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Program Principles

1. Effective science programs involve hands-on inquiry, problem solving, and decision making.

2. The development of students’ skills, attitudes, knowledge, and understanding of Science, Technology, Society, and the Environment (STSE) issues form the foundation of the science program.

3. Children have a natural curiosity about science and the world around them. This curiosity must be maintained, fostered, and enhanced through active learning.

4. Science activities must be meaningful, worthwhile, and relate to real-life experiences.

5. The teacher’s role in science education is to facilitate activities and encourage critical thinking and reflection. Children learn best by doing, rather than by just listening. The teacher, therefore, should focus on formulating and asking questions rather than simply telling.

6. Science should be taught in correlation with other school subjects. Themes and topics of study should integrate ideas and skills from several core areas whenever possible.

7. The science program should encompass, and draw on, a wide range of educational resources, including literature, nonfiction research material, audio-visual resources, technology, as well as people and places in the local community.

8. Assessment of student learning in science should be designed to focus on performance and understanding, and should be conducted through meaningful assessment techniques carried on throughout the unit of study.

Program Implementation

Program Resources

*Hands-On Science and Technology* is arranged in a format that makes it easy for teachers to plan and implement.

Units are the selected topics of study for the grade level. The units relate directly to the learning expectations outlined in *The Ontario Curriculum, Grades 1–8: Science and Technology* (2007) document. The units are organized into several lessons. Each unit also includes books for children, a list of annotated websites, and references for teachers (all of these are found at the end of the book and are organized by unit).

The introduction to each unit summarizes the general goals for the unit. The introduction provides background information for teachers, and a complete list of materials that will be required for the unit. This includes classroom and household materials, equipment, visuals, reading materials, and various other supplies.

Each unit is organized into lessons, based on the curricular expectations. The lessons are arranged in the following format:

**Expectations:** Included are the curricular expectations addressed in the lesson. Some expectations, such as those related to safety, are general, ongoing themes throughout the unit, and are not identified specifically at the beginning of a lesson.

**Science Background Information for Teachers:** Some topics provide teachers with the basic scientific knowledge they will need to present the activities. This information is offered in a clear, concise format, and focuses specifically on the topic of study.
**Materials:** A complete list of materials required to conduct the main activity is given. The quantity of materials required will depend on how you conduct activities. If students are working individually, you will need enough materials for each student. If students are working in groups, the materials required will be significantly reduced. Many of the identified items are for the teacher to use for display purposes, or for making charts for recording students’ ideas. In some cases, visual materials—large pictures, sample charts, and diagrams—have been included with the activity to assist the teacher in presenting ideas and questions, and to encourage discussion. You may wish to reproduce these visuals, mount them on sturdy paper, and laminate them so they can be used for years to come.

**Activity:** This section details a step-by-step procedure, including higher-level questioning techniques and suggestions, for encouraging exploration and investigation.

**Activity Sheet:** The reproducible activity sheets are designed to correlate with the expectations of the activity. Often, the activity sheets are to be used during the activity to record results of investigations. At other times, they are to be used as a follow-up to the activities. Students may work independently on the activity sheets, in small groups, or you may choose to read through the sheets together and complete them in a large-group setting. Activity sheets can also be made into overheads or large experience charts. Since it is important for students to learn to construct their own charts and recording formats, you may want to use the activity sheets as examples of ways to record and communicate ideas about an activity. Students can then create their own sheets rather than use the ones provided.

**Note:** Activity sheets are meant to be used only in conjunction with, or as a follow-up to, the hands-on activities. The activity sheets are not intended to be the science lesson itself or the sole assessment for the lesson.

**Extension:** Included are optional activities to extend, enrich, and reinforce the expectations.

**Activity Centre:** Included are independent student activities that focus on the expectations.

**Assessment Suggestions:** Often, suggestions are made for assessing student learning. These assessment strategies focus specifically on the expectations of a particular activity topic (assessment is dealt with in detail on pages 14–15). Keep in mind that the suggestions made within the activities are merely ideas to consider—you may use your own assessment techniques, or refer to the other assessment strategies on pages 14–15.

**Classroom Environment**

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

**Timelines**

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

**Classroom Management**

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

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

**Science Skills: Guidelines for Teachers**

While involved in the activities of *Hands-On Science and Technology*, students will use a variety of skills as they answer questions, solve problems, and make decisions. These skills are not unique to science, but they are integral to students’ acquisition of scientific literacy. The skills include initiating and planning, performing and recording, analyzing and interpreting, as well as communicating and the ability to work in teams. In the early years, basic skills should focus on science inquiry. Although the wide variety of skills are not all presented here, the following guidelines provide a framework to use to encourage students’ skill development in specific areas.

**Observing**

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

- gaining information through the senses
- identifying similarities and differences, and making comparisons
- sequencing events or objects

**Exploring**

Students need ample opportunities to manipulate materials and equipment in order to discover and learn new ideas and concepts. During exploration, students need to be encouraged to use all of their senses and observation skills. Oral discussion is also an integral component of exploration; it allows students to communicate their discoveries.

**Classifying**

This skill is used to group or sort objects and events. Classification is based on observable properties. For example, objects can be classified into living and nonliving groups, or into groups according to colour, shape, or size. One of the strategies used for sorting involves the use of Venn diagrams (either a double Venn or a triple Venn). Venn diagrams can involve distinct groups, or can intersect to show similar characteristics (please see next page).
3 Animal Groups

Expectations

- 2.7 Use appropriate science and technology vocabulary, including life cycle, migration, adaptation, body coverings, and classify, in oral and written communication
- 2.8 Use a variety of forms to communicate with different audiences and for a variety of purposes
- 3.1 Identify and describe major physical characteristics of different types of animals

Science Background Information for Teachers

Note: The animal groups named in this activity are not the only groups into which animals can be classified, only the most common. You will find that some animals, such as the octopus and spider, do not fit into any of the six groups. Students should be made aware of this. Animals that cannot be classified into any of the six categories can be placed into a seventh group, or you can have students create additional groups according to characteristics of the animals.

Birds: Have wings, feathers, and beaks. Most birds fly. Some birds, penguins and ostriches, for example, cannot fly.

Fish: Have scales and fins, and breathe through gills. Fish spend their lives in water.

Insects: Have antennae, six legs, and three body parts (note that spiders are not insects).

Reptiles: Are born on land, usually lay eggs, have scales, and breathe through lungs. Examples are snakes, alligators, crocodiles, lizards, and turtles.

Amphibians: Are hatched from eggs and born in water. At first, they live in water and breathe through gills. Later, they develop lungs and live on land. Examples are frogs, salamanders, toads, and newts.

Mammals: Have fur or hair, have live babies (except for egg-laying mammals such as the duckbill platypus), breathe through lungs, and feed their babies milk that they produce. Remember that whales, porpoises, and dolphins are mammals, too.

Materials

- pictures of a variety of animals from each of the six animal groups
- live animals, if possible
- drawing paper
- crayons
- pencils
- scissors
- glue
- 6 sheets of chart paper
- markers

Activity: Part One

Display the pictures of the animals for students to examine and observe. Ask:

- Can you describe what each animal looks like?
- How are the animals different?
- How are they the same?
- Which animals do you think belong in the same group?

Have students attempt to classify the animals into groups. (Birds, fish, and insects are the easiest animal groups to classify. You may guide students to sort these first, then to group all the mammals. Reptiles and amphibians will take more effort to differentiate, so students may be allowed to group them together as a preliminary classification. Later, they can separate the reptiles from the amphibians.)
Record the name of each animal group on a separate sheet of chart paper. Now, examine and discuss each group separately. Ask students:

- How are all birds the same?
- How do birds reproduce?
- How are all fish the same?
- Where are amphibians born?
- How do amphibians change as they grow?

Have students describe the characteristics of each animal group. Print these characteristics on the appropriate charts.

**Note:** Keep the six animal charts for use in subsequent lessons.

Give each student a picture of a different animal. Have students classify their animal by standing next to the chart with the name of the animal group their animal belongs to.

Mix up the animal pictures, hand them out to students again, and repeat the activity.

**Activity Sheet A**

**Directions to students:**

Draw a picture of one animal from each of the six animal groups. Print the name of the animal under each picture (1.3.1).

**Activity: Part Two**

Use a Frayer Model to further reinforce the characteristics of specific animal groups. For example:

<table>
<thead>
<tr>
<th>Characteristics:</th>
<th>Non-Characteristics:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish</td>
<td></td>
</tr>
</tbody>
</table>

**Activity Centres**

- Use masking tape to divide a large table into six sections. Label each section with the name of an animal group. Provide Plasticine, and have students make models of animals that belong to each group. As students participate in this activity, encourage them to give reasons why their model animals belong to specific groups. (Students can also sort plastic/toy animals into the six groups.)

- Make class big books for each animal group. Provide six trays, each labelled with the name of one of the animal groups. Also provide paper and art supplies. Have students draw pictures of animals that belong to each group, adding information that they know about the animal, either in print or with drawings. Have them place completed pictures in the appropriate trays. Add covers, bind the pages into books, and place in the class library.

**Assessment Suggestion**

Show students the Assessment Activity Sheet (1.3.2), and have students identify which animal belongs to each animal group (1.3.2). You may wish to challenge students by having them list additional animals under each category. These sheets can then be placed in students’ science portfolios.
Animal Groups

<table>
<thead>
<tr>
<th>Amphibian</th>
<th>Mammal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example:</td>
<td>Example:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fish</th>
<th>Reptile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example:</td>
<td>Example:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bird</th>
<th>Insect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example:</td>
<td>Example:</td>
</tr>
</tbody>
</table>
Name the Animal Group

amphibian
reptile

mammal
fish

bird
insect

___________________________________________

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