

Atlantic Canada Science Curriculum

New Brunswick **New**  *Nouveau*
Department of Education **Brunswick**
Educational Programs & Services Branch

Science 3

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CURRICULUM

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Additional copies of this document (*Science Grade 3*) may be
obtained from the Instructional Resources Branch.

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Foreword

The Pan-Canadian *Common Framework of Science Learning Outcomes K to 12*, released in October 1997, assists provinces in developing a common science curriculum framework.

The *Foundation for the Atlantic Canada Science Curriculum (1998)* describes in general terms the science curriculum for the Atlantic Provinces.

This curriculum guide provides teachers with the specific outcomes for science education. It also includes suggestions to assist teachers in designing learning experiences and assessment tasks. References for resources both print and electronic media, are indicated for each unit.

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Introduction

Background

The curriculum framework described in the *Foundation for the Atlantic Canada Science Curriculum* was planned and developed collaboratively by regional committees. The process for developing the specific science curriculum for Atlantic Canada (entry to grade ten) involved regional consultation with the stakeholders in the education system in each Atlantic province. The Atlantic Canada science curriculum (entry to grade ten) is consistent with the framework described in the Pan-Canadian *Common Framework of Science Learning Outcomes K to 12*.

Aim

The aim of science education in the Atlantic Provinces is to help students develop scientific literacy, an evolving combination of science-related knowledge, skills and attitudes. To develop scientific literacy, students require diverse learning experiences that provide opportunities to explore, analyse, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment. Scientific inquiry, problem-solving and decision making support students to become life-long learners and to maintain a sense of wonder about the world around them.



Program Design and Components

Learning and Teaching Science

What students learn is fundamentally connected to how they learn it. The aim of scientific literacy for all has created a need for new forms of classroom organization, communication, and instructional strategies. The teacher is a facilitator of learning whose major tasks include

- € creating a classroom environment to support the learning and teaching of science
- designing effective learning experiences that help students achieve designated outcomes
- stimulating and managing classroom discourse in support of student learning
- learning about and then using students' motivations, interests, abilities, and learning styles to improve learning and teaching
- assessing student learning, the scientific tasks and activities involved, and the learning environment to make ongoing instructional decisions
- selecting teaching strategies from a wide repertoire.

Effective science learning and teaching take place in a variety of situations. Instructional settings and strategies should create an environment that reflects a constructive, active view of the learning process. Learning occurs through actively constructing one's own meaning and assimilating new information to develop a new understanding.

The development of scientific literacy in students is a function of the kinds of tasks they engage in, the discourse in which they participate, and the settings in which these activities occur. Students' disposition towards science is also shaped by these factors. Consequently, the aim of developing scientific literacy requires careful attention to all of these facets of curriculum.

Learning experiences in science education should vary and should include opportunities for whole class, small group and individual work, discussion among students as well as between teacher and students, and hands-on/minds-on activities that allow students to construct and evaluate explanations for the phenomena under investigation. Such investigations and the evaluation of the evidence accumulated provide opportunities for students to develop their understanding of the nature of science and the nature and status of scientific knowledge.

Writing in Science

Learning experiences should provide opportunities for students to use writing and other forms of representation as ways to learn. Students, at all grade levels, should be encouraged to use writing to speculate, theorize, summarize, discover connections, describe processes, express understandings, raise questions, and make sense of new information using their own language as a step to the language of science. Science logs are useful for such expressive and reflective writing. Purposeful note making is also an intrinsic part of learning in science that can help students better record, organize, and understand information from a variety of sources. The process of creating webs, maps, charts, tables, graphs, drawing, and diagrams to represent data and results help students learn and also provides them with useful study tools.

Learning experiences in science should provide abundant opportunities for students to communicate their findings and understandings to others, both formally and informally, using a variety of forms for a range of purposes and audiences. Such experiences should encourage students to use effective ways of recording and conveying information and ideas and to use the vocabulary of science in expressing their understandings. It is through opportunities to talk and write about the concepts they need to learn that students come to better understand both the concepts and related vocabulary.

Learners will need explicit instruction in and demonstration of the strategies they need to develop and apply in reading, viewing, interpreting, and using a range of science texts for various purposes. It will be equally important for students to have demonstrations of the strategies they need to develop and apply in selecting, constructing, and using various forms for communicating in science.

The Three Processes of Scientific Literacy

An individual can be considered scientifically literate when he/she is familiar with, and able to engage in the following processes within a science context: inquiry, problem-solving, and decision making.

Inquiry

Scientific inquiry involves posing questions and developing explanations for phenomena. While there is general agreement there is no such thing as the scientific method, students require certain skills to participate in the activities of science. Skills such as questioning, observing, inferring, predicting, measuring, hypothesizing, classifying, designing experiments, collecting data, analysing data, and interpreting data are fundamental to engaging in science. These activities provide students with opportunities to practise the process of theory development in science and understand the nature of science.

Problem Solving

The process of problem solving involves seeking solutions to human problems. It consists of proposing, creating, and testing prototypes, products, and techniques to determine the best solution to a given problem.

Decision Making

The process of decision making involves determining what we, as citizens, should do in a particular context or in response to a given situation. Decision-making situations are important in their own right, and but they also provide a relevant context for engaging in scientific inquiry and/or problem solving.

Meeting the Needs of All Learners

Foundation for the Atlantic Canada Science Curriculum stresses the need to design and implement a science curriculum that provides equitable opportunities for all students according to their abilities, needs, and interests. Teachers must be aware of and make adaptations to accommodate the diverse range of learners in their class. To adapt instructional strategies, assessment practices, and learning resources to the needs of all learners, teachers must create opportunities that will address students' various learning styles.

As well, teachers must remain aware of and avoid gender and cultural biases in their teaching; they must also actively address cultural and gender stereotyping (e.g., about who is interested in and who can succeed in science and mathematics). Research supports the position that when science curriculum is made personally meaningful and socially and culturally relevant, it is more engaging for groups traditionally under-represented in science, and indeed, for all students.

It is important that teachers articulate high expectations for all students and ensure all students have equitable opportunities to experience success as they work toward achieving designated outcomes. Teachers should adapt classroom organization, teaching strategies, assessment practices, time, and learning resources to address students' needs and build on their strengths. The variety of learning experiences described in this guide provide access for a wide range of learners. Similarly, the suggestions for a variety of assessment practices provide multiple ways for learners to demonstrate their achievements.

While this curriculum guide presents specific outcomes for each unit, it must be acknowledged that students will progress at different rates. Teachers should provide materials and strategies that accommodate student diversity, and should validate students when they achieve the outcomes to the best of their abilities.

Assessment and Evaluation

The terms “assessment” and “evaluation” are often used interchangeably, but they refer to quite different processes. Science curriculum documents developed in the Atlantic region use these terms for the processes described below.

Assessment is the systematic process of gathering information on student learning.

Evaluation is the process of analysing, reflecting upon, and summarizing assessment information, and making judgments or decisions based upon the information gathered.

The assessment process provides the data, and the evaluation process brings meaning to the data. Together, these processes improve teaching and learning. If we are to encourage enjoyment in learning for students now and throughout their lives, we must develop strategies to involve students in assessment and evaluation at all levels. When students are aware of the outcomes for which they are responsible and of the criteria by which their work will be assessed or evaluated, they can make informed decisions about the most effective ways to demonstrate their learning.

The Atlantic Canada science curriculum reflects the three major processes of science learning: inquiry, problem solving, and decision making. When assessing student progress, it is helpful to know some activities/skills/actions that are associated with each process of science learning. Student learning may be described in terms of ability to perform these tasks.

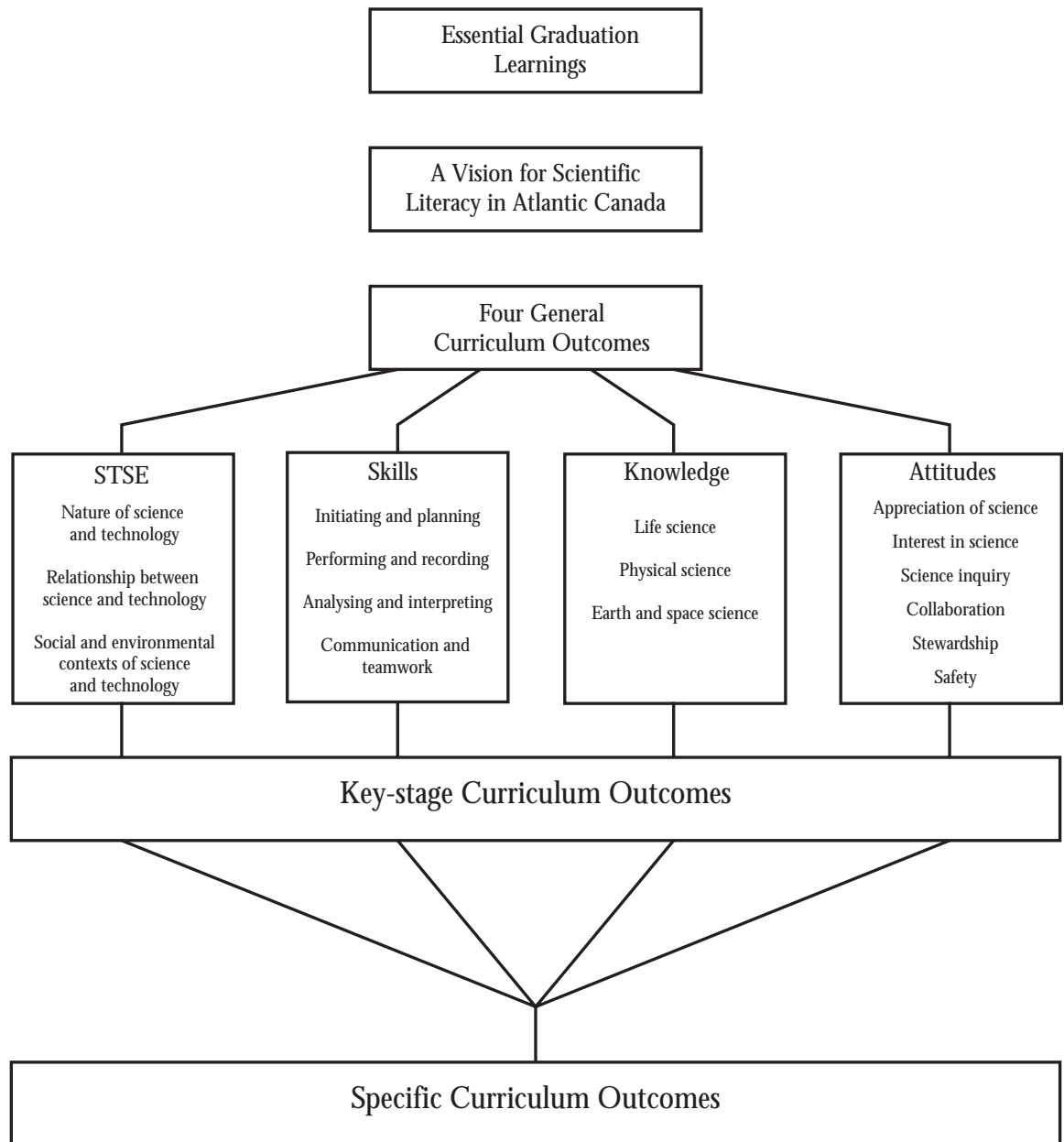


Curriculum Outcomes Framework

Overview

The science curriculum is based on an outcomes framework that includes statements of essential graduation learnings, general curriculum outcomes, key-stage curriculum outcomes, and specific curriculum outcomes. The general, key-stage, and specific curriculum outcomes reflect the Pan-Canadian *Common Framework of Science Learning Outcomes K to 12*. Figure 1 provides the blueprint of the outcomes framework.

Outcomes Framework



Essential Graduation Learnings

Essential graduation learnings are statements describing the knowledge, skills, and attitudes expected of all students who graduate from high school. Achievement of the essential graduation learnings will prepare students to continue to learn throughout their lives. These learnings describe expectations not in terms of individual school subjects but in terms of knowledge, skills, and attitudes developed throughout the curriculum. They confirm that students need to make connections and develop abilities across subject boundaries and be ready to meet the shifting and ongoing opportunities, responsibilities, and demands of life after graduation. Provinces may add additional essential graduation learnings as appropriate. The essential graduation learnings are:

Aesthetic Expression

Graduates will be able to respond with critical awareness to various forms of the arts and be able to express themselves through the arts.

Citizenship

Graduates will be able to assess social, cultural, economic, and environmental interdependence in a local and global context.

Communication

Graduates will be able to use the listening, viewing, speaking, reading, and writing modes of language(s) as well as mathematical and scientific concepts and symbols to think, learn, and communicate effectively.

Personal Development

Graduates will be able to continue to learn and to pursue an active, healthy lifestyle.

Problem Solving

Graduates will be able to use the strategies and processes needed to solve a wide variety of problems, including those requiring language, mathematical, and scientific concepts.

Technological Competence

Graduates will be able to use a variety of technologies, demonstrate an understanding of technological applications, and apply appropriate technologies for solving problems.

General Curriculum Outcomes

The general curriculum outcomes form the basis of the outcomes framework. They also identify the key components of scientific literacy. Four general curriculum outcomes have been identified to delineate the four critical aspects of students' scientific literacy. They reflect the wholeness and interconnectedness of learning and should be considered interrelated and mutually supportive.

Science, Technology, Society, and the Environment

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

Skills

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

Knowledge

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

Attitudes

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

Key-Stage Curriculum Outcomes

Key-stage curriculum outcomes are statements that identify what students are expected to know, be able to do, and value by the end of grades 2, 5, 8, and 12 as a result of their cumulative learning experiences in science. The key-stage curriculum outcomes are from the *Common Framework for Science Learning Outcomes K-12*.

Specific Curriculum Outcomes

Specific curriculum outcome statements describe what students are expected to know and be able to do at each grade level. They are intended to help teachers design learning experiences and assessment tasks. Specific curriculum outcomes represent a framework for assisting students to achieve the key-stage curriculum outcomes, the general curriculum outcomes, and ultimately, the essential graduation learnings. Specific curriculum outcomes are organized in units for each grade level.

Attitude Outcomes

It is expected that the Atlantic Canada science program will foster certain attitudes in students throughout their school years. The STSE, skills, and knowledge outcomes contribute to the development of attitudes, and opportunities for fostering these attitudes are highlighted in the Elaborations—Strategies for Learning and Teaching sections of each unit.

Attitudes refer to generalized aspects of behaviour that teachers model for students by example and by selective approval. Attitudes are not acquired in the same way as skills and knowledge. The development of positive attitudes plays an important role in students' growth by interacting with their intellectual development and by creating a readiness for responsible application of what students learn.

By the end of grade 5 (key stage), students will be expected to:

- appreciate the role and contribution of science and technology in their understanding of the world (409)
- realize that the application of science and technology can have both intended and unintended effects (410)
- recognize that women and men of any cultural background can contribute equally to science (411)
- show interest and curiosity about objects and events within different environments (412)
- willingly observe, question, explore and investigate (413)
- show interest in activities of individuals working in scientific and technological fields (414)
- consider their own observations and ideas as well as others during investigations and before drawing conclusions (415)
- appreciate the importance of accuracy and honesty (416)
- demonstrate perseverance and a desire to understand (417)
- work collaboratively while exploring and investigating (418)
- be sensitive to and develop a sense of responsibility for the welfare of other people, other living things, and the environment (419)

Curriculum Guide Organization

Specific curriculum outcomes are organized in units for each grade level. Each unit is organized by topic. Suggestions for learning, teaching, assessment, and resources are provided to support student achievement of the outcomes.

The order in which the units of a grade appear in the guide is meant to suggest a sequence. In some cases, the rationale for the recommended sequence is related to the conceptual flow across the year. That is, one unit may introduce a concept that is then extended in a subsequent unit. Likewise, one unit may focus on a skill or context that will be built upon later in the year.

Some units or certain aspects of units may also be combined or integrated. This is one way of assisting students as they attempt to make connections across topics in science or between science and the real world. In some cases, a unit may require an extended time frame to collect data on weather patterns, plant growth, etc. These cases may warrant starting the activity early and overlapping it with the existing unit. In all cases, the intent is to provide opportunities for students to deal with science concepts and scientific issues in personally meaningful and socially and culturally relevant contexts.

Unit Organization

Each unit begins with a two-page synopsis. On the first page, introductory paragraphs provide an unit overview. These are followed by a section that specifies the focus (inquiry, problem solving, and/or decision making) and possible contexts for the unit. Finally, a curriculum links paragraph specifies how this unit relates to science concepts and skills addressed in other grades so teachers will understand how the unit fits with the students' progress through the complete science program.

The second page of the two-page overview provides a table of the outcomes from the *Common Framework of Science Learning Outcomes K to 12* that the unit will address. The numbering system used is the one in the Pan-Canadian document as follows:

- 100s—Science-Technology-Society-Environment (STSE) outcomes
- 200s—Skills outcomes
- 300s—Knowledge outcomes
- 400s—Attitude outcomes (see pages 17–19)

These code numbers appear in brackets after each specific curriculum outcome (SCO). The outcomes have been expressed in a context in order to clarify their intent.

The Four-Column Spread

All units have a two-page layout of four columns as illustrated below. In some cases, the four-column spread continues to the next two-page layout. Outcomes are grouped by a topic indicated at the top of the left page.

Two Page, Four Column Spread

Page One

Page Two

Topic			
Outcomes	Elaborations—Strategies for Learning and Teaching	Tasks for Instruction and/or Assessment	Resources/Notes
Students will be expected to <ul style="list-style-type: none"> Specific curriculum outcome based on the Pan-Canadian outcomes (outcome number) Specific curriculum outcome based on the Pan-Canadian outcomes (outcome number) 	elaboration of outcome and strategies for learning and teaching elaboration of outcome and strategies for learning and teaching	Type of Assessment Tasks: <i>Informal/Formal Observation</i> <i>Performance</i> <i>Journal</i> <i>Interview</i> <i>Paper and Pencil</i> <i>Presentation</i> <i>Portfolio</i>	Provincial responsibility Resources suggested for use in N.B.

Column One: Outcomes

The first column provides the specific curriculum outcomes. These are based on the Pan-Canadian *Common Framework of Science Learning Outcomes K to 12*. The statements involve the Science-Technology-Society-Environment (STSE), skills, and knowledge outcomes indicated by the outcome number(s) that appears in parenthesis after the outcome. Some STSE and skills outcomes have been written in a context that shows how these outcomes should be addressed.

Specific curriculum outcomes have been grouped by topic. Other groupings of outcomes are possible and in some cases may be necessary to take advantage of local situations. The grouping of outcomes provides a suggested teaching sequence. Teachers may prefer to plan their own teaching sequence to meet the learning needs of their students.

Column One defines what students are expected to know and be able to do.

*Column Two: Elaborations—
Atlantic Science Curriculum*

The second column may include elaborations of outcomes listed in column one, and describes learning environments and experiences that will support students' learning. Italics is used in this column for commentary directed to the teacher

The strategies in this column are intended to provide a holistic approach to instruction. In some cases, they address a single outcome; in other cases, they address a group of outcomes.

*Column Three: Tasks for
Instruction and/or
Assessment*

The third column provides suggestions for ways that students' achievement of the outcomes could be assessed. These suggestions reflect a variety of assessment techniques and materials that include, but are not limited to, informal/formal observation, performance, journal, interview, paper and pencil, presentation, and portfolio. Some assessment tasks may be used to assess student learning in relation to a single outcome, others to assess student learning in relation to several outcomes. The assessment task identifies the outcome(s) addressed being assessed; the outcome number is in brackets after the task.


*Column Four: Resources/
Notes*

This column is a provincial responsibility.

Unit 1
Life Science:
Plant Growth and Changes

Plant Growth and Changes: Unit Overview

Introduction

Careful observation of the natural world reveals patterns of growth—how plants grow and respond to their natural environment. Students' awareness of plants begins with a variety of informal encounters within the local environment, but their deeper understanding develops from experience in planting, nurturing, and observing individual plants over an extended period of time. Some activities call for caution to be exercised, look for the  symbol.

Focus and Context

This unit starts off with an inquiry focus, as students investigate how various conditions affect plant growth, and explore the life cycles of plants. The unit then proceeds to introduce technologies that provide products and processes using plants to meet the needs of people.

Science Curriculum Links

Students will have explored the needs and characteristics of plants in grade 1. This unit on plant growth will complement and reinforce outcomes in the soils unit that is also completed in grade 3. Students should then have the background necessary for the grade 4 unit, *Habitats and Communities*, in which they explore features of plants that enable them to thrive in different places.

CURRICULUM OUTCOMES

STSE/Knowledge	Skills
<p>Students will be expected to</p> <p>100-29 identify and investigate life needs of plants and describe how plants are affected by the conditions in which they grow</p> <p>100-28 identify and describe parts of plants and their general function</p> <p>100-30 observe and describe changes that occur through the life cycle of a flowering plant</p> <p>102-12 describe ways in which plants are important to living things and the environment</p> <p>102-13 identify parts of different plants that provide humans with useful products, and describe the preparation that is required to obtain these products and how our supply of useful plants is replenished</p>	<p>Students will be expected to</p> <p>Initiating and Planning</p> <p>200-1 ask questions that lead to exploration and investigation</p> <p>200-3 make predictions, based on an observed pattern</p> <p>Performing and Recording</p> <p>201-5 make and record relevant observations and measurements, using written language, pictures, and charts</p> <p>201-6 estimate measurements</p> <p>Analysing and Interpreting</p> <p>202-2 place materials and objects in a sequence or in groups according to one or more attributes</p> <p>202-4 construct and label concrete-object graphs, pictographs, or bar graphs</p> <p>202-5 identify and suggest explanations for patterns and discrepancies in observed objects and events</p> <p>Communication and Teamwork</p> <p>203-2 identify common objects and events, using terminology and language that others understand</p> <p>203-5 respond to the ideas and actions of others and acknowledge their ideas and contributions</p>

Investigating Germination and Growing Conditions for Plants

Outcomes

Students will be expected to

- place seeds in groups according to one or more attributes (202-2)
- ask questions to investigate related to growing conditions for plants (200-1)
- make predictions about which conditions will be the best for plant growth (200-3)
- make and record relevant observations and measurements of plant growth during their investigations (201-5)
- construct and label bar graphs that show plant growth under different conditions (202-4)

Elaborations–Strategies for Learning and Teaching

Read ahead to the unit on “Exploring Soil.” It has outcomes related to soil conditions and effect on living things. Start planting now in preparation for those activities.

Students can bring in a variety of seeds to use in their investigations. In order to address outcomes found later in this unit related to the usefulness of plants, the teacher should supply herb or vegetable seeds. **Caution: Do not use commercial seeds that have been treated with powder fungicide.** Initially, students can compare the different kinds of seeds, noting their size, shape, colour, thickness, and appearance. Students can decide on some common attributes of the seeds, and group them accordingly. **Caution: Allergy Alert.** Teachers should be aware of any nut allergies if these are to be used in this activity.



Students should brainstorm their knowledge of plant needs. Students should generate questions that they might wish to investigate related to possible conditions in which to germinate and grow their plants. Students will probably know that plants need to be watered, but how much? How often? Examples of questions students might ask are: “Will the plant grow better if watered once or twice a week?”, “Will this plant grow better in the sunlight or darkness?” They can then make predictions about which conditions they feel will produce the best-growing plants, and record them in their journal.

Do not use commercial seeds that have been treated with powder fungicide. **Caution: Chemical Alert.** Students should not use any herbicides, pesticides, or other harmful chemicals as part of their tests.



Students should plant their seeds, being careful to record on the pot or cup the conditions that they will be using, so that plants don’t get mixed up. Students should accurately record their observations and measurements of the plant’s growth. This activity provides an excellent opportunity to develop the concept of a fair test (only one thing is tested at a time). Some conditions to try include varying the amount of water, light, temperature, wind, type of soil, and the inclusion of weeds.

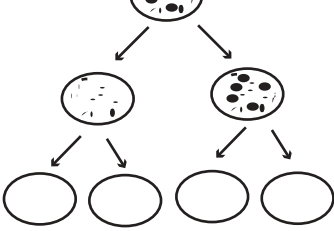
Students should construct a bar graph once all the data are collected. This can be used to reinforce mathematics graphing skills. Technology, such as spreadsheet and commercial software, can be used to generate the graph.

... continued

Investigating Germination and Growing Conditions for Plants

Tasks for Instruction and/or Assessment

Performance

- From all of the seeds you have been given, decide on a way to group them. (202-2) Explain your reasons for the way you grouped the seeds.
- 
- Fill in the chart “Helping Plants Grow” as you test conditions for growing plants. When you are finished, construct a bar chart to show the plants growth. From the list of conditions students have generated, various groups can select the variables they wish to investigate. Results can be shared with the class. Each of the variables should have a separate column in the chart. (201-5, 202-4)

Helping Plants Grow

Conditions	List the factors affecting plant growth
Date	Observations and drawings (include height of plant)
Conditions	
Date	

Journal

- I would like to find out if ... can make my plant grow faster. I predict that if ... (200-1, 200-3)

Interview

- What are some of the factors that might affect the growth of plants? *Groups might graph different variables such as the amount of water, light, and soil type and depth.* (200-3)

Resources

Teacher's Guide:

Pp. 22, 32, 37, 81

Student Resource:

Pp. 8, 12, 14, 30

Videos:

Growing, Growing
703178, VH

How a Plant Works
705700, VH

Let's Explore Plants
704215, VH

Plants
704836, VH

*Plants That Grow From Leaves,
Stems and Roots*
704686, VH

Where Plants Come From
706557, VH

Plant Classification
706005, VH

... continued

Investigating Germination and Growing Conditions for Plants (continued)

Outcomes

Students will be expected to

- draw inferences that identify and investigate life needs of plants and describe how plants are affected by the conditions in which they grow (100-29)
- identify and suggest explanations for patterns and discrepancies in the growth rate of similar plants grown in varying conditions (202-5)
- identify and describe parts of plants and their general function (100-28, 203-2)

Elaborations—Strategies for Learning and Teaching

Students should identify the conditions needed for plant growth (light, water, food, and space). They should describe the results and draw pictures to illustrate their plants. Based on their observations, students should draw inferences about the needs of plants. For example, based on an experiment of growing plants in different amounts of light, students can infer light affects how plants grow. Students could investigate how these conditions would affect a variety of plants, for example, cactus, aquatic plant, epiphyte, or hydroponic plants.

While the students' plants are growing in the classroom, they can take walks outside and compare plants in their local environment. They can note which kinds of plants grow on hills, under trees, in rocky areas, or by the seashore. Students may observe plants of the same kind growing in different locations, and note any differences. Students should suggest explanations for any observed patterns. Before the field trip, it is valuable if students develop an observation sheet to record their findings.

Students should be encouraged to use appropriate terminology for the parts of the plants; limit to roots, stem, seed, flower, trunk, bark and leaves. The functions of various parts can be explored through classroom discussion and observation, drawing on the results of investigations, as well as print and electronic resources. Students can draw, label and name a variety of local plants.

Investigating Germination and Growing Conditions for Plants (continued)

Tasks for Instruction and/or Assessment

Journal

- I am a plant. The conditions I need for growth are ... (100-29)

Paper and Pencil

- Draw pictures of the plants in your class that grew under different conditions. Which plants grew best? Tell me why? (100-29, 202-5)

Interview

- What conditions affect the growth of plants? (100-29)
- What do the roots do for a plant? (Teachers can question about other plant parts throughout this unit.) (100-28, 203-2)

Resources

Teacher's Guide:

Pp. 12, 17, 22, 27, 32, 42

Student Resource:

Pp. 4, 6, 8, 10, 12, 16

The Life Cycle of a Plant

Outcomes

Students will be expected to

- observe and describe changes, using written language, pictures, and charts, that occur through the life cycle of a flowering plant (100-30, 201-5)
- estimate measurements of the plant as it grows (201-6)

Elaborations–Strategies for Learning and Teaching

Students should grow flowering plants or have an opportunity to observe flowering plants (such as marigolds, bulbs) over a long period of time. Students can plant seeds in a container that allows a view of the seed as it germinates. Consider using a glass jar stuffed with damp paper towel, or a plastic bag taped to the window. The seeds are placed in view against the glass or plastic. As the seed germinates, students could use drawings to record their observations of the plant's life cycle, estimate the lengths of the various parts of the plants (for example, leaf size, root length, height), and take measurements. This activity can be used to address mathematics outcomes in measurement. Students could observe the bloom using a magnifying glass. The whole sequence of plant growth (germination, sprouting, buds forming, flowering, pollination, fruit/seed growth) can be observed. The newly formed seeds can be potted to continue the cycle back to seeds. Students may explore other ways to grow plants (e.g., clippings, bulbs, or the eye of a potato).

Students can investigate through hands-on experiences, video, print and electronic sources, how pollen and seeds are carried from place to place. Wind, rain, birds, insects and other means of transporting seeds can be noted. Students may recall how dandelions turn white and puffy as their life cycle continues, and the seeds are then spread by the wind.

The Life Cycle of a Plant

Tasks for Instruction and/or Assessment

Performance

- Draw pictures and label the different stages (germination, sprouting, buds forming, flowering, pollination, fruit/seed growth) of a flowering plant you are growing. (100-30, 201-5)
- Draw or cut out pictures of the stages of the life cycle of a flowering tree, and put them in order. Include a picture of seeds, the seed germinating, the flower buds starting to form, the flowering stage, and the seeds forming. (100-30)

Presentation

- Perform a skit or produce a video on the life cycle of a flowering plant. (100-29, 100-30)
- Fill in the table below.

Growth/Prediction Chart

Week	Predicted Growth	Actual Growth
1		
2		
3		
4		

Resources

Teacher's Guide:

Pp. 12, 22, 37, 42, 48

Student Resource:

Pp. 4, 8, 14, 16, 18

Videos:

Learning About Flowers and Their Seeds

705666, VH

Plants

702095, VH

How Plants Grow

706558, VH

Uses for Plants

Outcomes

Students will be expected to

- describe ways in which plants are important to living things and the environment (102-12)
- identify parts of different plants that provide humans with useful products, and describe the preparation that is required to obtain these products and how our supply of useful plants is replenished (102-13)

Elaborations–Strategies for Learning and Teaching

Students should describe the importance of plants to living things such as shelter, food, and oxygen. Students should explore a variety of uses for plants. Students could be introduced to products and processes, derived from plants, that have been developed to meet the needs of humans. Students, in groups or individually, could explore a use for plants, and present their findings to the class. This activity reinforces social studies outcomes on sustainability. Students could focus on the following:

- **Food:** The leaves of some plants can be eaten (for example, dandelions, beets, lettuce), or used for flavouring (for example, mint, oregano, savoury). The roots of some plants (for example, turnip, carrots, beets), some flowers (for example, nasturtiums), and many seeds (for example, sunflower, poppy) are edible. Students can grow small vegetables like carrots or peas, collect dandelions, or bring in a variety of edible seeds, roots, and fruits and have a vegetarian feast day. **Caution: Students should be warned that not all plants are edible.**
- **Art and decoration:** Students could collect local wildflowers and practice arranging or drying them, or use them to make a variety of craft items.
- **Medicines:** Some plants, for example, garlic, ginseng may be used in medicines. Students could interview people in their community to find out natural remedies using specific plants, and make a poster or collage to illustrate their findings.
- **Dyes:** Some plants, for example, beets (red), blueberries (blue), onions (yellow) are used to make dye. Students could tie-dye white T-shirts using the dyes from local plants.
- **Fibres:** The fibres from some plants are used to make items. For example, cotton is used to make cloth, straw is used in baskets, cellulose or tree fibres are used in making paper, and onion skins are used for paper). Students could make paper, do some basket weaving, or bring in clothes made from cotton.



... continued

Uses for Plants

Tasks for Instruction and/or Assessment

Journal

- You are an organism living in a forest. Describe how plants are important to your survival. (102-12)
- What would happen if you were an organism that depended on trees and the trees where harvested? (102-12)

Paper and Pencil

- Which of the following things contain plant parts? (Include pictures such as books, furniture, food, metal products.) (102-13)
- Classify food items according to the plant part used. (102-13)

How We Use Plants

Bark	Sap	Seed/ Flower	Roots	Stem/ Trunk	Leaves
cinnamon	maple (maple syrup)	apples	carrots	celery	lettuce

Interview

- Describe ways plants are important to us and all living organisms. (102-12)

Presentation

- Create a video, skit or a pictorial presentation on how plants are important for survival in a natural environment. (This could include water or land.) (102-12)
- Create a video, skit, or a pictorial representation on human uses of plants. (102-13)

Resources

Teacher's Guide:

Pp. 53, 58, 65, 71, 75

Student Resource:

Pp. 20, 22, 24, 26, 28

Videos:

Learning About Flowers and Their Seeds

705666, VH

... continued

Uses for Plants (continued)

Outcomes

Students will be expected to

- identify parts of different plants that provide humans with useful products, and describe the preparation that is required to obtain these products and how our supply of useful plants is replenished (102-13)
- respond to the ideas and actions of others and acknowledge their ideas about the uses and replenishing of plants (203-5)

Elaborations–Strategies for Learning and Teaching

- Provide oxygen: Animals need oxygen to breathe. Plants produce oxygen, and also can filter impurities from the air. Students can plant trees around the school yard as a naturalization project.
- Prevent Erosion: Plants are valuable to prevent erosion. Look in the grade 3 *Exploring Soils* curriculum unit for activities related to this use.
- Building Materials: Students could look at the wide variety of wood products that are made from the trunks of trees (e.g., plywood, lumber, panelling). If possible, students could visit a local sawmill to see how trees are processed into lumber.

Students should explore the issues related to the uses and replenishing of plants. A role play activity in which students formulate the ideas and propose solutions to various environmental issues may be valuable. Students would work in groups, and each group would work on a specific issue.

Depending on the locality, students could visit: the produce section of the grocery store, farms, garden shops, florists, logging camps, the seashore, companies employing silviculture techniques, paper mills, a factory that processes fruit, vegetables, flowers, or trees, or interview fishers, farmers, gardeners, environmentalists, grocers, or loggers. Guest speakers or field trips provide excellent opportunities to experience, first hand or from the experts, the uses, manufacturing techniques, and environmental concerns related to plant growth and replenishment. Students should understand that some plants, such as lady slipper orchids, are endangered and are not to be disturbed.

Uses for Plants (continued)

Tasks for Instruction and/or Assessment

Journal

- Today we visited (or had a visitor from) a _____ (farm, garden centre, paper mill, green house, or industrial processor of plant products). I learned that ... The best part of the trip (or talk/demonstration) was ... (203-5)

Interview

- Why is it important to replenish plants in our environment? (203-5)

Presentation

- Develop a presentation about being a user of plants which illustrates why it is important to replenish plants. (203-205)

Portfolio

- Select a piece(s) of work from this unit to put in your portfolio.

Resources

Teacher's Guide:

Pp. 58

Student Resource:

Pp. 22

Unit 2
Earth and Space Science:
Exploring Soils

Exploring Soils: Unit Overview

Introduction

Students soon discover there is more to soil than just dirt. It is a place for creatures to live, for plants to grow and, it provides a base for gardens, forests, fields, and farms. By examining soils, students discover soils are made up of more than one type of substance. The particular combination of materials in soil has a lot to do with what lives in it and on it. By focusing on the ways we can change soil, especially changes that occur as a result of water, students learn soil is affected by humans and the environment.

Focus and Context

Inquiry is the focus of this unit. Students should have many opportunities to observe, manipulate, and test various soil samples to explore their composition, water absorption, drainage, and how they erode. The importance of soils to living things, and how technological processes transform soil into other products is also emphasized.

Science Curriculum Links

This unit should complement the grade 3 unit, *Plant Growth and Changes*, since many of the activities can be used to address outcomes from both units.

Exploring Soils will provide the background knowledge necessary for the grade 4 unit, *Rocks, Minerals, and Erosion*.

CURRICULUM OUTCOMES

STSE/Knowledge	Skills
<p>Students will be expected to</p> <p>100-36 explore and describe a variety of soils and find similarities and differences among them</p> <p>100-37 investigate and describe soil components</p> <p>100-38a describe the effect of moisture on characteristics (e.g., cohesion - ability to hold together, texture, colour of the soils)</p> <p>100-38b compare the absorption of water by different soils</p> <p>100-39 observe and describe the effects of moving water on different soils</p> <p>100-35 investigate and describe how living things affect and are affected by soils</p> <p>101-12 demonstrate and describe ways of using earth materials to make useful objects</p>	<p>Students will be expected to</p> <p>Initiating and Planning</p> <p>200-1 ask questions that lead to exploration and investigation</p> <p>200-3 make predictions, based on an observed pattern</p> <p>Performing and Recording</p> <p>201-3 use appropriate tools for manipulating and observing materials and in building simple models</p> <p>201-5 make and record relevant observations and measurements, using written language, pictures, and charts</p> <p>201-7 identify and use a variety of sources of science information and ideas</p> <p>Analysing and Interpreting</p> <p>202-2 place materials and objects in a sequence or in groups according to one or more attributes</p> <p>202-4 construct and label concrete-object graphs, pictographs, or bar graphs</p> <p>202-7 propose an answer to an initial question or problem and draw simple conclusions based on observations or research</p> <p>Communication and Teamwork</p> <p>203-1 communicate questions, ideas, and intentions while conducting their explorations</p> <p>203-3 communicate procedures and results, using drawings, demonstrations, and written and oral descriptions</p>

Investigating Soils Composition

Outcomes

Students will be expected to

- ask questions and make predictions that lead to exploration and investigation about the composition of soil (200-1, 200-3)
- explore and describe a variety of soils and find similarities and differences among them (100-36)
- investigate and describe soil components using appropriate tools such as spoons, magnifying glasses, jars, and filters (100-37, 201-3)
- make and record observations and measurements in investigations related to soil composition (201-5)
- propose an answer to initial question related to soil composition based on their investigations (202-7)

Elaborations–Strategies for Learning and Teaching

This unit should be integrated with the curriculum unit, *Plant Growth and Changes*. As students determine the factors that affect the growth of plants, they should investigate soil type. Teachers should have students complete a chart with the column headings *What I know about soil* and *What I would like to find out*. Some things they might know could include “Soil has worms in it”, “Soil helps plants grow”, or “Soil has dirt and rocks in it”. Some things they might want to learn about could include “Is soil the same everywhere?”, “What kind of soil is best for growing plants?” or “How is soil made?”. Some of these questions will be investigated during this unit.

Soil composition questions will be the focus of this section. Students should explore a variety of types of soil samples from different areas (e.g., river banks, forest, grassy fields, top of a hill, bottom of a hill) to determine how the composition of soil varies. If students bring in soil samples from their back yards, the soil composition will probably be totally different than one from a more natural setting, since many homes are not built on the original soil but rather fill brought from elsewhere. **Caution: It is advisable to wear gloves when working with soil.**



Students can spread soil samples on newspapers, and note similarities and differences in properties such as colour, texture, and ability to hold together. Magnifying glasses can be used to further explore these soils.

Students can separate and view the components of various soil samples by putting each in a clear plastic jar, adding water, and shaking it. The jar should be left to settle for at least one day. Students can measure the layers to compare the amounts of the various components (e.g., clay, silt, sand, gravel, humus) in each soil sample. Measurements can be displayed using bar graphs. This activity can be used to address grade 3 mathematics outcomes.

Students can take soil samples and sieve them through mesh/screen of progressively smaller openings, such as chicken wire, colanders, and flour sieves. Students can compare the amounts of materials that result from the consecutive screenings.

From their explorations, students will be able to see similarities and differences in soil samples, and can draw pictures that show patterns that emerge from their settling investigations. They can compare and describe soils (e.g., particle size, colour, texture) from many locations. Ultimately, they will see that soil composition varies from one place to another.

Investigating Soils Composition

Tasks for Instruction and/or Assessment

Performance

- Take a soil sample, put it in a clear plastic container, and add water until the container is $\frac{3}{4}$ full. Put the lid on, and shake the container. Watch the contents settle.
 - As you watch the particles settle, do you notice any patterns?
 - Let the container settle overnight. Draw a picture of the settled soil in the container in your notebook.
 - Compare your soil sample composition with that of other classmates. (100-36, 100-37, 201-3, 201-5)
- Using different size screening materials (chicken wire, colander, flour sieve), separate your soil sample into different piles. Each pile for a given screen.

Describe the materials in each pile. Are all the particle types the same, or different? Compare the sizes of the piles after sifting/screening. Measurements can be displayed as a bar graph. (100-36, 100-37, 201-3, 201-5)

Journal

- Write what you learned about different types of soils. (202-7)

Paper and Pencil

- Predict what kinds of layers you are going to have after your soil sample settles. (200-1, 200-3)

Interview

- Are there places in your community where the soil is different? Compare the soil from a pasture to the soil on a mountain, or on a river bank. (202-7)

Resources

Teacher's Guide:

Pp. 12, 17, 22, 27, 39, 53, 58, 62

Student Resource:

Pp. 4, 6, 8, 10, 16, 22, 24, 26

Videos:

Dig
701741, VH

Every Stone Has a Story
704950, VH

Learning About Rocks and Minerals
705664, VH

Rocks and Minerals
701239, VH

Rocks: When is a Rock a Liquid?
704203, VH

What's the Earth Made of?
704948, VH

Water Absorption of Soils

Outcomes

Students will be expected to

- describe the effect of moisture on characteristics of the soils (100-38a)
- make predictions about the absorption of water by different types of soil and test these through exploration and investigation (200-3)
- compare the absorption of water by different soils (100-38b)
- construct and label bar graphs to show the amount of water absorbed by different soil samples (202-4)
- place soil samples (containers of soil) in order of their ability to absorb water (202-2)
- communicate procedures and results of investigations related to the testing of water absorption of soils, using drawings, demonstrations, and/or written and oral descriptions (203-3)

Elaborations—Strategies for Learning and Teaching

Students can investigate what happens when various types of soils become wet. For example, Do they feel different, pile up differently, or hold together differently? Are some soil types better for making mud pies than others? Do some soil types stick together better after drying? Do some soils hold more water than others?

During their explorations, students may notice that some soil samples seem to absorb more water than others. They should make predictions about which soil samples they think will absorb the most water, and then test their predictions with detailed investigations.

To test the water absorption capacity of various soil samples, students can put the same amount of each sample (e.g., sandy soil, gravelly soil, loam, potting soil, clay soil) in a plastic cup with small holes poked in the bottom. A variety of soil types can be obtained from hardware stores or garden shops. Students pour equal amounts of water on each sample, and measure the amount of water that drains through noting how much water was retained by each sample and with sample retained the most. A discussion of variables that might have affected their result could highlight, for example, the effect of taking soil samples after a rainy day versus taking soil samples in the middle of a dry spell.

Students can practice graphing skills with both of these activities (mathematics outcome F3).

As students are finishing their work on the capacity of soil to retain moisture, teachers can ask them to think about questions such as “When would you want to have soil that absorbs lots of water? When is the opposite true?” and “When would you want to have good drainage?” Students may have noticed in the unit, *Plant Growth and Changes* that some plants grow better in dry, well-drained soil, while others need to have very wet soil. They may note that driveways are often constructed with gravel that allows water to drain away, while a layer of topsoil is usually put over gravel on lawns to provide water absorption for the grass, as well as necessary nutrients for its growth.

Water Absorption of Soils

Tasks for Instruction and/or Assessment

Performance

- Complete the chart as you investigate the effect of water on different soil types. (100-38a)

Properties of Soils

Type of soil (clay, sandy, loamy, etc.)	Colour, texture and size (drawing of sample particle)	Ability to hold together when dry	Ability to hold together when wet	Colour when wet
clay	tiny reddish particles	can squish together, but will fall apart easily	clumps together and can form a ball	reddish-brown

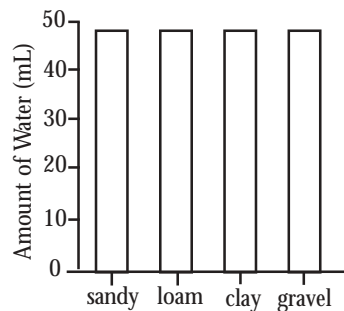
- Put four or five small holes (the size of a skewer) in the bottom of a styrofoam cup. Put 125 mL ($\frac{1}{2}$ cup) of soil in the cup.

Hold it over another styrofoam cup, and pour 125 mL of water over the soil. Measure the amount of water that drips out. Record your results in the chart.

Soils Absorb Water

Soil type or description	Amount of water absorbed
sandy	
loam or potting soil	
clay	

How much water does soil hold?



Compare your results to your classmates for different types of soils, and draw a bar chart to display your class results. (100-38b, 202-4, 202-2, 203-3)

Resources

Teacher's Guide:

Pg. 49, 53

Student Resource:

Pg. 20, 22

Moving Water and Soil

Outcomes

Students will be expected to

- observe and describe the effects of moving water on different types of soils (100-39)

Elaborations—Strategies for Learning and Teaching

From personal experiences have students discuss possible effects of moving water on various types of soil. Have students suggest methods they could try in class to test their predictions. Students can observe and describe patterns in soil that result from running water. For example, students can explore which soil materials move readily due to water movement and those that do not. They can pour water from a watering can on a pile of soil that contains a range of particle sizes, and record observations. On a smaller scale, students can pour water at one end of a cake pan containing sand or soil, and observe and describe what happens to the soil. The pan should be slightly tilted. Students should record their procedures and investigations using drawings, demonstrations and written/oral presentations. Students may be given the opportunity to observe the effects of moving water on soil in their community where such evidence exists. They can observe and describe patterns in soil that result from running water by noting changes in the school yard after a particularly heavy rain, looking at the ground near an eavestrough run-off, and noting the banks of rivers, creeks, streams and culverts.

Caution: It is advisable to wear gloves when working with soil.



The following activity could be done in conjunction with activities from the unit on *Plant Growth and Changes*. Given a pile of soil, students can investigate different methods of preventing the soil from washing away. One thing they might try is to investigate the effect of plant growth on erosion. Students can use small aluminum pie plates with a few holes in the bottom for drainage, and plant grass seed in one, and various other seeds in the rest. Leave one pie plate with only soil as the control. When the seeds have grown into plants, students can run or pour equal amounts of water on one side of the tipped pie plates, and note which plate has more soil running away from it. Students may also wish to test other means to prevent erosion, such as stretching nylon stockings or other meshed material over the pie plates. Netting is sometimes used to prevent soil erosion on the slopes besides many new highways. It provides a means of preventing erosion until grass or other plants can grow. Making ridges in the soil that run perpendicular to the flow of water (contour plowing) is a common technique used by farmers when plowing hills. To illustrate this, have students make plowing ridges in a tray of soil in a way that causes the least erosion when water is poured on the tilted tray.

Students can look for evidence in their community of erosion prevention strategies. For example, grass is often planted on the banks of highways to prevent the soil from washing away.

Moving Water and Soil

Tasks for Instruction and/or Assessment

Performance

- Take a soil sample with different particle sizes in it. Put it in a cake pan, tip the pan slightly and pour 250 mL of water on top. (100-39)

What happens to the soil? Do you notice any difference between the types of particles that were washed away and the ones that stayed?

- Go outside the school and look at the ground near a water runoff from the school roof (eavestrough). What do you notice about the soil under the eavestrough? (100-39)

Resources

Teacher's Guide:

Pp. 58

Student Resource:

Pp. 24

Videos:

Where Does Sand Come From?
702232, VH

Earth's Crust/Rocks and Soil
705963, VH

Interactions of Living Things and Soils

Outcomes

Students will be expected to

- investigate and describe how living things affect and are affected by soils (100-35)

- identify and use a variety of sources of science information to gather information about how living things affect and are affected by soils (201-7)

Elaborations–Strategies for Learning and Teaching

Investigations should focus on the following:

- investigating and describing living things found in the soil
- investigating plant roots and describing how they spread through the soil
- investigating and describing the recycling of biological materials in soils

Students can spread a sample of soil on a clear sheet of plastic and observe what crawls out of and through the soil, or they can lift rocks or other ground coverings to see the insects that are under them.

They can compare the insects and grubs that live in a variety of soils (e.g., clay, loam). Students can put different soil samples in plastic bags or small jars with some living things, and observe how they move through the soil, what they seem to be eating, and any signs of droppings. An ant farm or a plastic bag or device (made with two sheets of plexiglass held about 2 cm apart) containing insects, worms, and grubs would provide opportunities for closer observation. Where appropriate, have students observe in a natural setting.

Outcomes from this section complement outcomes from the grade 3 unit *Plant Growth and Change*. Students can investigate plant roots and describe how they spread through the soil. One way of doing this is to place moist paper towel inside a glass jar or plastic bag. Place popcorn (unpopped) between the glass/plastic and paper towel. Popcorn will sprout and roots and leaves will be visible to observe.

Students can make a classroom compost by collecting food scraps (such as apple cores, banana peels) from lunches and putting them in a plastic ice cream container. They need to put some holes in the top so air can get in and out, add in some bugs/worms to the container, and then let the food decompose. The compost container can be kept outside, but since the months schools are open are fairly cold, it should be kept inside for short periods of time to speed up the process. Students can explore the advantages of composting, and the uses for compost material.

Students could also explore the decomposing of materials by making a leaf litter. In the fall, students can pile up fallen leaves, and then in the spring, they can dig around them to see how much has decomposed.

Students can use other sources of information to learn more about how living things affect and are affected by soil. They may visit sites on the Internet on composting, watch videos, or read magazines that highlight beetles, worms, slugs, or other soil creatures.

Interactions of Living Things and Soils

Tasks for Instruction and/or Assessment

Performance

- Take some soil and put it in a clear container. Pack the soil down fairly tightly. Put three or four worms on top of this soil, and observe the worms periodically throughout the next couple of days. What happens to the soil over the two days? Why do you think worms are good for soil? (100-35)
- Put some potting soil in a small, clear plastic cup. Plant some seeds and care for them as they germinate and grow. Look for evidence of the roots through the cup, and draw what you observe. Why do you think roots need soil? (100-35)
- In a plastic jar, put vegetable or fruit scraps collected over a two week period. Add a layer of soil on top. Store the container in a warm place for a long time (a couple of months at least). Stir things around daily and add small amounts of water. Record your observations through writing and drawings during this time period.

After the compost process is finished, investigate the value of compost for plant growth. In one cup, plant seeds in regular potting soil or dirt from around the school or your home. In a second cup, mix your compost material with the soil, and plant the same kinds of seeds. Care for both cups the same way, and record your observations in a chart.

Research and write a report on composting, and include this with your observations from your own compost experiment. (100-35)

Using Compost

Date		Potting soil or dirt	Potting soil with compost
(insert date)	Observations		
	Growth Measurement		
(one week later)	Observations		
	Growth Measurement		

Resources

Teacher's Guide:

Pp. 31, 35, 44, 67

Student Resource:

Pp. 12, 14, 18, 28

Videos:

Let's Explore Soil and Rocks
704224, VH

Soil
702093, VH

Soil: An Introduction
703802, VH

Technological Products and Processes Related to Soil

Outcomes

Students will be expected to

- demonstrate and describe ways of using earth materials to make useful objects (101-12)
- communicate questions, ideas, and intentions while using earth materials to make useful objects (203-1)

Elaborations–Strategies for Learning and Teaching

Students can use a variety of materials that come from the earth to make useful products. They can make “pottery” from clay, experiment with different soil materials to make mud bricks, or collect small, colourful stones to use as decorations on objects such as empty tins, that can be turned into pencil holders. They can make ceramic shapes, or use beads to make jewellery.

Displays of pictures or objects can be set up around the room to illustrate the many uses for earth materials. The displays could include earthenware or pottery, pictures of mud huts, bead jewellery, and various ceramic, brick and concrete objects. Students may have objects at home they could bring and show to the class.

Technological Products and Processes Related to Soil

Tasks for Instruction and/or Assessment

Presentation

- In a group of two or three, choose an “earth” product to make and display for the class. Alternatively, this activity could have everyone making the same type of product. This activity can provide opportunities for connections to art and social studies outcomes. (101-12)
- Bring an earth product from home. Find out where the product was made, what it was made from, and what it is used for. Write this information clearly on a file card for display, and include it in a class display of earth products. (203-1)

Informal/Formal Observation

- Observe students as they work as a team to complete their products. Anecdotal records can be used to document their abilities to work as a team, communicate, and problem solve. (203-1)

Resources

Teacher's Guide:

Pp. 72

Student Resource:

Pp. 30

Videos:

Let's Explore Soil and Rocks
704224, VH

What Good Are Rocks?
702231, VH

Unit 3
Physical Science:
Invisible Forces

Invisible Forces: UNIT OVERVIEW

Introduction

Some forces involve direct pushes and pulls, where a surface is directly contacted, while others involve interaction from a distance. The intent of this unit is to introduce students to two kinds of forces that can act between objects, where the objects need not be touching one other.

Students learn that magnetic forces and static electric forces both involve attraction and repulsion, but have different origins and involve different kinds of materials. Students discover a variety of ways these forces can be applied or can affect their daily life.

Although gravity is an invisible force, it is not addressed until the grade 5 unit, *Forces and Simple Machines*.

Focus and Context

Inquiry, in the form of observation and recording, is the focus of this unit. Through explorations of magnetic and static electric forces, students observe and record the materials and conditions that alter the strength of these forces. Investigations of electrostatic forces are best done in the winter, when the air is very dry.

Science Curriculum Links

Students first learned about the concept of forces in the grade 2 unit, *Relative Position and Motion* during investigations of the factors that affect motion. This unit will extend students' experiences with two types of forces—magnetism and electrostatic forces. This exploration of forces will be extended in the grade 5 unit, *Forces and Simple Machines*.

CURRICULUM OUTCOMES

STSE/Knowledge	Skills
<p>Students will be expected to</p> <p>102-14 identify familiar uses of magnets</p> <p>100-31 investigate to identify materials that can be magnetized and materials that are attracted by magnets, and distinguish these from materials that are not affected by magnets</p> <p>100-32 investigate the polarity of a magnet, determine the orientation of its poles, and demonstrate that opposite poles attract and like poles repel</p> <p>100-33 identify conditions that affect the force of magnets and of static electric materials</p> <p>101-8 describe and demonstrate ways to use everyday materials to produce static electric charges, and describe how charged materials interact</p> <p>102-15 describe examples of the effects of static electricity in their daily lives, and identify ways in which static electricity can be used safely or avoided</p>	<p>Students will be expected to</p> <p>Initiating and Planning</p> <p>200-2 identify problems to be solved</p> <p>200-3 make predictions, based on an observed pattern</p> <p>Performing and Recording</p> <p>201-1 follow a simple procedure where instructions are given one step at a time</p> <p>201-3 use appropriate tools to manipulate and observe materials and to build simple models</p> <p>201-5 make and record relevant observations and measurements, using written language, pictures, and charts</p> <p>Analysing and Interpreting</p> <p>202-2 place materials and objects in a sequence or in groups according to one or more attributes</p> <p>202-7 propose an answer to an initial question or problem and draw simple conclusions based on observations or research</p> <p>202-8 compare and evaluate personally constructed objects with respect to their form and function</p> <p>202-9 identify new questions that arise from what was learned</p> <p>Communication and Teamwork</p> <p>203-3 communicate procedures and results, using drawings, demonstrations, and written and oral descriptions</p> <p>203-5 respond to the ideas and actions of others and acknowledge their ideas and contributions</p>

Magnetic Forces

Outcomes

Students will be expected to

- investigate to identify and group materials that can be magnetized and materials that are attracted by magnets, and distinguish these from materials that are not attracted to magnets (100-31, 202-2)
- investigate the polarity of a magnet, determine the orientation of its poles, and demonstrate that opposite poles attract and like poles repel (100-32)
- follow a simple procedure where instructions are given one step at a time to increase and test the strength of a temporary magnet by stroking it or storing it next to a stronger magnet (201-1)
- identify problems to be solved related to magnetizing materials (200-2)
- identify familiar uses of magnets (102-14)

Elaboration–Strategies for Learning and Teaching

Caution: Do not allow students to hold magnets near computers, computer discs, videos, audio tapes, or television sets.



Background for teacher: the designation of “north” and “south” on a magnet is an arbitrary standard. Given unmarked magnets, students will be unable to distinguish one pole from the other. Bar magnets on which the poles are marked can be used so students can see that opposite poles attract, and like poles repel.

Students can investigate materials that can be magnetized. Students will be curious about which materials will attract magnets, and will be eager to test out a wide variety of materials. They may encounter magnets that do not appear to be strong, or magnets that are so strong that pins or staples attracted by the magnet will stay together after the magnet has been removed. These situations can lead to discussions and investigations involving the strength of magnets, and how to magnetize materials such as pins and iron nails. Show students how to stroke an iron object or other magnetic metal with a magnet to make that object a magnet. They can then test materials to see if they can make them magnetic, or their weaker magnets stronger.

Students can follow a procedure to make a temporary magnet and assess its strength. They begin by selecting an iron nail, a magnet, and some staples. Then they can be instructed to stroke the nail five times in the same direction using the same end of the magnet. They can then put the iron nail into the staples, and record the number of staples that were attracted. They can repeat this procedure a number of times, and record the number of staples that are attracted. Students should be instructed in the proper way to handle and store magnets. Magnets gradually lose their strength if they are dropped repeatedly, or stored improperly.

Students should investigate the uses of magnets. Bar magnets and horseshoe magnets can be explored to determine objects are attracted to magnets, and those which are not. When students hold magnets together, they will discover that sometimes magnets attract, while other times they repel.

. . . continued

Magnetic Forces

Tasks for Instruction and/or Assessment

Performance

- Complete the chart as you investigate magnets. (100-31, 202-2)
- Set up tests to find out which end of a magnet is the north pole. Through writing and/or drawing, record your observations and inferences. (100-32)
- Scatter iron filings on a sheet of paper, and scatter salt on a second sheet. Hold different shapes, sizes and strengths of magnets under each sheet, and draw what you see when you slightly jiggle the sheets. (200-2)

Will this object be attracted to a magnet?		
Object	Prediction	Actual
paper clip		
⋮		

Journal

- Today I learned about magnets ... (Look for words like attract, repel, north, south in the student's description of what he/she learned.) (100-32, 200-2)

Interview

- How can you magnetize an iron nail? How can you prove that it has become magnetized? (200-2)
- What is the correct way for storing bar magnets? (200-2)
- Are all metals attracted to magnets? (200-2)
- How can you make this nail a stronger magnet? How can you make it weaker? (201-1)



Caution: Do not hold magnets close to computers, computer disks, videos or audio tapes.

Resources

Teacher's Guide:

pp. 17, 23, 29, 34, 41, 47, 51

Student Resource:

pp. 6, 8, 10, 12, 14, 16, 18

Videos:

Physical Science 1
704401, VH

Magnetism

705550, VH (Teacher Use)

Electricity and Magnetism

705996, VH (Teacher Use)

All About Magnets

706257, VH

Magnetism

706274, VH

. . . continued

Magnetic Forces (continued)

Outcomes

Students will be expected to

- make predictions about the number of objects a magnet can pick up under different conditions (200-3)
- make and record relevant observations during investigations about the number of objects a magnet can pick up under different conditions, and use the observations to identify conditions that affect the force of magnets (100-33, 201-5)
- propose answers to questions related to magnetizing materials (202-7)
- in cooperative groups, construct and evaluate a toy that is moved by attractive or repulsive magnetic forces (201-3, 202-8, 203-5)

Elaboration—Strategies for Learning and Teaching

Students can brainstorm various conditions (e.g., intervening solids, distance from magnet) to test the strength of the magnets, and then predict the number of staples that the magnet will pick up. The predictions should be recorded in a chart.

Students can then actually test the strength of magnets or magnetized objects by counting how many objects a magnet can hold (e.g., paper clips, nails). They can investigate each of the conditions identified in their brainstorming.

Students should use their observations from their investigations to make inferences about the strength of magnets under varying conditions and share them with their classmates.

Students can identify places and times in their lives where magnets are used on a regular basis. They can make a simple toy or device that has a magnet on it, and experiment with making it move using other magnets. Some students will choose to move their toys using attractive force, while others may use repulsion to get a better motion. Encourage them to work together, look at their options, and test out various ways of getting their toy to move.

Magnetic Forces (continued)

Tasks for Instruction and/or Assessment

Performance

- Complete the chart as you investigate how to increase the magnetism of an iron nail. (200-3, 100-33, 201-5)
- Use magnets and materials provided to make a toy you can move. For example, a toy boy or girl that can climb walls or a car that can be controlled. (201-3, 202-8, 203-5)
- Complete the chart below as you investigate factors that you think might affect the strength of the magnetic force. (100-33, 201-5)

Making a Nail a Stronger Magnet

Number of strokes	Prediction of number of staples attracted	Actual number of staples attracted
0		
5		

Factors affecting the Strength of a Magnet

# of sheets of paper between magnet and staples	# of staples picked up	Distance from magnet	# of staples picked up
1		0 cm	
2		1 cm	

Journal

- My testing proved I could make a magnet stronger by ... The types of things that are attracted to magnets include... (202-7)

Presentation

- Show the class the magnetic toy that you made. Explain how it works using terms like “attract” and “repel” or “pull” or “push”. (201-3, 202-8, 203-5)

Resources

Teacher's Guide:
pp. 29, 51, 74, 84

Student Resource:
pp. 10, 18, 26, 30

Electrostatic Forces (Forces arising from Static Electricity)

Outcomes

Students will be expected to

- describe and demonstrate ways to use everyday materials to produce static electric charges, and describe how charged materials interact (attract, repel) (101-8, 203-3)
- identify materials to be used to investigate conditions which affect the force of static electricity, and suggest ways to use them in their investigations (202-7)
- make and record relevant observations during investigations to identify conditions that affect electrostatic forces, draw simple conclusions about these conditions (100-33, 201-5, 202-7)

Elaboration–Strategies for Learning and Teaching

This section of the unit is best done in the winter when the air tends to be dry. Students can start their exploration of static charges by rubbing a variety of materials together, and determining if the materials will then attract other objects, such as puffed rice, confetti, suspended pith balls or balloons, or other objects they wish to test.

Students can observe attraction and repulsion caused by static electricity using materials such as suspended balloons, fur, water, combs, and confetti. Students can rub two balloons with the same material (cotton, fur or wool), explore how the balloons interact, and then record the results. They can also rub a balloon with one piece of material (e.g., fur), and then rub other pairs of different materials together, and note how the suspended balloon interacts with each of these other materials. For each pair of materials, the balloon should be attracted to one and repel the other. Students can also see what happens when a charged material (e.g., wool that has been rubbed) touches the balloons. Students can make and record their observations, and draw simple conclusions such as “some things cause more static”.

Which material will cause the greatest static charge in rubber?

balloon rubbed with	amount of confetti
cotton	not much
fur	
wool	lots

Background for Teacher - When two materials are rubbed, electrons will move from one material to another, and the materials will have opposite charges due to an excess of electrons on one of the materials (negative) and a reduction of electrons on the other (positive). If two balloons are rubbed with the same material, both balloons will have the same charge, and will repel each other. They will both be attracted to the original material with which they were rubbed, since opposite charges attract. Any other pair of materials that are rubbed together can then be held close to the balloons, and one of the pair will attract the balloon, while the other will repel it. If a highly charged object is attracted to the balloon so much that it touches it, electrons will be transferred as they touch. Both the balloon and the objects now hold the same charge, and will repel each other.

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Electrostatic Forces (Forces arising from Static Electricity)

Tasks for Instruction and/or Assessment

Performance

- Working in groups of two to four students, try to find ways to attract the most puffed rice using static electric forces. Write down what you tried and the observations you made. (100-33, 201-5, 202-7)
- Complete the chart as you investigate which materials will produce the most charge on a balloon. When you are finished, write what you discovered. Students can repeat this activity with a garbage bag and a plastic drinking straw. (100-33, 101-8, 201-5, 202-7, 203-3)

Which material will cause the greatest static charge in rubber?

balloon rubbed with	# of puffed rice attracted
cotton	
fur	

Interview

- Have you ever been able to stick a balloon to the wall without any tape or adhesive? How did you do it? Did it stay very long? (101-8, 203-3)
- How can you get two balloons that are suspended on threads to move away from each other without actually moving them apart? (101-8, 202-7, 203-3)

Resources

Teacher's Guide:

pp. 64, 69, 74

Student Resource:

pp. 22, 24, 26

Videos:

Physical Science 1
704401, VH

Electrostatics

702285, VH (Teacher Use)

Electrostatics

705538, VH (Teacher Use)

All About Electricity

706253, VH

Electricity

706267, VH

. . . continued

Electrostatic Forces (Forces arising from Static Electricity) (continued)

Outcomes

Students will be expected to

- identify new questions from what has been learned about static electricity (202-9)

- describe examples of the effects of static electricity in their daily lives, and identify ways in which static electricity can be used safely or should be avoided (102-15)

Elaboration–Strategies for Learning and Teaching

Students could discuss what they found out about static cling from their investigations. Students should be encouraged to identify new questions based on their investigations that could be investigated at another time. Some questions that students might ask are “Do different types of clothes cause more static cling than others?”, “Why do clothes dried in a clothes dryer have more static than the clothes on a clothes line?”

Products that inhibit static electricity (e.g., spray products used for clothes) or use static electricity (e.g., dusters and new brooms that pick up dust using static charge attraction) can be displayed around the classroom. Students might explore techniques to reduce static attraction or “static cling”, such as making things moist, or touching them to grounded metal. Students may relate this to why hair can stand on end when combed.

Electrostatic Forces (Forces arising from Static Electricity) (continued)

Tasks for Instruction and/or Assessment

Interview

- Describe what you know about static electricity and carpeted floors. (202-9)

Paper and Pencil

- Describe what can happen when taking your clothes out of the dryer. How do you think this is related to static cling? (102-15, 202-9)

Presentation

- Create a poster that shows products developed to reduce static (e.g., hair conditioners, sprays for clothes, static cling sheets for the dryer). (102-15)

Resources

Teacher's Guide:

pp. 64, 79

Student Resource:

pp. 22, 28

Unit 4
Physical Science:
Materials and Structures

Materials and Structures: UNIT OVERVIEW

Introduction

Students learn about the nature of materials, not just by observing them but, more importantly, by using them—sometimes in their original form and sometimes as part of things the students construct. The emphasis in this unit is on building things, and on selecting and using materials to fit the task at hand. Students learn that the characteristics of structures they build, such as strength, are linked to the properties of the materials they use, and to the particular way the materials are configured and connected.

Focus and Context

The focus of this unit is problem solving. Students should be provided with a number of challenges or design tasks over the course of the unit. Upon receiving these the students will follow steps in the problem solving process to design solutions. **Proposing:** Students should be given opportunities to research a variety of designs already in use, and investigate the properties and ways of joining materials to see why they will be suitable for the particular task or challenge. They will then be in a position to propose solutions to the task or challenge. **Creating:** Students gather materials and tools they have chosen and design a solution to the task or challenge. This will involve revisions of the original plan as problems are encountered. **Testing:** Students will test and evaluate their design, compare it to the designs of others, and refine their designs as appropriate.

Students should be presented with several structural challenges or tasks that require individuals or small groups to complete the design technology cycle. These challenges should involve using a variety of materials, the acquisition of a variety of techniques for joining materials, and improving the strength and stability of structures.

Science

Curriculum Links

Students have distinguished between objects and materials in grade 1. This unit will provide the background necessary for a grade 5 unit, *Properties and Changes of Materials*, as well as give students the design skills necessary for the grade 6 unit, *Flight*.

CURRICULUM OUTCOMES

STSE/Knowledge	Skills
<p>Students will be expected to</p> <p>100-34 describe the properties of some common materials and evaluate their suitability for use in building structures</p> <p>101-11 investigate ways to join materials and identify the most appropriate methods for the materials to be joined</p> <p>102-16 identify shapes that are part of natural and human-built structures, and describe ways these shapes help provide strength, stability, or balance</p> <p>101-10 use appropriate tools to safely cut, shape, make holes through, and assemble materials</p> <p>101-9 test the strength and stability of personally built structures, and identify ways of modifying a structure to increase its strength and stability</p> <p>102-17 evaluate simple structures to determine if they are effective and safe, if they make efficient use of materials, and if they are appropriate to the user and the environment</p>	<p>Students will be expected to</p> <p>Initiating and Planning</p> <p>200-2 identify problems to be solved</p> <p>200-5 identify materials and suggest a plan for how they will be used</p> <p>Performing and Recording</p> <p>201-1 follow a simple procedure where instructions are given one step at a time.</p> <p>201-2 manipulate materials purposefully</p> <p>201-3 use appropriate tools for manipulating and observing materials and in building simple models</p> <p>201-6 estimate measurements</p> <p>201-8 follow given safety procedures and rules and explain why they are needed</p> <p>Analysing and Interpreting</p> <p>202-5 identify and suggest explanations for patterns and discrepancies in observed objects and events</p> <p>202-8 compare and evaluate personally constructed objects with respect to their form and function</p> <p>Communication and Teamwork</p> <p>203-2 identify common objects and events, using terminology and language that others understand</p> <p>203-3 communicate procedures and results, using drawings, demonstrations, and written and oral descriptions</p> <p>203-5 respond to the ideas and actions of others and acknowledge their ideas and contributions</p>

Proposing Solutions to Building Challenges

Outcomes

Students will be expected to

- identify problems to be solved while creating structures (200-2)
- describe the properties of some common materials, and evaluate their suitability for use in building structures (100-34)
- investigate ways to join materials and identify the most appropriate methods for the materials to be joined (101-11)

Elaborations–Strategies for Learning and Teaching

In the initial stage of the design process students are given a challenge that requires them to build a structure from materials. During the design process, students will encounter many problems (e.g., which materials to select, how to join them) they will have to solve. Before the actual construction phase starts, students should focus on selecting the appropriate materials and designing a structure for the task. Bridge and tower building are common challenges, but teachers and students can use their imagination to develop other tasks that encourage creative and critical thinking in the construction of models, and increase awareness of the variety of design structures and materials used in different situations. The task should be well-defined, and the appropriate features (e.g., be able to hold 200 pennies, should have a minimum height of 1 metre) should be identified. To get the most out of a problem, students should take time in the initial stage to explore options, examine materials and ways of joining them, and locate structures that have been built for similar reasons, or structures exhibiting shapes that give stability and strength.

Students should explore and describe the properties of some everyday materials that can be used in their constructions. Samples of cardboard, putty, popsicle sticks, cotton balls, plastic, toothpicks, wooden blocks, paper, cans, Styrofoam, pipe cleaners or straws should be available for students to use and evaluate their appropriateness. As they investigate the properties of these materials, they should determine a situation or structure for which a particular material would be well-suited. For example, cotton balls would not be a suitable material to build a house for people, but may make an excellent material for lining a bird's house, insulation or cushioning.

Students can also explore ways of joining materials. Firstly, this would involve identifying and evaluating common adhesive material: Students would then identify, evaluate, and apply ways of joining, such as the overlapping of components, the insertion of one component into another (e.g., paper clips into straws or toothpicks in peas), or the use of specialized items for joining (e.g., such as staples, or velcro™).

Caution: Students are to take care when stapling thick layers of paper/fabric or when using a hammer and nails.



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Proposing Solutions to Building Challenges

Tasks for Instruction and/or Assessment

Performance

- Make a list with the class, of problems which might arise in building a structure. (200-2)

Test materials and ways of joining them to determine which ones would be most appropriate for your structure. The development of the solution to this challenge will be continued throughout the unit. (101-11)

- Which glue works best for which material? Given various types of glue, add a drop of each to the materials being tested, and let the glue dry. Test the glue by counting the number of pennies or the number of paper clips that can be supported on the joint. (101-11)

Journal

- Today we had to test materials to determine which ones we might want to use in our structure. This is what we learned about trying to join the materials ... (101-11, 100-34)

Paper and Pencil

- Match the material with the structure for which it is most suited. (100-34)

Interview

- Which type of materials are you planning to use in your structure? Why? (100-34)

Material	Structure
cement	houses
wood	sidewalks
plastic	toys
etc.	etc.

Resources

Teacher's Guide:

pp. 16, 25, 31, 50, 54, 58, 66, 72

Student Resource:

pp. 6, 10, 12, 18, 20, 22, 26, 28

Videos:

Construction: Designing and Planning a Structure
703775, VH
(Teacher and Student Use)

Architecture

706348, VH

... continued

Proposed Solutions to Building Challenges (continued)

Outcomes

Students will be expected to

- identify shapes that are part of natural and human-built structures, and describe ways these shapes help provide strength, stability, or balance (102-16)

- identify materials that could be used to solve the problem posed, and suggest a plan for how they will be used (200-5)

Elaborations–Strategies for Learning and Teaching

Students should explore building simple structures with shapes such as triangles and squares, and test the structures to see which provide the most stability and strength. As they join materials and construct objects and examine structures, they should gain an appreciation for shapes such as triangles, columns, and arches, and the importance of a strong, supportive base. Students can examine human-built structures, such as umbrellas, stepladders, bridges, and towers, identify shapes within them, and describe reasons why the shapes are important to the structure. They can observe the symmetry in plants and animals, and then examine human-built objects that try to mimic this symmetry (e.g., compare the shape of a plane to that of a bird). They can also look at structures built by animals, for example, bird nests or beaver lodges.

Once students have investigated various materials and ways of joining them, they can group them based on the function they could serve and their suitability for the intended task.

Students can identify materials that would be best suited for a particular challenge, and suggest a plan for their use. Alternatively, some materials could be identified by the class or teacher as being appropriate for the challenge, and limits placed on the amount of each material to be used in the construction. For example, a challenge could require students to build a structure to hold three apples, one on top of the other. It could be left at this or extended to include a 20 cm by 20 cm square of nylon netting and a bottle of glue. Both approach has its advantages. The first approach does not limit the creativity of the student, while the second approach forces the students to think critically about how to best use a limited amount of material.

Have students draw a rough sketch of their plan before beginning the structure. They can then use this plan, and refine it as necessary in the next stage of the design process.

Opportunities to hear an architect talk about designing structures, or to visit a construction site, are valuable experiences to increase students' knowledge of the design and construction process.

Proposing Solutions to Building Challenges (continued)

Tasks for Instruction and/or Assessment

Performance

- Over a period of a week, observe various buildings and structures and keep a record of the shapes (e.g., rectangles, triangles) and structures (e.g., arches, columns) you see. (102-16)
- Using a sheet of paper and two soup cans, fold the paper to form a bridge that spans the two cans and holds the greatest amount of pennies. Test your design against those of your classmates. What things were done to make the strongest bridge? (102-17)
- Using straws and small paper clips (or soaked peas and toothpicks), form a variety of shapes (e.g., triangles, squares, pentagons). Gently push on the shapes to determine their stability. Which shape is the most stable, and does not bend easily? (102-17)

Journal

- Draw a sketch of the plan for building your structure. As you proceed through the construction phase, note any problems you had, and how you solved them. (200-5, 101-11)

Resources

Teacher's Guide:

pp. 21, 25, 31, 36, 43, 50, 54, 66, 72, 75

Student Resource:

pp. 8, 10, 12, 14, 16, 18, 20, 26, 28, 30

Creating Solution to Structural Challenges

Outcomes

Students will be expected to

- use appropriate tools to safely cut, shape, make holes, and assemble materials (101-10, 201-3)
- follow safety procedures and rules while constructing structures and explain why they are needed (201-8)
- estimate measurements in order to select required materials for their structure (201-6)
- manipulate materials purposefully to create the structure (201-2)
- respond to the ideas of partners while constructing the structure, acknowledge these ideas and contributions, and make changes in the structure as deemed necessary (203-5)

Elaborations–Strategies for Learning and Teaching

In this part of the design cycle, students make their structures using the materials provided. Students should work cooperatively in pairs or small groups as they build their structure.

Tools and the construction processes used during this unit should be age-appropriate. Students can use safety scissors, a paper hole punch, school glue or other tools deemed safe by teachers to cut, make holes, or join materials when constructing.

Students should be aware of important safety rules, such as not running with scissors, and taking care with staplers. Students should be warned of the dangers of putting anything metal (e.g., scissors) in electrical sockets.

As students select materials for their construction, they can estimate, for example, the number of straws or the amount of aluminum foil they might need.

There should be opportunities for students to try their plan, encounter problems as they construct the structure, problem-solve together, and share questions, ideas and suggestions. Changes in the planning should be noted in the drawing. Students should discuss with their partners why changes should be made.

Background for Teacher: Teachers could make observations on these aspects of the activity as part of the assessment. Teachers should allow opportunity for changes in the plans, and discuss these changes with students.

Creating Solutions to Structural Challenges

Tasks for Instruction and/or Assessment

Performance

- Using your plan for materials and how you are going to join them safely build your structure. As you work on your structure, talk with your partner about any problems you encounter. Adjust your plan based on your discussions. (201-2, 203-5, 201-8)
 - Design a bridge that allows two-way “dinkie” traffic. The bridge should be strong enough to hold 10 cars at a given time, must span a distance of 50 cm, and must be 10 cm off the ground.
 - Design a tower that is 20 cm high, and capable of holding a paper (or plastic) cup with 15 marbles while a fan, set on medium speed, fans it from a distance of 0.5 m. (201-2, 203-5, 201-8)

Journal

- Problems we had while building our structure included... We solved them by ... (201-2)

Interview

- Describe the structure you are building and how your project is progressing. (203-3)
- What problems did you encounter and how did you deal with them? (203-3)

Portfolio

- Include the plans for your structure in your portfolio. Also include a report on the problems you encountered, and how you solved them. You may use drawings as part of the explanation. (201-2, 203-5)

Informal/Formal Observation

- An observational checklist to use as students construct their structures might include: (101-10, 201-3, 203-5, 201-8)
 - Student uses tools safely.
 - Student knows the correct use for each tool.
 - Student communicates and works well with partners.
 - etc.

Resources

Teacher's Guide:

pp. 31, 36, 43, 50, 54, 58, 62, 66, 72

Student Resource:

pp. 12, 14, 16, 18, 20, 22, 24, 26, 28

Evaluating the Structural Solution

Outcomes

Students will be expected to

- test the strength and stability of personally built structures, and identify ways of modifying a structure to increase its strength, stability, form and function (101-9, 202-8)
- identify materials or parts of a structure that failed and suggest why (202-5)
- evaluate simple structures to determine if they are effective and safe, if they make efficient use of materials, and if they are appropriate to the user and the environment (102-17)
- illustrate their construction process, using drawings with written explanations, and/or oral descriptions and demonstrations; and describe the structures and components of the structures they have built (203-3, 203-2)

Elaborations–Strategies for Learning and Teaching

When students have completed their structure, they should share what they have constructed with the rest of the class. The structures can be tested and evaluated. Students should focus on the features of a design that give more strength, flexibility, or other specified properties. They can be given a the opportunity to modify their design, or construct a new one based on what they have learned.

Students should recognize many designs are possible and there is no one “right” answer or product. Structures are evaluated on the basis of how they perform or suit the purpose for which they were designed. The design process is the main focus of the exercise. Students learn important strategies and techniques for working together, problem solving, testing structures, and refining designs. They have the opportunity to learn from mistakes and other students. Their ability to work in this manner is what is important. Students may make a structure that does not function the way in which it was intended, but in the process may have learned more about structures and design than if they had not run into problems.

Evaluating the Structural Solution

Tasks for Instruction and/or Assessment

Performance

- Test your structure to determine if it can do that for which it was designed. Identify ways you could improve your structure. (101-9, 202-8, 102-17)

Journal

- Update your journal to include a drawing of your final structure, and how it performed when tested. (203-3, 203-2)
- What I learned from designing a _____ is ... (101-9, 202-8, 102-17)

Presentation

- Present your structure to your classmates. Describe problems that you solved, the strengths of your design, and any weaknesses you think it has. (203-3, 203-2, 202-5, 102-17)

Resources

Teacher's Guide:

pp. 12, 16, 25, 31, 36, 43, 50, 54, 58, 66, 72, 75

Student Resource:

pp. 4, 6, 10, 12, 16, 18, 20, 22, 26, 28, 30

