the class some adaptations that allow animals to survive in their particular habitats, then students will have an opportunity to create an imaginary bird to live in a specialized habitat. Students must justify their choices of adaptations by explaining why each adaptation helps their creature to survive.

Background Information

• adaptation: any structural or behavioural characteristic that helps a living thing survive in its habitat

Some Examples of Adaptations

<table>
<thead>
<tr>
<th>Size</th>
<th>Flight (moving away quickly from danger)</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>mice can hide easily because they are small</td>
<td>fast movement (snake)</td>
<td>camouflage (many insects are the same colour as a leaf or twig)</td>
</tr>
<tr>
<td>wolves are large, and can prey on other large animals such as caribou</td>
<td>strong muscles (rabbit)</td>
<td>bright (male birds are brightly coloured, so if danger threatens they distract the predator from female and nest)</td>
</tr>
<tr>
<td></td>
<td>big feet (rabbit)</td>
<td>dull (female birds blend in with leaves/trees)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reproduction (Seed Dispersal)</th>
<th>Hibernation/ Migration</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>burrs (attach to fur of animals)</td>
<td>bears hibernate in the winter</td>
<td>stick bugs, praying mantis</td>
</tr>
<tr>
<td>milkweed/dandelions (fluffy seed heads are blown by the wind)</td>
<td>birds migrate south for the winter</td>
<td>shaped like branches of a tree</td>
</tr>
<tr>
<td>galls (insects hide in plant stems)</td>
<td></td>
<td>birds beaks/feet (are adjusted to the food they eat and whether they swim or perch in branches)</td>
</tr>
</tbody>
</table>

Materials

• pencils and coloured pencils
• white paper and construction paper
• scissors, glue, stapler, and any other construction tools
• books with pictures of different animals to discuss adaptations
• Worksheets 7-1 to 7-3

Teacher Preparation

• Photocopy the worksheets (one of each for each pair of students).
• Have materials available for drawing or for making birds out of construction paper.

Instructional Strategies

Reflections

• All animals have special adaptations that help them survive in their habitats. Their size, their shape, their colour, their method of movement, the specific food they eat, and other behaviours all help them survive in a particular habitat.
• For example, a rabbit has sharp teeth for biting off pieces of grass and leaves. It has eyes placed on the sides of its head to be better able to see predators approaching. It has strong legs for running away from predators.
• Birds have specially adapted bones (lightweight because they are hollow), beaks (specialized for cracking seeds, filtering water for food, or tearing their prey) and feet (specialized for perching, walking, swimming, or capturing prey).
• Show some pictures of animals and point out some adaptations of those animals, or have students identify the adaptations.
• Humans have adaptations too! Brainstorm different adaptations we have that help us survive. (For example, we have flexible fingers, big brains, and strong teeth.)

Activity Time
• Hand out the worksheets. Students will work in pairs to look at the diagrams and design an imaginary bird that is adapted to a special habitat.
• Allow students to choose a habitat for their bird. Here are some suggestions:
  - a clear cut forest area with only stumps of trees and small plants.
  - a parking lot in a shopping mall that is near some grass-covered land
  - a part of the city where there are many tall sky scrapers
  - a large garbage dump
  - a schoolyard
  - an area of the ocean where there has been an oil spill
  - any other unusual habitat
• Make sure students understand that must create a bird that has adaptations to help it survive in its environment. They should consider criteria such as beak type, feet type, size, colour of male and female, materials to build a nest, location and size of nest, number of eggs, food, whether they feed at night or during the day, where they sleep, and any other specialized adaptations they may need to survive in the conditions of the chosen environment. Allow students to be imaginative—the birds don’t have to be entirely realistic.
• Instruct students write a paragraph explaining the reason for each adaptation. They should also draw, paint, or build a model of their bird that shows the adaptations.

Wrapping Up
Have the students show and discuss the adaptations that they have given their creation. The rest of the class can comment on the design and ask questions.

Building on the Experience
• Some students may wish to create an additional creature from any of the animal types (insects, mammals, reptiles, fish, amphibians) for presentation. They can create their own habitat for their creation.
• Other students may wish to look at an existing animal and determine the adaptations that allow it to survive.

Remediation
• Encourage students to look at other students’ work and explain in their own words why certain adaptations were chosen for the imaginary creatures.

Curriculum Links
The Arts: Visual Art - design proportions of the creature
Language: Oral and Visual Communication - presentation skills (voice: loudness, intonation, clarity; eye contact with audience)

Assessment Suggestions/Strategies
This assignment can be assessed for adaptations (content and explanations), presentation skills, and illustrations.
Worksheet 7-1
Adaptation: How Can I Fit In?

[CATCH Name and Date lines]

Circle a habitat for your imaginary bird from the following list (if you choose another habitat check with your teacher first):

- a clear cut forest area with only stumps of trees and small plants.
- a parking lot in a shopping mall that is near some grass covered land
- a part of the city where there are many tall sky scrapers
- a large garbage dump
- a schoolyard
- an area of the ocean where there has been an oil spill
- any other unusual habitat_____________________________________

Think about the following criteria as you design your bird:

1. What size will your bird be? Why?

2. What type of beak will it have? What will it eat?

3. Does your bird eat at night or in the day? Why?

4. Where does it sleep? Why?

5. What type of feet does it have? Why?

Worksheet 7-1 Continued _
Worksheet 7-1 Continued

6. What type of nest does your bird build (size, location, materials used)? Why?

7. How many eggs does it lay in the nest? Why? What colour are they? Why?

8. What colours are the male of the species? Why?

9. What colours are the female of the species? Why?

10. Are there any other special adaptations?

11. Remember to create an illustration of the male and female birds and their nest. Choose a way to display this information for your classmates.
Worksheet 7-2
Bird Beaks

[CATCH page of bird beaks (provided by Bev)]
Worksheet 7-3
Feet of Birds

[CATCH page of bird beaks (provided by Bev)]
Activity 8
Arthropods and Other Invertebrates

[CATCH box with expectation codes: ]

[ROLAND I used the Overview/materials/teacher prep/reflections from the page I had, then wrote the rest, adding some background information and the two worksheets to make sure students covered the expectations of classifying a) invertebrates and b) comparing arthropods.]

Overview
Bottled specimens are provided in the Resource Pack so that students can compare the body parts of various invertebrates. Live specimens are also very interesting to observe, so students can set up simple habitats and collect specimens. Students will observe a variety of invertebrates and record their observations individually. In groups, students will choose one invertebrate to research in detail. Student groups will present their findings to their classmates for evaluation.

Background Information
Although there are eight distinct phyla under the heading Invertebrates, students can classify invertebrates into just four simpler groups:

- sponges
- worms (including earthworms, tapeworms, roundworms)
- molluscs (snails, clams, squid, octopus)
- arthropods

Arthropods make up the largest invertebrate phylum. This phylum includes the following classes:

- insects
- spiders
- crustaceans such as lobsters and crabs
- many-legged animals such as millipedes

Live specimens such as the ones suggested are easy to keep in the classroom for short periods. If they have been collected from outside, they can be released back to their original habitats when the unit is finished. Animals such as mealworms could be passed on to a Grade 4 or Grade 2 class that may be working on the Habitats and Communities (Grade 4) or Growth and Changes in Animals (Grade 2) units. When these animals need to be discarded, place them in the freezer overnight to kill them [ROLAND doesn’t this seem a little harsh, after we’ve been stressing that students respect living things? But I don’t have any other suggestions...], then dispose of them in the garbage or outside in a compost. Instructions for setting up habitats for the live specimens, and suggestions on where to find them, are provided in the Appendices, p. 00.

Materials
- bottled specimens*
- live specimens (e.g., mealworms,* snails, sow bugs, worms)
- hand lenses*
- students’ science notebooks
- various books about invertebrates and arthropods, and especially about the specific specimens being studied
- Beginner’s Guide to Animal Autopsy*
- Studying Insects (transparencies)*
- Worksheets 8-1 and 8-2
*included in Resource Pack

Teacher Preparation
- A few days before this activity, have selected students assist with the collection and setting up of live specimens. (Note that this unit is best done in the fall or spring to allow for easy collection of live specimens.)
- Set out the bottled and live specimens for viewing at stations around the room.
• Have books and transparencies ready for students to view.
• Photocopy the worksheets (one of each per student).

**Instructional Strategies**

**Reflections**
Discuss with the class the proper respect for living specimens (some suggestions for viewing the live specimens are provided in the Appendices, p. 00). Students must never handle or move the animals in such a way as to harm them. This includes dropping them; students should always hold the specimens directly above a desk or lab bench, not over the floor.

**Activity Time**
• Place students in small groups for observation purposes. Each student will fill out the worksheet individually. Hand out the worksheets and assign student groups to viewing stations.
• Let students get to work. After an appropriate interval, have students rotate to a new station, continuing until students have observed and taken notes on every specimen.
• After all the specimens have been observed, come together as a group. Hand out Worksheet 8-2 and go over it with the class.
• As a class, classify each specimen into one of the four invertebrate phyla (note that these are simplified groups; there are actually eight phyla of invertebrates), and, if the specimen is an arthropod, into one of the four classes of arthropod. Alternatively, assign three or four specimens for each group to classify, then discuss them as a class.
• Working as a class or with the students in their small groups, have students compare the characteristics of different kinds of arthropods using the specimens or pictures in books. Have students count the number of legs and body parts for the different types of arthropods (see Worksheet 8-2 for more information).
Wrapping Up
- Have students work with their group to choose one invertebrate to research in detail. Student research must include finding out in which phyla of invertebrate the animal belongs and, if it is an arthropod, in which class of arthropod the animal belongs. Other questions students could find answers to include:
  - What/how does the animal eat?
  - Where does the animal live? How is it adapted to its habitat?
  - What animals prey upon (eat) this animal?
  - Does the animal have any special adaptations that help it escape predators?
  - How does the animal reproduce?
  - How does the animal breathe?

- Students will report their findings to the class as a short oral presentation.

Building on the Experience
Interested students can research more than one animal.

Assessment Suggestions/Strategies
You may or may not wish to collect Worksheet 8-1 for evaluation. Use peer or teacher evaluation to assess student presentations for:
- content
- whether all group members participated
- appropriate scientific vocabulary
- whether the animal was correctly classified
Worksheet 8-1
Observing Invertebrates

[CATCH Name and Date lines]

Use this sheet to record your observations of the invertebrates you examine. Think about these criteria:

1. What size is the specimen?
2. What colour/texture is it?
3. How many body segments does the specimen have?
4. How many pairs of legs does it have?
Worksheet 8-2
Arthropods and Other Invertebrates

[CATCH Name and Date lines]

Invertebrates can be placed into four groups, or **phyla**:

| **sponges** | • no backbone  
|            | • soft body with many holes or pores |
| **worms** (e.g., earthworms, tapeworms, roundworms) | • no backbone |
| **molluscs** (e.g., snails, clams, squid, octopus) | • no backbone  
|            | • soft bodies with a “foot”  
|            | • usually with a shell |
| **arthropods** (e.g., insects, spiders, lobsters) | • no backbone  
|            | • segmented body  
|            | • hard exoskeleton  
|            | • jointed legs |

*There are actually eight invertebrate phyla; these are simplified groups.

**Arthropods** make up the largest invertebrate **phylum** (singular of phyla). There are four classes of **arthropods**:

| **insects** (e.g., bee, mosquito, beetle) | • 3 pairs of legs  
|            | • 3 main body parts (head/thorax/abdomen) |
| **spiders** | • 4 pairs of legs  
|            | • 2 main body parts |
| **crustaceans** (e.g., lobsters, crabs, shrimp) | • 5 pairs of legs  
|            | • almost all live in water |
| **many-legged animals** (e.g., millipedes, centipedes) | • 15 to 175 pairs of legs |

**Can you classify each specimen in your class:**

a) into one of the four invertebrate phyla?

b) if it is an arthropod, into one of the four arthropod classes?
Activity 9
Who am I?

[CATCH box with expectation codes: ]

Overview
Students will use the knowledge that they have gained about vertebrates and invertebrates to create a game that they can challenge their classmates to play. They will create a game board that includes clues to help their classmates guess the chosen animal.

Background Information
Game cards should have a system of numbered ‘doors,’ with clues behind each ‘door.’ Students will request that a ‘door’ be opened, and the presenter will read the clue. Students will then have an opportunity to guess the animal (e.g., three chances). If students have not guessed, another ‘door’ can be opened and the procedure repeated until the solution is reached. The shape of the game board could vary according to the students’ creativity, or the dimensions and shape could be specified. Some suggestions appear below.

[CATCH Illustrations sent with hard copy (1/3 page)]

Materials
- construction paper
- Bristol board
- pens, pencils, coloured pencils, markers
- notebooks and resource books

Teacher Preparation
- Collect materials for students to use during this activity.
- Refer to Activities 5, 6, and 8 in particular to refresh your knowledge of kingdoms, phyla and classes so you can assist the students in their review.
- Create a list of phyla or classes that should be represented in this game (depends on number of individuals or pairs).
- Decide whether the students would benefit from working on this as individuals or whether there might be some students who would benefit from being paired up.

Instructional Strategies
Reflections
- Begin by reviewing some of the names of the kingdoms, phyla, and classes that have already been discussed (e.g., kingdom Animalia, invertebrates, arthropods, amphibians). Have students read their notes to remind themselves of the different terms.
- Ask students to recall and describe some animals and their structural characteristics.
- Explain that they will choose an animal and create clues for their classmates based on structural characteristics. These clues will be used for a guessing game called “Who Am I?”
- In order to ensure that a variety of different groups are represented, assign individuals or pairs a particular phylum or class from which to choose their animal. Alternatively, have students sign up for a particular phylum or class, limiting the number of students for each.
- Explain the format of the game card.

Activity Time
- Give students time to choose the animal. They will need to find eight to ten distinct facts to use as clues for their animal. Specify that at least three of the clues should be in the form of a comparison. For example, if they have chosen a worm, a clue could be worded, “This animal has the shape of a reptile with no legs. It does not have vertebrae.”
• Encourage comparisons between characteristics of vertebrates and invertebrates in the clues, and encourage the use of appropriate vocabulary.
• On the answer card, remind students to identify their animal by kingdom; whether it is a vertebrate or an invertebrate; and what phyla of invertebrate (i.e., sponges/ worms/ molluscs/ arthropods) or class of vertebrate (i.e., mammal/ reptile/ amphibian/ fish/ bird) it is.
• Students should include an illustration of the animal so that all students will be able to relate the clues to the animal’s structure.
• Some interesting and challenging animals could include those that do not fit exactly into a group, such as duck-billed platypus, an echidna, or a bat.

Wrapping Up
• When the game cards are complete, it is time to play the game.
• Give each presenter or pair a turn to challenge classmates to guess the chosen animal. The object of the game is to have accurate clues that do not give away the answer too quickly, so that more information is presented for students to consider. Afterwards, display the game cards around the room.

Building on the Experience
• Students should enjoy looking at the game cards when they are on display. This will reinforce the concepts that have been covered in the activity.

Extension
• Some students may want to create different game boards for the game, do more than one game card, or research an animal further.

Curriculum Links
Language: Oral and Visual Communication - The media works (game cards) and the presentation skills can be evaluated.

Assessment Suggestions/Strategies
• Assess the contents of the game cards for accuracy of information, use of appropriate vocabulary, and effectiveness of comparisons.
• Evaluate presentation skills or have students evaluate their peers.
• If you have asked students to create game boards, evaluate them for neatness and originality.
Activity 10
Take a Closer Look!

[CATCH box with expectation codes: ]

Overview
Students will learn to use a microscope so that they will be able to examine microscopic living things in the next activity. They will learn the parts of a microscope, how to set up a slide with a cover slip, what the magnification means, and how the slide is moved under the lens.

Background Information
Microscopy is important in many fields of science, extending to electron microscopes which are able to provide information about viruses and even atomic structure. Students who enjoy microscopes may wish to consider future careers such as cytology (study of cells), haematology (study of blood), histology (study of tissues), pathology (study of diseased tissues), and micro-geology (study of crystalline structure of rocks).

[CATCH labelled diagram of a microscope (1/2 page). Please provide the same diagram unlabelled for Worksheet 10-1]

<table>
<thead>
<tr>
<th>Part</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>eyepiece</td>
<td>to view the specimen</td>
</tr>
<tr>
<td>tube</td>
<td>to hold the lens in place</td>
</tr>
<tr>
<td>stage</td>
<td>to hold the slide and specimen</td>
</tr>
<tr>
<td>mirror</td>
<td>to reflect light onto the specimen</td>
</tr>
<tr>
<td>base</td>
<td>to support the whole microscope</td>
</tr>
<tr>
<td>arm</td>
<td>to carry and hold the microscope</td>
</tr>
<tr>
<td>lens (objective)</td>
<td>to magnify the specimen</td>
</tr>
<tr>
<td>clips</td>
<td>to hold down the slide and specimen</td>
</tr>
</tbody>
</table>

Answers to Review Questions
1. You should be looking at the objective from the side of the microscope, not through the eyepiece.
2. You should go back to step 6 of the rules and work forward again.
3. The image is magnified, inverted, and reversed (bigger than normal, upside down, and backwards).
4. When you move the slide to the right, the object in the microscope moves to the left. If you move the slide up, the object on the slide appears to move down.
5. On many microscopes the magnifications would be:

<table>
<thead>
<tr>
<th>Magnification</th>
<th>Objective</th>
<th>Eyepiece</th>
<th>Magnification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low power</td>
<td>4x</td>
<td>10x</td>
<td>40x</td>
</tr>
<tr>
<td>Medium power</td>
<td>10x</td>
<td>10x</td>
<td>100x</td>
</tr>
<tr>
<td>High power</td>
<td>40x</td>
<td>10x</td>
<td>400x</td>
</tr>
</tbody>
</table>

Materials
- microscopes* (you can get more from your local Resource Centre)
- glass slides* and cover slips*
- hair (students may provide this)
• feathers,* thread*
• droppers*
• Activity Card
• Worksheets 10-1 and 10-2
  *included in Resource Pack

Teacher Preparation
• Photocopy Worksheets 10-1 and 10-2 (one per student).
• Photocopy the Activity Card and cut out a letter “e” for each student, plus some extras.
• Set out enough microscopes for each pair of students to use (if there are enough).
• Provide a glass slide, a cover slip, and a dropper for each microscope (have spares on hand in case some get broken).
• Provide thread and feathers for students to view after working with the “e.”

Instructional Strategies

Reflections
• Students will work with microscopes again in Grade 8 during the Cells unit. This activity is meant to be a basic introduction to microscope use. Students will learn the parts of the microscope and what they do. They will also learn how to focus on a specimen.
• Begin the lesson by teaching the parts of the microscope. If possible, use a real microscope as a prop to illustrate the different parts and their functions.
• Hand out Worksheet 10-1 and have students label the diagram of a microscope.

Activity Time
• Before students approach the microscopes, remind them that microscopes are delicate instruments that must be handled responsibly and carefully. Caution the students never to handle broken glass with their bare hands. If a slide is accidentally broken, it should be picked up using a moistened paper towel.
• Have students follow the steps on Worksheet 10-2 together step by step with the teacher for the first time.
• Once they understand the process, allow them time to practice with other specimens.

Wrapping Up
• As a class, discuss some of the difficulties students experienced in using a microscope. Have the students suggest solutions to these problems. Insist that they use appropriate terminology for the parts of the microscope when discussing any problems.
• Have students discuss and record answers to the questions at the end of Worksheet 10-2.

Building on the Experience
• The next activity will provide more practice with the microscope. If any students are experiencing difficulties, pair them up with students who have demonstrated skill in this area.
• Interested students may wish to investigate careers that involve microscopy, or locate books in the library that contain pictures of magnified objects and specimens.

Assessment Suggestions/Strategies
• Assess students as they practice the skills needed to view microscopic specimens.
• Have students show you when they feel they have the dry letter ‘e’ in focus, and then again when they have the wet letter ‘e’ in focus, to assess their skill.
• Evaluate the worksheets for completeness and accuracy.
Activity Card

Cut out the letters on this page and hand them out to the class.

e   e   e   e   e   e   e   e   e

e   e   e   e   e   e   e   e   e
e   e   e   e   e   e   e   e   e
e   e   e   e   e   e   e   e   e
e   e   e   e   e   e   e   e   e
e   e   e   e   e   e   e   e   e
e   e   e   e   e   e   e   e   e
e   e   e   e   e   e   e   e   e
e   e   e   e   e   e   e   e   e
e   e   e   e   e   e   e   e   e
Worksheet 10-1
The Microscope

[CATCH Name and Date lines]

1. Label the different parts of this microscope.
2. Beside the name of the part, explain what this part does.

[CATCH diagram of a microscope, unlabelled, with numbered lines coming from each part of the microscope. Students will label and write a description of each part of the microscope. (1/2 to 2/3 page)]
Today you will learn how to use a microscope. It is important that you handle, use, and care for this precision instrument properly. Follow the steps below, and you will find the instrument easy and fun to use!

**Microscope Tip:** The magnifying power is determined by multiplying the X number on the eyepiece by the X number on the objective.

**Rules for Using the Microscope:**

**Part 1: Getting Ready**
1. Use the diagram on Worksheet 10-1 to locate and learn the parts of the microscope.
2. Always carry the microscope by the arm with your other hand under the base.
3. Remove the dust cover and check to see that the low power objective is directly above the opening in the stage. Place the microscope on the desk with the arm toward you.
4. Put the mirror in place under the stage. While looking into the eyepiece, adjust the mirror so that you have maximum light coming through the body tube. If you have a light source instead of a mirror, turn it on.

**Caution:** Do not allow direct sunlight to reflect on the mirror and into the microscope. You might damage your eyes.

**Part 2: Viewing the Letter “e”**
5. Place the small printed letter “e” provided by your teacher on a microscope slide. Place a cover slip on top of the letter.
6. Place this “dry mount” on the microscope so that the letter is directly over the opening in the stage.
7. **While looking from the side of the microscope,** gently turn the coarse adjustment knob to lower the objective until it is just above the paper or until it stops automatically.
8. Look through the eyepiece and slowly turn the coarse adjustment knob up until the letter comes into focus. If you don’t see the letter, check to see that it is directly over the opening in the stage, then repeat steps 7 and 8.
9. When you get the object in focus using the coarse adjustment, use the fine adjustment knob to sharpen the focus. The fine adjustment knob should not be turned more than one complete turn in either direction.
10. Practice moving the piece of paper from side to side and forward and backward. Change the focus and practice focusing again.

**Worksheet 10-2 Continued**
Worksheet 10-2 Continued

Part 3: Using Medium and High Power Objectives
11. Without moving the adjustment knobs, rotate the nosepiece so that the medium power objective is over the stage opening. Use fine adjustment to bring the object into sharp focus.
12. If you have a third objective on your microscope, your teacher will tell you if you should use this high power objective. Use only fine adjustment to focus using the high power objective.
13. Practice until you feel comfortable using the microscope.

Part 4: Using a Wet Mount
14. Remove the slide from the microscope. Remove the cover slip from the slide and add two drops of water to the letter. Carefully place the cover slip on the slide again. View this “wet mount” under the microscope.

Microscope Tip: Avoid air bubbles under the cover slip by placing the edge of the cover slip on the slide and gently lowering it onto the slide.

15. Try some other specimens as dry or wet mounts. Use a piece of your hair, a thread, or a feather. Practice focusing following the steps on this sheet.
16. Wipe the slide and cover slip with a tissue after taking apart a wet mount to reuse the slide and cover slip. Make sure that you handle them with care.

Microscope Questions
Write complete sentence answers in your science journal to the following questions:
1. Where should you be looking when turning the body tube down?
2. What is the procedure to follow when you can’t locate the object under low power?
3. How does the image of the ‘e’ appear in the microscope?
4. As you view the object through the eyepiece, in what direction does the object move if you move the slide to the right? What if you move the slide up?
5. Fill in the information and calculate the magnification below.

<table>
<thead>
<tr>
<th></th>
<th>Objective</th>
<th>Eyepiece</th>
<th>Magnification</th>
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</thead>
<tbody>
<tr>
<td>Low power</td>
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<td>Medium power</td>
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<tr>
<td>High power</td>
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</table>
Activity 11
Tiny Living Things

Overview
Students will use their microscope skills to observe and draw some microscopic living things. By observing the actions of the microscopic organisms, students will describe the ways in which these organisms meet their needs for food, water, air, and movement. Students may collect some of the specimens for observation.

Background Information
Microscopic living organisms are found in many moist or aquatic places. They tend to prefer a dimly lit location. Some can be harmed by bright sunlight, although many algae need sunlight since they are plants with chlorophyll. Tap water contains chlorine which is harmful to living organisms, but it will evaporate if the water is left to stand.

Set up different types of cultures so that there will be a variety of organisms for students to view. A hay infusion provides broken-down plant material in a form which is digestible by micro-organisms. Rice also provides nourishment. Culture containers should have a loose cover or no cover to allow oxygen to dissolve in the water.

Materials
- water (if tap water is used, let it stand overnight in an open container - otherwise use pond, puddle, or river water)
- hay or dried grass, a few grains of rice
- microscopes* (you can get more from your local Resource Centre)
- glass slides* and cover slips*
- droppers*
- Worksheet 11-1 (can be double-sided if students need more space for observation)
* included in Resource Pack

If possible, any of the following:
- small sample of compost (no large living organisms present)
- water from the bottom of an aquarium
- water from near the bottom of a pond or small stream
- masking tape and scissors (optional)

Teacher Preparation
- Prepare hay infusion samples a week in advance to allow some of the organisms to increase in numbers. A hay infusion is prepared by gently boiling water with hay or dried grass for about 10 minutes. The mixture should be cooled to room temperature or overnight before adding rice, additional pond water, aquarium water, or compost. Small aquatic plants and twigs can be added also. The culture should stand out of direct sunlight for several days.
- Get students to help you collect specimens from outdoors. Sift compost directly from the moist part of the compost pile or from piles of wood chips on paths or around gardens.
- If aquarium water is available, take the sample from near the bottom. To obtain samples of material from the bottom of an aquarium, take a glass tube or large straw long enough to reach to the bottom, and hold your finger over the opening in the top until you have it in place. Release your finger slightly and water will rise in the tube. Put your finger over the opening again when removing it from the tank. Allow the water to drain into a small beaker. Repeat this process several times until there is enough volume for class study. The same process can be
used to obtain pond or stream water for study. Alternatively, use a gravy baster. Add these samples to a hay infusion so the organisms will have sufficient food.

- Provide microscopes, glass slides, cover slips, droppers, worksheets, and specimens for each pair of students.

**Instructional Strategies**

**Reflections**
- As a class, review the rules for using a microscope. Remind students how to handle the microscopes and slides safely.
- Discuss with the students the fact that they will be handling live organisms that must be treated with respect. Remind students to wash their hands after working with the specimens.

**Optional:** Demonstrate a method for preparing a wet mount that will accommodate larger organisms:
- Cut a piece of masking tape into four thin strips and place them on the slide to form an open square the size of the cover slip.
- Put a few drops of the liquid containing the specimens into this “well” and place the cover slip on top. This results in a greater depth for the organisms to move in. It will take some practice to master. You may also want to use depression slides, although the well in these slides has different focal planes and can be difficult for students to use.

**Activity Time**
- Instruct students to prepare wet mounts from a water sample, and to search the slide for living organisms.
- Once they have located an organism, students should observe the movement and habits of the creature. If possible, they should try to watch for feeding and methods of movement.
- Have students sketch and describe the organism on Worksheet 11-1.
- Students should observe at least two organisms in a sample and, if time permits, prepare and observe wet mounts from more than one sample.

**Wrapping Up**
- Students will find it difficult to identify the organisms they observe. It is sufficient for students to draw several organisms and to describe the organisms’ behaviour.
- When students have completed their observations, have them share some of their most interesting discoveries with the rest of the class.

**Building on the Experience**
- Invite students who have difficulty finding organisms on their own slides to see other students’ slides.
- Interested students may want to bring in a few reference books to try to identify what they see. This will also give the students an idea of the variety of microscopic organisms around them.

**Curriculum Links**

**The Arts:** Visual Arts - sketching live organisms

**Assessment Suggestions/Strategies**
- During the activity, students should call the teacher over to show their organisms. Assess the validity of the observed specimen (i.e., to make sure that it is not an air bubble or a piece of debris).
- Observe students as they work together to determine if they are on task.
- Collect and evaluate the worksheets for completeness and content of observations.
Worksheet 11-1
Tiny Living Things

[CATCH Name and Date lines]

<table>
<thead>
<tr>
<th>Sketch</th>
<th>Observations</th>
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Activity 12
A Scientific Inventory

Overview
Students will identify as many plants and animals as possible in a given plot of land 1m² in size. They will describe the habitat, prepare sketches of the specimens, and then use field guides to identify their specimens.

Materials
For each group:
- 4.5 m of string*
- 6 -10 Popsicle sticks*
- scoop or plastic spoon
- hand lens*
- 2 - 3 small containers (e.g., petri dishes*)
- metre stick or measuring tape
- pencils, clipboards
- gloves (optional, but should be used by students with sensitive skin or allergies)
- newspaper in a plastic bag for students to sit or kneel on (students can provide this)
- Worksheets 12-1 and 12-2
*included in Resource Pack

Teacher Preparation
Note: Metre sticks or measuring tape can be shared between two groups. Students can supply their own garden gloves.
- Prepare a set of supplies for each group (2 to 4 students in a group).
- Photocopy a double-sided worksheet for each student.
- Choose an area where the students can spread out for their investigation (e.g., a nearby park, schoolyard, or meadow). Note that a larger variety of plants and animals will be seen in a more natural environment. Also, check the area for broken glass and any other potentially hazardous substances.
- Prepare and send out permission forms if students will be leaving the school property.

Instructional Strategies

Reflections
- Discuss expected behaviour for the trip.
- Students will be going out into an open area and spreading out on the ground. Remind them to respect the plant and animal life they see. Also, remind them that no plants are to be uprooted and no living leaves are to be removed from plants in the study area.
- Instruct students to use Popsicle sticks to push plant leaves aside gently, and observe underneath them. Students will lift any insects in the area gently into the petri dish using a scoop or a Popsicle stick. Afterwards, students will return the animals to their original location. Note: Picking up small creatures with your fingers may damage the animals.
- Caution students to observe bees, wasps, and butterflies where they are without touching them. Picking them up could injure the animal or the student.
- Interesting creatures often shelter under rocks. Remind students to remove the rock gently, make their observations, and then replace the rock gently to its original position.

Activity Time
- Inform students that they are going to be investigative scientists. They will take an inventory of the plant and animal life in the area. Ask, “Why do you think an inventory of the plants and animals in an area might be important for scientific research?”
- Hand out the supplies to each student group, then take the class to the location you have chosen.
• Make sure students spread out so there is at least 3 m between groups. Have students throw a Popsicle stick into an open area near them. This will be the centre of their plot of land. Students will then go to that area and mark out their 1m x 1m plot of land around it. Using the measuring device, students can put four Popsicle sticks at the four corners of the plot, and then tie the string around the sticks to mark out the area.

• Once the plot is marked out, students can start their inventory. Allow 20 to 30 minutes for observations and note recording.

• First, students should observe and sketch the whole plot, drawing and labelling the position of rocks, twigs, plants, and trees if there are any.

• Next, students should sketch and record information about the different individual plants, and estimate the size and number of each type of plant in their plot.

• Finally, students should observe and sketch as many animals as possible, and record whether each seems native to the environment or is just passing through. All sketches should be as accurate as possible for further identification. Have students estimate and record the dimensions of each animal along with the drawing.

• When the inventory is complete, remove the Popsicle sticks and string, collect all materials, and return them to the classroom. Make sure that nothing is left behind to litter the area.

Wrapping Up

• Upon returning to the classroom, ensure that all students wash their hands thoroughly with soap and water.

• Students will now try to identify their specimens using field guides and reference books. This is a time for students to collaborate and share their knowledge and findings so that as many organisms as possible can be identified.

• When they have completed this, begin a class discussion by posing the following questions:
  - Why did we select a site by throwing a Popsicle stick? (Answer: We wanted an unbiased selection method, a random location.)
  - What might have been different if we had marked off sites of our own choosing? (Answer: The results could be biased, and may not be as representative of the area. The inventory results would be skewed, containing more flowers or rocks or whatever attracted the group.)
  - What was the most interesting organism (plant or animal) you saw? Why?
  - What was the most plentiful plant you saw?
  - Why are inventories like this important for scientific studies? (Answer: Positive or negative changes in local plant and animal populations can be indicators of other biological changes. Often, a small change in plant and animal populations is an early indicator of more significant changes. For example, the appearance of Foxtail Grass and declining numbers of Chicory plants along roadsides is an indication of increasing salinity of the soil. A lack of significant change indicates stability in the biological system.)

Building on the Experience

• Post student reports to reinforce the content learned and allow students to view the work of others.

Extension

• Students may wish to investigate some of the non-native species that have been introduced into local surroundings, some of the problems that these have caused in the environment, and why imported species have survived so well. For example, students could study the sea lamprey, the zebra mussel, the European starling, the Norway Maple, or purple loosestrife.

Assessment Suggestions/Strategies

• During the activity, assess students’ ability to stay on task, work co-operatively, and follow instructions.

• When students have finished the identification of all organisms, collect the worksheets and mark them for completeness, care taken with sketches, descriptions, and accuracy of identification.
Worksheet 12-1
A Scientific Inventory

[CATCH Name and Date lines]

Draw a bird’s eye view diagram of the whole area of your plot. Include positions and labels for things that catch your eye when you first look at your plot (e.g., rocks, trees, shrubs, flowers, fallen branches). Label the dimensions of the plot.

Use these questions to guide your thinking:

1. Where are the biggest plants found? Where are the smallest or shortest plants?

2. Do weeds or mosses grow well in one place and not in another? Why?

3. Can you see any damage due to humans?

4. Are there many different types of plants, or does the plot contain only a few different types?

5. Why do you think these plants and animals are here?
Worksheet 12-2
Observation Sheet

[CATCH Name and Date lines]

Examine the individual plants and animals in your plot. Record your observations below.

<table>
<thead>
<tr>
<th>Sketch with Dimensions</th>
<th>Interesting Observations (Where is it? Colour? Does it move? How? Anything else?)</th>
<th>Name of Organism</th>
</tr>
</thead>
<tbody>
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</table>
Activity 13
How Can I Tell a Pine From a Spruce?

[CATCH box with expectation codes: ]

Overview
Students will learn to use a key to identify coniferous trees. They will examine several types of coniferous trees or branches. This can be done as an outdoor activity or as an in-class activity.

Background Information
Coniferous trees are trees that produce their seeds inside a cone. They often have needle-like or scale-like leaves. Most people confuse evergreen trees (trees that lose their leaves a few at a time throughout the year) with coniferous trees. Although most coniferous trees are evergreen, there are two types that are deciduous (lose their leaves all at once in the fall): the tamarack that is found in the east of Canada (Ontario); and the larch that is found in the west (Alberta). These two trees produce cones but lose their leaves in the winter.

Materials
- coniferous trees or branches from them, preferably with cones or samples of cones (approximately ten different ones if possible; include duplicates to see if the students’ identification is consistent)
- Worksheets 13-1 and 13-3 (Worksheet 13-2 is optional)

Teacher Preparation
- Locate an area with a variety of coniferous species, or collect several types of coniferous tree branches and their cones (usually found under the tree if not on the branch). Note that branches will last longer if they can be kept cool, and/or placed in a plastic bag to keep them from drying out excessively.
- If observing trees outside, number the trees that you wish the students to visit, so that they can compare their results later.
- Prepare and send out permission forms if the class will be leaving school property.
- Photocopy Worksheet 13-1 and 13-3 (one per student).

Instructional Strategies

Reflections
- Introduce the topic by talking about the use of identification keys. Many people enjoy hobbies that require plant or animal identification. Some examples include bird watching, wildflower identification, and tree identification hobbies. Keys are useful for identifying many types of plants and animals. Survey the students to see if they know anyone who participates in these activities.
- If you are going outside, remind the students that they should not remove leaves (needles or scales) from any of the trees. They should examine them on the tree. Students should not pull leaves off the branches if the activity is done in the classroom, either. It will spoil the specimen for others.
- Review the key on Worksheet 13-1 with the students. Ask them what kind of characteristics are used for the key. They should recognize that the characteristics are structural characteristics. Explain that they should begin with the characteristics at the top of the key and work down. (Note that this key is not strictly a dichotomous key. There are times when the key divides into more than two paths.)

Activity Time
- Students do not have to do their identification in any specified order; however, they should record their answers beside the appropriate number so that later answers can be compared.
- Give students adequate time to examine the specimens (approximately 3 to 5 minutes per specimen). When calculating the time spent outside, don’t forget to include travel time.
- If working outside, have students describe the whole tree and then compare the general shape with other kinds of conifers. If working inside, students will only be able to examine the leaves, branch surface, and cones. Have the students examine each specimen and record their findings.
Wrapping Up

- Have the students compare their results to see how many correct identifications they have made.
- Ask the students about any difficulties they had. Students can compare the specimen that they found most difficult to identify with the specimen they found the easiest to identify.

Building on the Experience

- If the students found this activity difficult, the process could be reviewed by other students. The steps and thinking process that leads to a conclusion could be discussed in front of the class by ‘student experts.’
- Coniferous trees are very useful to people. Some students may wish to research the many products in which conifers are used.
- Other students may be interested in using a deciduous tree identification key to identify the deciduous trees (trees that lose all their leaves at once in the fall) in the area.

Assessment Suggestions/Strategies

Evaluate Worksheet 13-3 to assess students’ ability to observe the structural characteristics and to use the identification key.

Curriculum Links

Mathematics: Data Management - reading charts and tables (key)
Worksheet 13-1
Key to Coniferous Trees in Ontario

[CATCH Name and Date lines]

[CATCH full-page key to coniferous trees in Ontario—use diagram provided by author but do not copy exactly (copyright issues—it has been taken from a book on trees)]
Worksheet 13-2
Extension: Key to Deciduous Trees in Ontario

[CATCH Name and Date lines]

[CATCH full page key to deciduous trees; use key provided by author but do not copy exactly (i.e., change wording or shape) since it has been taken from a book on trees]
Worksheet 13-3
Observation Sheet

[CATCH Name and Date lines]

<table>
<thead>
<tr>
<th></th>
<th>Foliage Type</th>
<th>Arrangement and Appearance of Leaves</th>
<th>Appearance of Twigs</th>
<th>Name of Tree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
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*Worksheet 13-1 continued*
Worksheet 13-1 Continued

<table>
<thead>
<tr>
<th></th>
<th>Foliage Type</th>
<th>Arrangement and Appearance of Leaves</th>
<th>Appearance of twigs</th>
<th>Name of Tree</th>
</tr>
</thead>
<tbody>
<tr>
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Activity 14
Dig Into the Past!

[CATCH box with expectation codes: ]

Overview
Students will complete an individual research project on the topic of fossils. They will compare fossils from the past with present-day animals. This project will be completed as a homework research assignment.

Background Information

- **fossil**: remains or traces of ancient organisms

The study of fossils provides evidence from the past that animal and plant life has changed over geological time. Many fossilized specimens are no longer alive on the earth. Some species, however, have not changed and exist on the earth in the same forms as they did in the past. Two examples are the ginkgo tree and the coelacanth. The ginkgo tree is found in Asia but has been brought to North America to be planted in urban areas because it is resistant to air pollution. The coelacanth is a marine fish that is thought to be the ancestor of land animals. It was thought to be extinct at one time, but live specimens have been discovered recently.

Materials

- student-provided resources
- resources provided by teacher (optional)
- Worksheet 14-1

Teacher Preparation

- Photocopy the worksheet (one per student).
- Collect resources for student use. Don’t forget to collect some books at a reasonable level for ESL or special needs students.

Instructional Strategies

Reflections

- Introduce the topic of the research unit. Encourage students to discuss what they already know about fossils.
- Go over the expectations for the research unit (e.g., the research project should be completed on time, should be written in the student’s own words, should include illustrations). Encourage students to find information at the library, in an encyclopedia, and from the internet. Students must include a bibliography listing the resources used.
- Make sure everyone knows when the project is due.

Activity Time

This project is meant to be a homework assignment. Encourage students to begin working on it as soon as possible so that they do not leave it all to the last day.

Wrapping Up

Collect the projects for assessment.

Building on the Experience

Remediation

Show students some different levels of projects so they can see what makes an excellent project as compared to a poor one. Provide feedback in the form of suggestions for improvement.

Curriculum Links

Language Arts: Writing - Assess students’ work for spelling, grammar, capitalization, and punctuation.
**Assessment Suggestions/Strategies**
Assess the projects for content (adequate information, written in student’s own words) and presentation (appearance of the project: neatness, illustrations).
Worksheet 14-1
Fossil Research Project

[CATCH Name and Date lines]

• Answer the following questions to complete your research. Remember to write out your answers in complete sentences in your own words.
• This page is for your rough notes only. Do not use this paper for your final copy.
• You must provide a bibliography of all the resources that you used. Your teacher or the librarian can show you how to write this down.
• Make sure that you use more than one resource to complete your work. Always write down your source whenever you are making jot notes.
• Include illustrations to help explain your answers. These may be drawn, photocopied, or downloaded from the computer.

Questions:
1. What is a fossil?

2. How is a fossil formed?

3. What are the different types of fossils that are found? (Some are preserved in different ways.)

4. How do fossils provide evidence of changes in animals over geological time?

5. Compare some similarities and differences between the fossilized animals of the past and the animals of the present?
Activity 15
Design Your Own Investigation

[CATCH box with expectation codes: ]

Overview
Students will design an experiment to determine whether certain insects or other animals will grow larger if given large quantities of food. Students need to know what their chosen organism eats, and what other conditions must be provided. They will ensure that they have designed a fair test. The results will be communicated to the class in the form of a presentation.

Background Information
The animals used earlier in this unit may be used for this activity. Alternatively, insects may be purchased at a pet store. Crickets are sold as food for lizards. Pond snails can be purchased also.

Materials
• student-provided materials (teacher may assist with some of their needs)
• Investigation Folio (located in the Appendices, p. 00)

Teacher Preparation
• Photocopy the Investigation Folio (one per student or per group).
• Collect materials for student presentations (Bristol board, paper, construction paper, markers, etc.).

Instructional Strategies
Reflections
• Have students discuss the elements of a fair test (e.g., investigate only one variable; keep other variables constant).
• As a class, decide on a maximum time for the investigation. Stress the importance of deciding a plan before beginning the actual activity.
• Review the Investigation Folio as a class, making sure that everyone understands what to do.

Activity Time
• Students will work in groups of 4 to 6. They must prepare a plan for this investigation and have it approved by the teacher before they begin.
• As students work with their groups to decide on their plans, circulate and ask questions such as:
  - What organism has your group chosen? Why?
  - How will you provide a habitat for it?
  - What is the question you wish to answer?
  - What materials will you need? Where will you obtain your materials?
  - Which variables will you hold constant? Which variable are you going to change?
  - How will you know if the change has an effect on your organism?
  - What will you measure?
• When the group’s plan is approved, students should begin to collect their materials and bring them in to the class to set up their investigation. Allow class time for students to set up the investigations, and allow some time each day for maintenance and observations.
• Remind students that no investigation is a failure. It is up to the group members to observe and analyse what has happened, even if the results are different from what they expected.

Wrapping Up
When the investigations are complete, groups will present their procedure, results, and conclusions to their classmates. Allow opportunity for questions and discussion.

Building on the Experience
Student and class discussion of each presentation will help students understand their observations and conclusions.

Interested students may wish to continue caring for their organisms, or may wish to repeat their work while incorporating some of the suggestions for improvement generated by the group or the class.

**Curriculum Links**

**Language:** Oral and Visual Communication - presentation skills and preparing media works to illustrate their findings

**Assessment Suggestions/Strategies**

- Use peer or teacher assessment to evaluate the groups’ abilities to work together co-operatively during the planning, setting up, and maintaining of the investigation.
- Assess the group presentation for clarity, content, organization, and the participation of all members.
- You may want to assess the presentation for the Oral and Visual Communication skills displayed.
Activity 16
Let’s Go to the ROM! (Optional)

[CATCH box with expectation codes: ]

Overview
The ROM has an excellent insect gallery that is available for classroom use. The Discovery Centre can also be booked for hands-on investigation. Students will compare the arthropods they have already examined with preserved and fossil specimens in the museum collection, looking at adaptation and natural interrelationships.

Materials
• clipboards
• pencils
• permission forms
• Worksheets 16-1 and 16-2

Teacher Preparation
• Photocopy and send out the permission forms. Ask for parent volunteers to accompany the class.
• Photocopy the worksheets (one of each per student, plus one extra sheet of Worksheet 16-1 Continued per student). Photocopy a few extra sheets for students who may run out of space.
• Collect enough clipboards so each student can have one.

Instructional Strategies
Reflections
• Review behaviour expectations for the field trip. Have students look over the worksheets so that they are aware of what they need to focus on during the trip.
• Assign groups to travel with each adult supervisor.

Activity Time
Students will go to the ROM and view the insect gallery exhibits. They will use the displays to gather information to complete their charts. After completing their charts, students should focus on the questions on Worksheet 16-2. Encourage them to discuss possible answers with their group members.

Wrapping Up
Upon return, have a class discussion about what students observed at the ROM. As a class, review the answers to the questions on Worksheet 16-2.

Building on the Experience
Students can do further research on any of the arthropods that they have seen during the field trip using videos, picture books, or the internet.
Assessment Suggestions/Strategies

- Observe students during the field trip. Provide a checklist for all adult supervisors which includes space to record information about the students’ behaviour, their co-operation with the other members of the group, and their ability to remain on task.
- Collect and evaluate student worksheets for completeness and accuracy of details.
Worksheet 16-1
Let's Go to the ROM!

[CATCH Name and Date lines]

Fill out the charts on this page and the following pages with your observations. Try to include 3 to 5 fossil specimens. Ask your teacher for more worksheets if you need them.

<table>
<thead>
<tr>
<th>Arthropod #1</th>
<th>Arthropod #2</th>
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<tr>
<td>Name:</td>
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<td>Sketch:</td>
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<td>Size</td>
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<td>Texture</td>
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<tr>
<td># of Pairs of Legs</td>
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<tr>
<td># of Body Segments</td>
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<tr>
<td>General Notes</td>
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Worksheet 16-1 continued
Worksheet 16-1 Continued

[CATCH Name and Date lines]

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<th>Arthropod #:</th>
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<td>Name:</td>
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<td>Sketch:</td>
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<td># of Pairs of Legs</td>
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<td># of Body Segments</td>
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<tr>
<td>General Notes</td>
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</tbody>
</table>


Worksheet 16-2
What Did You See at the ROM?

[CATCH Name and Date lines]

These questions will help you frame your thoughts about what you have observed. You may have other observations or reflections you would like to add.

1. Describe the range in size and shape of the arthropods you observed.

2. How did these arthropods compare to others you have already observed in class? (Describe similarities and differences.)

3. How would you explain some of these differences? What adaptations have you observed?

4. Were there any characteristics you found surprising/interesting?

5. What other animals do arthropods depend on for food?

6. How did ancient arthropods (fossil specimens) differ from modern-day specimens?
Activity 17
Think About What You’ve Learned

[CATCH box with expectation codes: ]

Overview
By now, students will have a better understanding of what “diversity of living things” really means. This activity asks students to reflect on their learning and identify some of the most interesting things that they have learned.

Materials
- student notes
- Worksheet 17-1

Teacher Preparation
Photocopy the worksheet (one per student).

Instructional Strategies
Reflections
- Begin a class discussion reviewing some of the highlights of this unit (classification, kingdoms, invertebrates/vertebrates, arthropods, interesting animals, fossils, etc.).
- Encourage students to talk about what they remember and to look into their notes and records of activities to refresh their memories.

Activity Time
Hand out Worksheet 17-1 for students to complete. Students may use their notes to assist them with their responses, or you may choose to have them review their notes beforehand. Give everyone adequate time to complete the work. Some may need longer than others.

Wrapping Up
Discuss the answers to Worksheet 17-1 after everyone has finished or after you have collected and assessed the worksheets. Allow time for students to discuss their own answers and figure out what they missed.

Assessment Suggestions/Strategies
- Evaluate the worksheet for accuracy and completeness.
- You may wish to use the ASAP Performance Tasks and/or Test Items, included in the Appendices, p. 00.
**Worksheet 17-1**  
**Think About What You’ve Learned**

[CATCH Name and Date lines]

At the beginning of this unit, you went outside to look at different animal and plant species found in your neighbourhood. Name and sketch the three most interesting or unusual ones that you observed. Explain why you thought they were interesting.

<table>
<thead>
<tr>
<th>Name and Sketch</th>
<th>Why is it Interesting or Unusual?</th>
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</tbody>
</table>

*Worksheet 17-1 Continued*
Answer the following questions in complete sentences.

1. What are classification systems?

2. Besides classifying animals, how are classification systems used in our everyday surroundings?

3. What do animals need to survive? (Hint: Think about what you need to provide in a container to keep an animal alive.)

4. What is meant by cold blooded and warm blooded animals?

5. What type of characteristics are used in animal classification systems?

6. How do we know that animal life has changed over geological time?
APPENDIX I: RESOURCES

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APPENDIX I: RESOURCES

RELATED RESOURCES
[ROLAND as you can see, we’re missing some bibliographic info. Is this ok for the field test, or can you ask the authors for the missing info?]

Fiction

Non-Fiction
Burgett. Science. Scholastic
Flanagan, Teliatnik, Christopher. Focus on Science. D.C. Heath Canada, Ltd.

Park. The Beginner’s Guide to Animal Autopsy. Scholastic

Non-Fiction for Enrichment
Bassano, Sharron and Mary Ann Christison. Life Science, Content & Learning Strategies_Star Science Through Active Reading Series
Discover the Wonder (Grade 6 text). (available in thematic modules or as a text; pertinent modules are: The Living Planet; Adaptations; and Wetlands: Making Decisions)
Biology – The Web of Life (text # 0-201-86954-3; teacher’s edition # 0-201-86955-1)

Interesting Resources Available Through Marsha Feldberg Associates
phone: 905 709 4118/fax: 905 709 1803
mfeldassoc@trebnet.com (Exclusive Educational Products)

Excellent transparencies, wall charts, and mini units are available from Milliken:
Grade 2 - 3 Level for ESL Students
Life in our Backyard #B6035
Life in the Desert #B6037
Life in a Pond #B6039

Grade 3-4 Level for ESL Students
Insects #B6044
Feathers #B6042
Animal Life Cycles #B2883
Explorations in Life Science #B1428

Grade 7 Level for Enrichment
#B6-51

Wall charts
The Frog #5249
The Earthworm #5251
The Bug #5280
Materials From Kendall Hunt
Investigating Animals and Their Needs (ESL - Gr. 1 level)
Investigating Life Cycles (ESL - Gr. 3 level)
Investigating Ecosystems (ESL - Gr. 5 level)

Materials From World Book
Animal Kingdom CD Rom set
Make it Work! Insects #3949

Ecology Series
Life in the Deserts
Life in the Mountains
Life in the Oceans
Life in the Polar Lands
Life in the Rain Forest
Life in the Woodlands

Info-Adventures (for ESL)
Amazing Animals
Dangerous Animals

Videos
Amphibians (Eyewitness)
Amphibians (Wonder Why)
Animal Predators and the Balance of Nature (Magic Lantern)
Animals #9 (Wonder Why)
Animals with Backbones (Magic Lantern)
Birds (Eyewitness)
Fish (Wonder Why)
Insects #16 (Wonder Why)
Insects (Eyewitness)
Mammals (Wonder Why)
Plants and Animals Depend on Each Other (Magic Lantern)
Reptiles (Wonder Why)

CD-ROM
The Animal Kingdom CD-ROM Set by World Book
Endangered CD-ROM Set by World Book

Web Site
http://sccao.oise.utoronto.ca/tdsb
GLOSSARY

adaptation any structural or behavioural characteristic that helps a living thing survive in its habitat (e.g., size, flight, colour, seed dispersal, hibernation, shape)

amphibians a class of vertebrates that are cold blooded, generally have moist or slimy skin, and undergo metamorphosis; the young live in the water and breathe with gills, while the adults develop lungs to permit them to live on land

animals (kingdom Animalia) living things that eat and move around, and do not contain chlorophyll

arthropod the largest invertebrate phylum, including insects, spiders, crustaceans, and many-legged insects such as millipedes; arthropods have segmented bodies, hard exoskeletons, and jointed legs

behavioural characteristics the way that a person or organism acts or responds to events or stimuli; including likes, dislikes, fears

birds a class of vertebrates that have bodies covered with feathers, are warm blooded, lay eggs, have two wings, two legs and lungs, and whose mouthparts form a beak or bill

classification system a system in which a set of objects is sorted or classified according to the particular characteristics found in the members of the set

cold blooded animals that take on the temperature of their surroundings

coniferous trees that produce their seeds inside a cone and often have needle-like or scale-like leaves

deciduous trees that lose their leaves all at once in the fall

dichotomous key a classification system that divides a set of objects into two groups at every level until they can no longer be separated into two groups; often used in identification keys
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>evergreen</td>
<td>trees that lose their leaves a few at a time throughout the year</td>
</tr>
<tr>
<td>fish</td>
<td>a class of vertebrates that are cold blooded, live in the water, breathe through gills, and use fins for locomotion</td>
</tr>
<tr>
<td>fossil</td>
<td>remains or traces of ancient organisms</td>
</tr>
<tr>
<td>fungi</td>
<td>living things that do not move around, absorb nutrients from dead or living organisms, and do not contain chlorophyll</td>
</tr>
<tr>
<td>habitat</td>
<td>the environment in which a plant or animal lives (or is naturally found)</td>
</tr>
<tr>
<td>invertebrate</td>
<td>an animal without a backbone (e.g., worm, snail, ant, bee); many invertebrates have hard shells or outer body coverings called exoskeletons (e.g., beetle, ladybug)</td>
</tr>
<tr>
<td>mammals</td>
<td>a class of vertebrates that are warm blooded, have lungs, hair/fur, and generally four limbs; the females nurse the young from milk or “mammary” glands</td>
</tr>
<tr>
<td>moneran</td>
<td>(kingdom Monera) a living thing that can be seen only with a microscope, and does not contain a nucleus</td>
</tr>
<tr>
<td>physical characteristics</td>
<td>the way a person or organism looks; its appearance; including colour, height, weight</td>
</tr>
<tr>
<td>plants</td>
<td>(kingdom Plantae) living things that produce their own food through photosynthesis, and contain chlorophyll (a green pigment used during photosynthesis)</td>
</tr>
<tr>
<td>protists</td>
<td>(kingdom Protista) living things that can be seen only with a microscope, and contain a nucleus</td>
</tr>
<tr>
<td>reptiles</td>
<td>a class of vertebrates that are cold blooded, have dry and/or scaly skin, lay eggs on land, and breathe with lungs</td>
</tr>
<tr>
<td>structural characteristics</td>
<td>the way a person or organism is structured; the way the parts are put together; including the number of legs, body parts, eyes</td>
</tr>
<tr>
<td><strong>tree diagram</strong></td>
<td>a hierarchy classification scheme named for its resemblance to an inverted tree; each category becomes more specific and more exclusive the further one proceeds.</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>vertebrate</strong></td>
<td>an animal with a backbone (e.g., human, dog, snake, bird)</td>
</tr>
<tr>
<td><strong>warm blooded</strong></td>
<td>animals that maintain their body temperature within a very narrow temperature range</td>
</tr>
</tbody>
</table>
INSTRUCTIONS FOR SETTING UP A MEALWORM HABITAT

Mealworms are the larvae of the beetle. They are very easy to raise in captivity. They have been a pest problem over the last hundred years wherever milled grains such as flour, oatmeal, bran, or corn meal are kept. In the wild, these beetles live and breed in bird’s nests and can be found in chicken coops. The larva are hardy and can be handled for observation. They have nocturnal habits (they are active at night). The larva hatch from eggs that are laid by the adult beetle. When they are large enough, adults emerge. Because they’re considered as pests, take care to keep them from escaping from their container. They may invade the staff room or the family studies area. They are not dangerous to humans.

For mealworm habitats, use a large plastic or glass jar with metal or fabric mesh to cover the jar opening. Make sure the lid is tight fitting so the mealworms will not escape. A preserving jar with a two-part lid makes it possible to remove the inside of the lid and replace it with mesh, and the lid is easy to tighten. Fill the jar to a depth of 5 - 10 cm with a mixture of bran and rolled oats (not the instant oatmeal cereal; use plain rolled oats for baking), about half and half. Cut three circles of paper towels, dampen them, and place them over the top of the oatmeal/bran mixture. Add about two to three dozen mealworms. Place a slice of apple or potato on top for food and moisture. Don’t be concerned if one to five larvae die. This is normal. The larva will pupate (turn into a pupa) between the layers of paper towels before emerging as adults. To maintain the culture, the bran/oatmeal mixture should be kept moist at all times (but not wet). Watch the mixture. When it becomes powdery, transfer the mealworms to a new mixture. Remember, the mealworms live in what they eat.

Mealworms can be purchased at most big pet stores. They’re sold as food for lizards and amphibians. The female beetle lays 500 - 600 eggs and, at room temperature, they will hatch in 10 to 12 days. The larva mature in 4 to 6 months. The pupa stage lasts two to three weeks and adults may live 2 to 3 months.

When observing the larva, scoop some mealworms and mixture into a small margarine tub using a plastic spoon. Do not pick up the larva with your fingers, but scoop one up using the spoon, and transfer it to your hand. It will crawl on your hand, so make sure that it is held low over a desk or counter in case it crawls over the edge.

[CATCH illustration of mealworm habitat—see author’s diagram]
INSTRUCTIONS FOR SETTING UP A SOW BUG HABITAT

Sow bugs or pill bugs are very common land crustaceans. They can be found under logs or rocks in shady areas. Lifting up a rock will usually uncover several of them. They’re often incorrectly called “potato bugs,” but they do not really have any connection with potatoes. They feed on dead leaves and wood, and are part of the decomposer team that reduces the fallen leaf litter to soil and enhances compost in the forest. When kept in a container, it is interesting to see the way the skeletonize the leaves, leaving only the leaf veins. Sow bugs and pill bugs breathe through gills and must remain in a moist environment. Sow bugs, when disturbed, will “play dead.” Pill Bugs, when disturbed, will roll up into a little ball (hence the name, pill). They are closely related and are often found together.

In captivity, keep them in a container with soil at the base and sticks and dead leaves on top. Keep the container moist by lightly watering the soil periodically. The container can be a large, clean jar. The lid should have a few holes (made by hammering a nail through the metal to pierce it). Alternatively, keep them in a small glass aquarium with a glass lid. The glass lid can be cut at most hardware stores to fit the opening. Ask for a smooth or polished edge to prevent cuts from sharp edges. This is a very versatile animal container, and not too expensive to buy.

Once you have decided on your container, prepare it for the sow bugs. Take soil from outside (this may have some other interesting creatures present, also) or use potting soil to fill the container about 3 - 5 cm deep. Cover the soil with about 10 cm of dead leaves and twigs. For interest, add some pieces of moistened newspaper. Newspaper is made of wood pulp and is easily digested by the sow bugs and pill bugs. Water the soil. The habitat is ready to add the creatures.

In order to observe these crustaceans, place a moistened paper towel in an open container (e.g., a bin or tray). The crustaceans can be placed on the paper towel for observation. If the students wish to handle the crustaceans, their hands should be moist so that the crustaceans can remain moist for “breathing.” Use hand lenses to see more detail. Sometimes “baby” sow bugs can be observed dropping out from underneath the adults. They are pinkish grey and look like miniature replicas of the adults.

[CATCH diagram of sow bug habitat—see author’s drawings (1/2 to full page)]
INSTRUCTIONS FOR SETTING UP A WORM HABITAT

There are many species of worms, but a distinction will only be made here between garden earthworms (found on the sidewalk after a rain) and compost or manure worms found in an indoor or outdoor compost pile. Garden earthworms are usually large, somewhat grey, and do not like to be crowded in a container. They are very territorial and do not like to be too close to other members of their species. Their size makes them easier to observe with a hand lens. They cannot be kept for very long in a container and should be released after a week, or two weeks if they are maintained in a cool place. Compost or manure worms (sometimes called red wigglers) are usually small, reddish in colour, and are not territorial. They can be fairly crowded in their container and, as long as they are well fed, they survive quite happily for a long time. Neither type of worm likes high light conditions; they will stay under the surface as long as it is light out. Worms must be kept moist because they “breathe” by absorbing oxygen dissolved in the moist coating covering their entire body. They must not be submerged in water or they will drown. This explains why worms take refuge on the sidewalk when it rains: their tunnels are flooded.

You can make a container for worms out of a shoe box that is lined with plastic to keep it from leaking. Keep the lid on at all times, particularly at night, since worms will tend to crawl into the darkness and will be dead by dehydration in the morning. An alternative container is a plastic bin (not clear) with a tight fitting lid. If planning to keep a worm compost for a prolonged period, drill tiny holes in the bottom of the bin, and raise it off the table or counter a little to allow air circulation under the bin. A plastic grid used for fluorescent lights works well.

If keeping garden earthworms, fill the box or bin with outdoor or potting soil through which the worms can tunnel. Outdoor soil is most suitable. To feed the worms, add leaves, fruit peelings or cores, and vegetable parings to the surface of the soil. Remember to chop them into small pieces. The worms will crawl out at night and pull the food down. You may also see the presence of worm castings (looks like little piles of mud) on the surface after a day or so. Ensure that the soil is kept moist but not wet. These worms can be collected just after a rain from the sidewalk or by digging down about 30 cm into the soil in a garden or meadow.

If keeping red wigglers, fill the box or bin half full with shredded (easily done in a paper shredder) and moistened (wet in the sink and then allow it to drain) newspaper. Do not use fine paper as the edges are sharp enough to cut the worms. Chop up food scraps (fruit and vegetables) and bury them throughout the newspaper. There is no need for soil. The worms will digested this paper and scraps into a soil-like substance known as compost. Maintain this mixture to be moist but not wet. These worms are found in compost piles and can be acquired by digging down in a compost file, or by sorting outdoor small red worms.

In order to observe the worms, place a moistened paper towel in an open container (bin or tray). Place the worms on the paper towel for observation. If students wish to handle the worms, their hands should be moist so that the worms can remain moist for “breathing.” Use hand lenses to see more detail.

[CATCH diagram of worm habitat – see author’s drawings (1/2 to full page)]
INSTRUCTIONS FOR SETTING UP A SNAIL HABITAT

Land snails or pond snails are easy to keep. Land snails need to be moist, but will drown under water. Pond snails need to be kept under water. Land snails can be found in meadows and woods under leaf litter, after a heavy dew, or during a rainy drizzle; or, in a garden early in the morning. Land snails have a shell that is marked with alternating bands of beige and brown spiralling around the shell. They feed on vegetation. If no land snails can be found, slugs can be collected instead. These are commonly found in grass or gardens. Slugs can live happily in a container that would be used for land snails, but they need to eat slices of apple, lettuce, or fruit rinds and occasionally, rat chow. Pond snails can be found in local ponds, streams, and rivers. Their shell is usually brown, but it can vary in shape from being curled like a ram’s horn to spiralling, to pointy at the end. They feed on algae and aquatic plants. Pond snails cannot be taken out of the water to be observed.

Make a container out of a jar for either snail type. Place a lid on the land snail container; however, this is not necessary for the pond snail. An aquarium similar to the one described for sow bugs can also be used. A lid on a pond snail aquarium is not necessary, but it does reduce evaporation and keep out dust.

In the container for land snails, create a habitat by adding soil mixed with finely broken egg shells (for calcium to be incorporated into the shell) and a little sand to keep the soil from packing down hard. The snails like to dig under the surface to lay their eggs. If you have more than one snail, there is a strong probability of having eggs laid and having them hatch into tiny snails. Adult snails are hermaphrodites, which means they contain both male and female organs. They are able to breed with any other snail of their species that they happen to meet. Slugs enjoy the same habitat. They, too, need to be kept moist.

Pond snails should be kept in a sample of the water from which they have been taken. When adding more water to the container, set the water out in an open container overnight, and then add it to the snails. This gives time for most of the chlorine to evaporate, and bring the new water to the same temperature as the water in the container. Sudden temperature changes will kill snails. They will lay their eggs on the glass walls or on the plants in a jelly-like blob. With a hand lens, it may be possible to see the snail embryos developing in the clear egg cases. Pond snails are also hermaphrodites.

Land snails prefer Romaine lettuce, but the students may wish to experiment with small quantities of native plants from areas to see if they will eat it, too. Pond snails can eat lettuce and aquatic plants (these can be purchased at an aquarium store or a student may have extra from their aquarium). Pond snails will also eat Romaine lettuce if small pieces are floated on the water.

In order to observe the land snails for the activity, place a moistened paper towel in an open container (bin or tray). Place a piece of Romaine lettuce on the paper towel. Place the land snails on the lettuce for observation. If the students wish to handle the snails, their hands should also be moist so that the snails can remain moist for movement. Use hand lenses to see more detail. The snail could also be placed on a black piece of construction paper to observe the slime trail that it leaves behind wherever it goes. The snails actually slide on their slime trail. Students may observe silvery slime trails on the sidewalk on the way to school.

[CATCH diagram of snail habitat (1/2 to full page) – see author’s diagram]
APPENDIX II: ASSESSMENT

ASAP PERFORMANCE TASK: MUSEUM CURATOR

**Overview:**
The students will demonstrate their understanding of the similarities and differences between different groups of living things by designing a model of a display case that shows how classification of animals is based on their similarities and differences.

**Materials:** a variety of sizes and types of paper, markers or pencil crayons, glue, cardboard boxes for each group of students, cardboard scraps, found materials

**Time Required:** 3 days (at home or in class)

**Type of Activity:** hands on (paper and pencil if they decide to make a poster)

**Student Grouping:** Individual or pair/share

**Safety:** scissor safety

**Teacher Tips:**
1. Remind the students to complete their work in detail and include sufficient information to show the similarities and differences between the different groups of animals.

2. Students might just choose crustaceans and birds. Try to ensure that the class chooses from all classes and phyla.

3. **Prior knowledge** should include an understanding of the characteristics of vertebrates and invertebrates; the similarities and differences among vertebrates and invertebrates; formal classification systems based on structural characteristics.

4. **Prior skills** to be developed include compiling and recording data through investigation; designing structures.

5. **Communication skills** could be assessed by:
   - paper and pencil (written notes and descriptions)
   - oral presentations
   - student/teacher conference
ASAP PERFORMANCE TASK: MUSEUM CURATOR (CONTINUED)

Evaluation: Students can be evaluated on:

understanding basic concepts - describing the similarities and differences among vertebrates and invertebrates; describing the classification system they used

design and inquiry skills - initiating and planning; performing and recording; analyzing and interpreting

communication skills - clarity and precision of supporting evidence; clarity and precision of vocabulary
You have been asked by the National Museum of Science to put together a new display case showing the diversity of living things. The display case will show the similarities and differences between the different phyla (vertebrates, invertebrates) and the different classes. Your task is to design a model of a display case that the Museum would be able to use. Your display case should be organized so that visitors will be able to see clearly the different classes of animals. A written description should be included with your display.
ASAP PERFORMANCE TASK: LOST AND FOUND

**Overview:**
Students will prepare a presentation to identify an unfamiliar animal using a formal classification system.

**Materials:**
art/writing supplies, research materials (books, encyclopedia, videos, Internet)

**Time required:**
2 x 40 minute periods

**Type of activity:**
research

**Student grouping:**
individual or pair/share

**Teacher Tips:**
1. The school librarian could be involved in this task. S/he could provide the research time and materials, teach research skills/techniques and provide access to the Internet.

2. **Prior knowledge** should include an understanding of formal classification systems based on structural characteristics; the difference between warm- and cold-blooded animals; the differences between vertebrates and invertebrates.

3. **Prior skills** to be developed include compiling data through investigation; communicating the results for specific audiences using media works, oral presentations and written notes and descriptions.

4. **Communication skills** could be assessed by:
   - paper and pencil
   - oral descriptions (media works/drawings)
   - student/teacher conference

**Evaluation:**
Students can be evaluated on:

**Understanding basic concepts** - using a formal classification system based on structural characteristics; recognizing that regulating body temperature is the essential difference between cold and warm-blooded animals; differentiating between vertebrates and invertebrates

**Design and inquiry skills** - initiating and planning; researching and recording; analysing and interpreting

**Communication skills** - clarity and precision of supporting evidence; clarity and precision of vocabulary
STUDENT WORKSHEET: LOST AND FOUND

You have discovered an unfamiliar animal in the forests of Brazil. Biologists have asked you to prepare a presentation for the scientific community, using a formal classification system, which will identify this animal.

In your presentation, consider the following:

a. the animal’s structural characteristics (type of skeleton, circulatory system, reproductive system)

b. the animal’s physical appearance

c. is the animal warm- or cold-blooded? How do you know?

d. is the animal a vertebrate or an invertebrate? Why? Describe it
ASAP PERFORMANCE TASK: POND STUDY

Overview:
Students will examine samples of micro-organisms either from a visit to a pond, a video, or ready-made slides in order to describe how micro-organisms meet their daily needs.

Materials: 
for the pond study: nets, containers, hand lenses, clipboards, writing materials, microscopes, slides
for the video: a video on pond study
for the slides: ready-made slides, microscopes

Time Required: 2 X 40-minute periods

Type of Activity: individual or pair/share

Safety: Pond study: Review safety rules prior to the field trip. Consider sun blocks, hats, allergies, boundaries, buddies.

Teacher Tips:
1. Prior knowledge should include an understanding of the characteristics of micro-organisms; how micro-organisms meet their basic needs; the tools necessary to gather and examine micro-organisms.

2. Prior skills to be developed include the use of a microscope; identification techniques/skills; observing; recording.

3. Communication skills could be assessed by:
   - paper and pencil (board game, computer game)
   - oral descriptions/presentations
   - student/teacher conference

Evaluation: Students can be evaluated on:

understanding basic concepts - describing the ways in which micro-organisms meet their daily needs; identifying the tools necessary to assist their observations

design and inquiry skills - using the microscope and describing its functions; initiating and planning; performing and recording; analyzing and interpreting data

communication skills - clarity and precision of supporting evidence; clarity and precision of vocabulary
STUDENT WORKSHEET: POND STUDY

Your task is to teach students in another class about the micro-organisms found in a pond.

A. Visit a pond and collect micro-organisms.
   or
B. View a video on micro-organisms.
   or
C. Examine slides of micro-organisms.

In your presentation consider:

- why your sample is a micro-organism

- the characteristics of micro-organisms

- the tools you used or would use to catch and examine these micro-organisms

- the ways in which micro-organisms catch food, eat, digest food, move and respire

- the ways in which micro-organisms adapt to their environment

- why it is important to maintain the habitat of these micro-organisms.
ASAP TEST ITEMS

1. Check (√) the box which describes invertebrates.
   - [ ] have backbones
   - [ ] have endoskeletons
   - [ ] have exoskeletons
   - [ ] none have skeletons

2. Check (√) the box to identify the arthropods.
   Examples of arthropods are:
   - [ ] insect
   - [ ] oyster
   - [ ] clam
   - [ ] spider
   - [ ] crayfish
   - [ ] octopus
   - [ ] snake
   - [ ] squid
   - [ ] lion
   - [ ] snail

3. Check (√) the box to identify the molluscs.
   Examples of molluscs are:
   - [ ] insect
   - [ ] oyster
   - [ ] clam
   - [ ] spider
   - [ ] crayfish
   - [ ] octopus
   - [ ] snake
   - [ ] squid
   - [ ] lion
   - [ ] snail
4. How are warm-blooded animals different from cold-blooded animals? Circle the correct answer.
   
   A. Warm blooded animals have a higher metabolism in warm weather.
   B. Warm blooded animals are more aggressive in captivity.
   C. Warm-blooded animals always have a higher blood temperature.
   D. Warm-blooded animals normally maintain a fairly constant internal temperature at all air temperatures.
   E. Warm-blooded animals are found only in warm climates.

5. What features do most insects have? Circle the correct answer.

<table>
<thead>
<tr>
<th>Number of LEGS</th>
<th>Number of BODY PARTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. 2</td>
<td>4</td>
</tr>
<tr>
<td>B. 4</td>
<td>2</td>
</tr>
<tr>
<td>C. 6</td>
<td>3</td>
</tr>
<tr>
<td>D. 8</td>
<td>3</td>
</tr>
</tbody>
</table>

6. What features do most crustaceans have? Circle the correct answer.
   
   A. They live in water; they have exoskeletons; they have eight legs
   B. They have jointed feet and legs; they have exoskeletons; they live in water
   C. They have inner skeletons; they bear their young alive; they have body coverings of scales
   D. They have claws; they have inner skeletons; they live in water
7. Complete the following chart describing the characteristics of these vertebrates.

<table>
<thead>
<tr>
<th>Vertebrates</th>
<th>Move:</th>
<th>Breathe:</th>
<th>Produce young:</th>
<th>Body covering:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amphibians</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reptiles</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. Explain why formal classification systems of animals are not based on physical appearance or behaviour.

9. Investigate how an animal, such as the tiger, has changed over time. How do we know what the animal looked like (e.g., the sabre tooth tiger)?
### ASAP UNDERSTANDING BASIC CONCEPTS

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Understanding of basic concepts</strong>&lt;br&gt; <strong>MET (page 13)</strong></td>
<td>- shows understanding of few of the basic concepts&lt;br&gt;- demonstrates significant misconceptions&lt;br&gt;- gives explanations showing limited understanding of the concepts</td>
<td>- shows understanding of some of the basic concepts&lt;br&gt;- demonstrates minor misconceptions&lt;br&gt;- gives partial explanations</td>
<td>- shows understanding of most of the basic concepts&lt;br&gt;- demonstrates no significant misconceptions&lt;br&gt;- usually gives complete or nearly complete explanations</td>
<td>- shows understanding of all of the basic concepts&lt;br&gt;- demonstrates no misconceptions&lt;br&gt;- always gives complete explanations</td>
</tr>
<tr>
<td><strong>Understanding of relevant concepts, principles and theories</strong></td>
<td>demonstrates significant misconceptions which detract from the meaning when explaining concepts, principles or theories&lt;br&gt;does not identify or explain sources of error</td>
<td>demonstrates minor misconceptions which do not detract from the meaning when explaining concepts, principles or theories&lt;br&gt;identifies but does not explain sources of error</td>
<td>demonstrates no significant misconceptions when explaining concepts, principles or theories&lt;br&gt;identifies and partially explains sources of error</td>
<td>demonstrates no misconceptions or revises prior misconceptions when explaining concepts, principles or theories&lt;br&gt;identifies and explains sources of error</td>
</tr>
<tr>
<td><strong>Applying relevant concepts, principles and theories</strong></td>
<td>analyses information in a way that shows some contradictions or confusion evident in their use of the concepts</td>
<td>analyses, interprets and evaluates information in a way that shows an occasional contradiction or confusion in the use of concepts;</td>
<td>analyses, interprets, and evaluates information in a way that essentially shows an understanding of the concepts;</td>
<td>analyses, interprets, and evaluates information in a way that shows a clear understanding of concepts;</td>
</tr>
<tr>
<td><strong>Explaining concepts, principles and theories</strong></td>
<td>gives explanations that are incomplete, inaccurate and lack detail</td>
<td>gives explanations that have major errors in accuracy and lack detail</td>
<td>gives explanations that are complete and accurate but the level of detail is inconsistent</td>
<td>gives explanations that are complete, accurate and detailed</td>
</tr>
</tbody>
</table>
### ASAP INQUIRY RUBRIC

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MET (page 13)</strong></td>
<td>applies few of the required skills and strategies;</td>
<td>applies some of the required skills and strategies;</td>
<td>applies most of the required skills and strategies;</td>
<td>applies all (or almost all) of the required skills and strategies;</td>
</tr>
<tr>
<td><strong>Initiating and Planning</strong></td>
<td>states questions in an untestable form and identifies few of the</td>
<td>restates questions in a testable form that identifies some components</td>
<td>restates questions a testable form that identifies most components</td>
<td>restates questions in a testable form that identifies the components needed for a fair test;</td>
</tr>
<tr>
<td><strong>Understanding the need</strong></td>
<td>identifies the components needed for a fair test;</td>
<td>needed for a fair test;</td>
<td>needed for a fair test;</td>
<td>develops a set of procedures that are appropriate but are limited in their efficiency, clarity, or completeness;</td>
</tr>
<tr>
<td><strong>Making a plan</strong></td>
<td>no set of procedures is attempted, or the procedures are incoherent or</td>
<td>identifies and controls some variables;</td>
<td>identifies and controls most major variables;</td>
<td>identifies and controls major variables;</td>
</tr>
<tr>
<td></td>
<td>unworkable;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>does not identify or control variables;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Performing and Recording</strong></td>
<td>does not follow any procedures to conduct a fair test;</td>
<td>follows most identified procedures to conduct a fair test;</td>
<td>follows identified procedures to conduct a fair test, and makes some</td>
<td>follows identified procedures to conduct a fair test, and justifies modifications;</td>
</tr>
<tr>
<td><strong>Carrying out the plan</strong></td>
<td>data are not recorded or is irrelevant;</td>
<td>data are of limited relevance, is limited in scope, and/or contains</td>
<td>some modifications;</td>
<td>data are relevant and may be extensive in scope and detail;</td>
</tr>
<tr>
<td></td>
<td>display of information is disorganized, not precise, accurate or</td>
<td>display of information is somewhat organized, and somewhat precise,</td>
<td>display of information is organized and mostly precise, accurate and</td>
<td>display of information is organized, precise, accurate and complete;</td>
</tr>
<tr>
<td></td>
<td>complete;</td>
<td>accurate and complete;</td>
<td>complete;</td>
<td>all units are included;</td>
</tr>
<tr>
<td></td>
<td>units are not indicated;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Analysing and Interpreting</strong></td>
<td>relevant data are not analysed or explained;</td>
<td>relevant data are partly identified and explained, without analysis;</td>
<td>relevant data are identified and explained with partial analysis;</td>
<td>relevant data are identified, analysed and explained;</td>
</tr>
<tr>
<td><strong>Looking back</strong></td>
<td>conclusion/ inference is absent, incoherent, illogical, or irrelevant,</td>
<td>conclusion/ inference is not well supported by the data; or is partially</td>
<td>conclusion/ inference is valid, clearly stated and supported by the</td>
<td>conclusion/ inference is valid, clearly stated and supported by the data;</td>
</tr>
<tr>
<td></td>
<td>and not supported by the data;</td>
<td>supported by the data and is not clearly stated;</td>
<td>data;</td>
<td>conclusion addresses the original task;</td>
</tr>
<tr>
<td></td>
<td>conclusion does not address the original task;</td>
<td>conclusion partly addresses the original task;</td>
<td>conclusion addresses the original task;</td>
<td></td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>
## ASAP DESIGN RUBRIC

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MET (page 13)</strong></td>
<td>applies few of the required skills and strategies</td>
<td>applies some of the required skills and strategies</td>
<td>applies most of the required skills and strategies</td>
<td>applies all of the required skills and strategies</td>
</tr>
<tr>
<td><strong>Inquiry and design skills</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Initiating and Planning</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understanding the need</td>
<td>does not demonstrate an understanding of the problem;</td>
<td>demonstrates a partial understanding of the problem;</td>
<td>demonstrates a basic understanding of the problem;</td>
<td>demonstrates a thorough understanding of the problem;</td>
</tr>
<tr>
<td>Making a plan</td>
<td>no plan is attempted for designing a product, or the plan is incoherent or unworkable;</td>
<td>develops a plan for designing a product that is limited in appropriateness, efficiency, clarity, and completeness;</td>
<td>develops a plan for designing a product that is appropriate, clear and complete;</td>
<td>develops a reproducible plan for designing a product that is appropriate, efficient, clear, and complete;</td>
</tr>
<tr>
<td></td>
<td>does not take into account predetermined criteria;</td>
<td>identifies and takes into account some predetermined criteria;</td>
<td>identifies and takes into account most predetermined criteria;</td>
<td>identifies and takes into account all predetermined criteria;</td>
</tr>
<tr>
<td><strong>Performing and Recording</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carrying out the plan</td>
<td>does not follow a plan to build a product;</td>
<td>follows most steps in a plan to build a product;</td>
<td>follows all steps in a plan to build a product, and makes required modifications;</td>
<td>follows all steps in a plan to build a product, and makes and records required modifications;</td>
</tr>
<tr>
<td></td>
<td>needs assistance to select appropriate materials and equipment to build a product;</td>
<td>selects appropriate materials and equipment to build a product;</td>
<td>selects appropriate materials and equipment to enhance the performance and design of the product;</td>
<td>selects appropriate materials and equipment and adapts materials to enhance the performance and design of the product;</td>
</tr>
<tr>
<td></td>
<td>tests the product and records results that are irrelevant or not related to predetermined criteria;</td>
<td>tests the product and records results that are limited in scope, contain major inaccuracies or have limited relevance to predetermined criteria;</td>
<td>tests the product and records results with sufficient scope and detail that are relevant to predetermined criteria;</td>
<td>tests the product and records results with extensive scope and detail that are relevant to predetermined criteria;</td>
</tr>
<tr>
<td></td>
<td>makes no modifications or re-testing of the product;</td>
<td>makes modifications but does not re-test product;</td>
<td>makes and records modifications and retests product;</td>
<td>makes, records and justifies modifications, and re-tests product;</td>
</tr>
<tr>
<td></td>
<td>display of information is disorganized, not precise, accurate or complete;</td>
<td>display of information is somewhat organized, and somewhat precise, accurate and complete;</td>
<td>display of information is organized and mostly precise, accurate and complete;</td>
<td>display of information is organized, precise, accurate and complete;</td>
</tr>
<tr>
<td></td>
<td>units are not indicated;</td>
<td>units are often incorrect or are not included;</td>
<td>most units are included;</td>
<td>all units are included;</td>
</tr>
<tr>
<td>Criteria</td>
<td>Level 1</td>
<td>Level 2</td>
<td>Level 3</td>
<td>Level 4</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Analysing and</td>
<td>relevant criteria are not analysed or explained;</td>
<td>relevant criteria are partly identified and explained, without analysis;</td>
<td>relevant criteria are identified and explained with partial analysis;</td>
<td>relevant criteria are identified, analysed and explained;</td>
</tr>
<tr>
<td>Interpreting</td>
<td>conclusion/ inference is absent, incoherent, illogical, or irrelevant,</td>
<td>conclusion/ inference is not well supported by performance of the</td>
<td>conclusion/ inference is valid, understandable and supported by the</td>
<td>conclusion/ inference is valid, clearly stated and well supported by the</td>
</tr>
<tr>
<td>Looking back</td>
<td>and not supported by the performance of the design;</td>
<td>performance of the design; or is partially supported performance and</td>
<td>performance of the design;</td>
<td>performance of the design;</td>
</tr>
<tr>
<td></td>
<td>product does not address the original problem;</td>
<td>is not clearly stated;</td>
<td>product addresses the original problem;</td>
<td>product fully addresses the original problem;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criteria</td>
<td>Level 1</td>
<td>Level 2</td>
<td>Level 3</td>
<td>Level 4</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Communication of required knowledge MET (page 13)</td>
<td>communicates with little clarity and precision; rarely uses appropriate science and technology terminology and units of measurement;</td>
<td>communicates with some clarity and precision; sometimes uses appropriate science and technology terminology and units of measurement;</td>
<td>generally communicates with clarity and precision; usually uses appropriate science and technology terminology and units of measurement;</td>
<td>consistently communicates with clarity and precision; consistently uses appropriate science and technology terminology and units of measurement;</td>
</tr>
<tr>
<td>Clarity and precision of supporting evidence</td>
<td>communicates information without stating the question or problem that was solved and states conclusions that are not supported with adequate evidence; uses tables, charts and/or diagrams but their purpose is unclear</td>
<td>communicates information describing the question or problem that was solved and states conclusions with some supporting evidence; uses some tables, charts and/or diagrams and their purpose is clear</td>
<td>communicates information describing the question or problem that was solved and states conclusions with an adequate amount of evidence; uses tables, charts, and/or diagrams where appropriate and their purpose is clear</td>
<td>communicates information clearly describing the question or problem that was solved and states conclusions with specific and detailed evidence; uses tables, charts and/or diagrams in appropriate contexts and their purpose is clear</td>
</tr>
<tr>
<td>Clarity and precision of vocabulary including mechanics</td>
<td>uses colloquial language in place of proper science or technology terminology; major errors in spelling and/or grammar that interfere with meaning</td>
<td>uses some colloquial language in place of proper science or technology terminology; major errors in spelling and/or grammar, but meaning is clear</td>
<td>usually uses proper science or technology terminology in proper context; minor errors in spelling and/or grammar but meaning is clear</td>
<td>consistently uses proper science or technology terminology in proper context; no errors in spelling and/or grammar and meaning is clear</td>
</tr>
<tr>
<td>Clarity and precision with measuring</td>
<td>records numerical data inaccurately and inconsistently which affects the results of the investigation; attempts calculations but they are incomplete and/or incorrect; uses incorrect SI units or often does not include any units or symbols; constructs graphs with assistance</td>
<td>records numerical data consistently but with some errors in accuracy which affects the results of the investigation; completes calculations but some calculations are incorrect leading to erroneous conclusions; uses SI units using words or a mixture of words and symbols with some incorrect units; constructs graphs with some assistance</td>
<td>records numerical data consistently but with minor errors in accuracy which do not affect the results of the investigation; completes calculations with some minor errors which do not lead to erroneous conclusions; uses SI units with symbols with an occasional incorrect unit; constructs graphs with some minor errors</td>
<td>records numerical data consistently and accurately; completes calculations correctly; consistently uses correct SI units with symbols; constructs accurate graphs</td>
</tr>
<tr>
<td>Criteria</td>
<td>Level 1</td>
<td>Level 2</td>
<td>Level 3</td>
<td>Level 4</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Relating of science and technology to each other and the world outside the school</td>
<td>shows little understanding of connections between science and technology in familiar contexts;</td>
<td>shows some understanding of connections between science and technology in familiar contexts;</td>
<td>shows understanding of connections between science and technology in familiar contexts;</td>
<td>shows understanding of connections between science and technology in both familiar and unfamiliar contexts;</td>
</tr>
<tr>
<td></td>
<td>shows little understanding of connections between science and technology and the world outside the school;</td>
<td>shows some understanding of connections between science and technology and the world outside the school;</td>
<td>shows understanding of connections between science and technology and the world outside the school;</td>
<td>shows understanding of connections between science and technology and the world outside the school, as well as their implications;</td>
</tr>
<tr>
<td>Interpreting and applying concepts</td>
<td>shows little evidence of interpreting and applying concepts and principles in familiar situations</td>
<td>shows some evidence of interpreting and applying concepts and principles in familiar situations</td>
<td>shows sufficient evidence of interpreting and applying concepts in familiar situations</td>
<td>shows evidence of interpreting, applying and evaluating concepts in familiar as well as some new situations</td>
</tr>
<tr>
<td>Making informed decisions</td>
<td>needs assistance to distinguish between fact and opinion when making connections in social, environmental, economic and/or political contexts</td>
<td>needs some assistance to distinguish between fact and opinion when making connections in social, environmental, economic and/or political contexts</td>
<td>distinguishes between fact and opinion when making connections in social, environmental, political and/or economic contexts</td>
<td>distinguishes between fact and opinion and considers their merit when making connections in social, environmental, political and/or economic contexts</td>
</tr>
<tr>
<td>Perceptions and Influence of Science and Technology</td>
<td>needs assistance to identify and explain the factors that influence people’s perceptions of science and technology in their daily lives</td>
<td>identifies some factors that influence people’s perceptions of science and technology in their daily lives</td>
<td>identifies the factors that influence people’s perceptions of science and technology in their daily lives</td>
<td>identifies and evaluates the factors that influence people’s perceptions of science and technology in their daily lives</td>
</tr>
<tr>
<td></td>
<td>identifies few instances of how science and technology are used in daily lives</td>
<td>identifies some instances of how science and technology are used in daily lives</td>
<td>identifies ways we use science and technology in daily lives</td>
<td>identifies and evaluates the influence science and technology have on daily lives</td>
</tr>
</tbody>
</table>
## ASAP USING TOOLS, EQUIPMENT AND MATERIALS RUBRIC

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inquiry and design skills</strong> (including skills in the safe use of tools, equipment, and materials) MET (Page 13)</td>
<td>uses tools, equipment, and materials correctly only with assistance;</td>
<td>uses tools, equipment, and materials correctly with some assistance;</td>
<td>uses tools, equipment, and materials correctly with only occasional assistance;</td>
<td>uses tools, equipment, and materials correctly with little or no assistance;</td>
</tr>
<tr>
<td>Choosing and using tools and equipment</td>
<td>needs assistance to choose and accurately use appropriate tools and equipment in order to gather and analyze data or construct products</td>
<td>needs some assistance to choose and accurately use appropriate tools and equipment in order to gather and analyze data or construct products</td>
<td>chooses and uses appropriate tools and equipment accurately and with only minor errors in order to gather and analyze data or construct products</td>
<td>chooses and uses appropriate tools and technologies accurately and proficiently in order to gather and analyze data or construct products</td>
</tr>
<tr>
<td>Choosing and using materials</td>
<td>needs continuous assistance to choose appropriate materials and use them efficiently and effectively</td>
<td>needs some assistance to choose appropriate materials and use them efficiently and effectively</td>
<td>chooses appropriate materials and uses them efficiently and effectively requiring only occasional assistance</td>
<td>chooses appropriate materials and uses them efficiently and effectively</td>
</tr>
<tr>
<td>Caring for tools, materials and equipment</td>
<td>needs continuous assistance and supervision to follow appropriate and safe procedures for cleaning, maintaining and storing tools, materials and equipment being used</td>
<td>needs occasional reminders to follow appropriate and safe procedures for cleaning, maintaining and storing tools, materials and equipment being used</td>
<td>needs few reminders to follow appropriate and safe procedures for cleaning, maintaining and storing tools, materials and equipment being used</td>
<td>follows appropriate and safe procedures for cleaning, maintenance, and storage of tools, materials and equipment being used</td>
</tr>
<tr>
<td>Understanding safety considerations</td>
<td>does not follow safety considerations without constant supervision</td>
<td>follows some safety considerations but needs some supervision</td>
<td>follows most safety considerations but needs occasional supervision</td>
<td>follows all safety considerations without supervision</td>
</tr>
</tbody>
</table>
Clarify and define the Opportunity or Problem. This will provide a more accurate setting for your ideas.

Research the Situation. Identify the requirements, available resources and restrictions. Develop some criteria. Create lots of ideas!

Pick the best idea; develop a plan then go ahead and do it. Test all or any part of your solution if it seems appropriate.

Look back at your criteria and reflect on how well you achieved them. Always consider what improvements could be made if you did it all again.

More information may be needed to understand the Situation. Other people or different sources of information may have to be consulted.

New technologies or areas of knowledge may have to be explored. Skills may be identified that require time to learn at some stage.

Skills, materials, or equipment may be inadequate. Things can go wrong! Mini-problems may have to be solved. Consider other ways of doing it.

New insights may arise suggesting a rethinking of the wording of your definition. Problems may even begin to look like Opportunities.

The circumstances may have to be observed more closely or over a longer period of time to define the range of possibilities.

Ongoing evaluation may reveal significant concerns. This could cause a return to earlier stages to rethink a definition, criteria or your ideas.

Backtracking

Backtracking

Backtracking

IDEAS INVESTIGATION

Backtracking

APPENDIX III: DESIGN AND INQUIRY TOOLS

DESIGNING WITH SPICE
OBSERVATION
Look around for things that create questions in your mind. Identify questions that for you require explanation.

LIMIT
Identify the variables involved in the event. Limit the number of variables to the test variable(s) most likely to cause the event (hypothesis).

DEVISE
Devise a correlational study or experiment to test the test variable(s) selected (hypothesis) and collect the data.

EVALUATE
Organize, analyze the data and come to a conclusion. Apply your conclusion to the test variable(s) (hypothesis).

REPORT AND RECYCLE
Communicate the investigation to others and if the conclusion does not support the hypothesis, select another test variable(s) and redesign the test.

Backtracking
The circumstances may have to be observed more closely or over a longer period of time to define the test variable(s) in a clearer way.

Backtracking
New insights may arise suggesting a rethinking of the design of the test.

Backtracking
Ongoing evaluation may reveal significant concerns. This could cause a return to earlier stages to rethink a test variable(s) or test.

Side Trip
More information may be needed to understand the event. Other people or different sources of information may have to be consulted.

Side Trip
New insights or areas of knowledge may have to be explored. Skills may be identified that require time to learn at some stage.

Side Trip
Skills, materials or equipment may be inadequate. Things can go wrong! Mini-problems may have to be solved. Consider other test designs.

OBSERVATION
Look around for things that create questions in your mind. Identify questions that for you require explanation.

LIMIT
Identify the variables involved in the event. Limit the number of variables to the test variable(s) most likely to cause the event (hypothesis).

DEVISE
Devise a correlational study or experiment to test the test variable(s) selected (hypothesis) and collect the data.

EVALUATE
Organize, analyze the data and come to a conclusion. Apply your conclusion to the test variable(s) (hypothesis).

REPORT AND RECYCLE
Communicate the investigation to others and if the conclusion does not support the hypothesis, select another test variable(s) and redesign the test.
Situation:
Describe what is happening in this box

Problem:
Write what your project must do in this box:

Design and construct a …
Ideas

Draw a picture of your chosen idea or design.
Construction:

Things I Need:

____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________

Construction:

How I will make it:

____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
Evaluate/Discovery Log:
The things I was really happy with when the design was made...
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________

Evaluate/Discovery Log:
The things I learned when working on this challenge...
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
Investigation Folio (OLDER)

Name: 
Grade: 
Date: 
Teacher: 

Observations and Variables:
Describe the situation and identify a few variables which may be changed or measured:


Limit:
Write a causal question relating two variables identified above:


Prediction: Write how you think the two variables are related:
If ____________________________
then ____________________________
because _________________________
Devise a Plan:
Describe how you intend to test the chosen variables:

Remember, you have two different methods possible:
Experiment: change one variable in set steps and measure the changes in the other variable
Correlational Study: measure the changes in two variables as they change naturally
Evaluate and Report:
Describe the relationship found between the variables and explain the relationship:

Learning Log: The things I really liked about the plan of action …

Learning Log: How could I improve the investigation?

Learning Log: The things I learned when working on this investigation…