


Question, Investigate, Discover!

A CLOSER LOOK:

Let's Explore Plants and Soils

SCIENCE 3

A CURRICULUM RESOURCE

NOVA SCOTIA

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Contents

Introduction

The purpose of this document is to give teachers background information, student activities, and activity sheets for Science 3. This booklet addresses outcomes in the Plant Growth and Changes unit and the Exploring Soils unit.

Aim

The aim of science education in the Atlantic provinces is to develop scientific literacy.

Scientific literacy is an evolving combination of the science-related attitudes, skills, and knowledge students need to develop inquiry, problem-solving, and decision-making abilities; to become lifelong learners; and to maintain a sense of wonder about the world around them. 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.

Three Processes of Scientific Literacy

An individual can be considered scientifically literate when he or she is familiar with, and able to engage in, three processes: inquiry, problem solving, and decision making.

INQUIRY

Scientific inquiry involves posing questions and developing explanations for phenomena. While there is general agreement that 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 understand and practise the process of theory development in science and 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 they also provide a relevant context for engaging in scientific inquiry and/or problem solving.

Science Skills

INTRODUCTION

The skill of observing is important because almost all other science skills are based upon it. Scientists make observations and construct several inferences about each observation. In many cases, it is possible to make more than one inference to explain an observation or set of observations.

An **observation** is an experience that is obtained through one of the senses. An **inference** is an explanation of an observation.

Observing items closely provides opportunities to describe objects in greater detail. Tools such as hand-held magnifiers, box magnifiers, microscopes, and optical microscopes allow a variety of extensions of the sense of sight. These instruments allow observations that extend the senses, in this case, the naked eye.

OBSERVING

Observation involves using all the senses. Observations of different qualities or properties of matter should be taught. This is extensive in grade primary and grade 1 science. The development of the skill of observation is sequential (as are most skills) and requires regular reinforcement.

Some science activities are specifically designed to teach a skill. Other activities teach valuable information about the object or event being observed. Language development used to describe what is seen helps clarify the observations.

Qualitative observations are the ones most frequently considered by students. These describe the objects using the senses. **Quantitative observations** are important in science; these tell how much or how many by giving an amount with the description.

Observations involving changes are useful and should be included in reporting whenever possible. Changes such as plant and animal observations help identify and explain what is happening in science.

Planning for and accurately recording observations increases their reliability. Recording in one or more of the following representations is part of the science reporting that students should do. These representations include symbolic, contextual, concrete, pictorial, and verbal (any written and/or oral language).

INFERRING

Distinguishing between observations and inferences needs to be done continually. The thought process used in constructing an inference may take place quickly. This process is often conditioned by past experiences.

In many cases, it is possible to make more than one inference to explain an observation or set of observations. Scientists make observations and construct several inferences about each. Then, they can make new observations to see if the inferences are acceptable explanations of the old and new observations.

QUESTIONING

Questioning is important. Teachers should use operational questions that allow students to continue to explain and support their observations and inferences. Questions to consider:

1. What questions do you have?
2. What do you see?
3. What is happening?
4. What happened?
5. What did you know about the problem before you began your study?
6. What sense did you use to make that observation?
7. That is an interesting inference. What observation(s) did you use to support your inference?
8. What observation(s) did you make that allow you to say that?
9. What evidence do you have for saying _____?
10. What evidence do you have to support your inference?
11. Have you considered all the evidence?
12. What further information do you need?
13. What new ideas did you discover?

COMMUNICATING

Observation experiences enable students to become involved in their learning. Describing objects and/or changes in objects after making observations, identifying the sense(s) used, and using quantitative observations can lead to inferences. Many times the inferences are uncertain and tentative. These can become a basis for further investigation of the objects or changes in objects.

Students may use a variety of methods for communicating their findings. Different groups might report their findings in different ways appropriate to their understandings and learning styles.

Getting Ready to Explore Plants and Soils

Let's Explore Plants and Soils is a hands-on, student-centred curriculum resource for Science 3 Earth and Space: Exploring Soils and Life Science: Plant Growth and Changes. Teachers may wish to set up soil and plant portfolios for the students in order to keep the various activity sheets and observation record sheets together in one folder.

Some soil safety suggestions:

- Do not investigate soil from a contaminated area and always wash hands after handling soils as they may contain unhealthy bacteria or organisms.
- Some soils can become dry and dusty and cause respiratory irritations.
- Do not take glass containers on field trips.

Exploring Soils

Curriculum Outcomes

These are curriculum outcomes related to soil as presented in *Atlantic Canada Science Curriculum: Grade 3* (2005). This document can be found in the Document Depot of the Nova Scotia Department of Education website at www.EDnet.ns.ca.

STSE/Knowledge	Skills
Students will be expected to **100-39** observe and describe the effects of moving water on different types of soil **101-12, 203-1** demonstrate and describe earth materials while exploring objects made from them **100-36, 100-37, 201-3, 201-5** investigate, describe, and record a variety of soils and their components using words and diagrams	*Students will be expected to* **100-38, 200-3** describe, predict, and compare the absorption of water by different types of soil **100-35** investigate and describe how living things affect and are affected by soils **200-1, 200-3** ask questions and make predictions that lead to exploration and investigation about the composition of soil **203-3** communicate procedures and results of investigations related to water absorption of soils using drawings, demonstrations, and/or written and oral descriptions

Activity 1: Investigating Soil Composition

Outcomes:

Students will be expected to

100-36/100-37/201-3/201-5 investigate, describe, and record a variety of soils and their components using words and diagrams

200-1/200-3 ask questions and make predictions that lead to exploration and investigation about the composition of soil

Questions:

- What is soil?
- Is soil the same everywhere?
- What particles are in soil?
- How can I compare soil from difference areas?
- What properties does my sample of soil have?
- What fair test can I do to look at two samples of soil?
- What evidence do I have for my conclusion(s)?
- How can I record my observations? My predictions? My inferences?
- What measurements can I make?
- Do different soils have different particles?
- Do different particles have different properties?
- What data and/or evidence do I have to support my explanations?
- Are there living things in my soil samples?

Assessment:

- Do a fair test based on a question that you will explore.
- Describe the materials in your pile of soil. Are all the types of particles the same? Give examples. Record your information.
- Predict what kinds of layers the soil will have after it settles. Compare your prediction with your observations. Make an inference(s) based on your evidence. Record your information.
- Are there any patterns in your soil samples? Are there patterns when the soil and water settle?

Materials:

- activity sheets
- clear plastic jar
- different samples of soils from the local area
- dissecting microscopes and/or Intel Play QX3 Computer Microscope
- magnifying tools that may include hand-held magnifiers
- science logs
- sieves/filters (optional)
- two-way viewer
- water

- Using a chart, students list questions to guide their exploration of soils.

Procedure:

"What I Know about Soils" and "What I Would like to Find out about Soils" are column headings that can be used. These questions can be the focus of the investigations. (See Activity Sheet 1.1)

- Students should record their investigations in their science logs, including observations, questions, notes, activity, pictures, measurements, and explanations. Sorting activities with pictures and explanations provides evidence to support their findings.
- Students could view various types of soil, looking to see similarities and differences between them. Students could record the various properties of the soils such as colour, texture, ability to hold together, and appearance of particles. Magnifying glasses could be used to explore these soils. Other tools such as sieves and filters may be useful.
- Using the dissecting microscope or Intel Play QX3 Computer Microscope, students should save labelled images of the different kinds of soils. They could use magnified images of soil particles to illustrate that soils are composed of many different materials. Comparisons between types of soil could be made with printed images.
- A variety of soil samples from different areas can be used for exploring. Spreading out the samples, for example, on newspapers will give some information. Putting samples in a clear plastic jar, adding water, and shaking the jar will provide opportunity for additional observations and inferences. Letting the jar settle to view in a day or so will allow measurements to be collected. The layering of the soil samples can be observed. Bar graphs can be made by hand or computer. Various sieves can be used for sorting. Comparisons of the different soils' compositions, based on evidence from the observations, will lead to inferences of the places from where soils came.

Science Terms:

bar graph, clay, components, different, explore, fair test, filters, forest, grassy field, gravel, hill, infer, investigate, magnifying, measure, observe, particle, patterns, predict, river bank, sample, sands, screen, sieve, silt, similar, soil texture, soil, texture, tools

Student Name: _____

Activity Sheet 1.1: Soil Composition

Investigating Soil Composition

What I know about soils:	What I would like to find out about soils:

What I found out:

Student Name: _____

Activity Sheet 1.2: Soil Sample

My Soil Sample	
Observations Inferences	Diagram
Properties	What is it like?
Definition	What is it unlike?

Activity 2: Soils—A Sense-ational Experience

Outcomes:

Students will be expected to

100-39 observe and describe the effects of moving water on different types of soil

100-38/200-3 describe, predict, and compare the absorption of water by different types of soil

Background:

Students will use their observations to describe the various components of soil and record their observations about the characteristics of soil. Students will understand the importance of soil in a number of contexts.

Soil is important for meeting the needs of all living things—plants and animals. It provides water, nutrients, air, and anchorage for plants. It contributes a habitat, food, air, and clean water for many animals living in the soil and above it. Humans rely on soil for food, clean water, shelter, transportation, clothing, and plants, which give us oxygen to breathe.

It is important to make the distinction between soil and dirt. Soil is loose material at the surface of the earth that is capable of supporting plant and animal life. Dirt, on the other hand, is material that has no life-supporting value. Teachers may wish to discuss with your students the phrase "Don't treat soil like dirt."

Students will be making several observations about their soil sample and its texture. These observations will help them when they categorize the soil in later activities. There are two main tests to determine soil texture: the feel test and the ribbon test.

The first step in this series of soil explorations is to collect some soil samples. These can be collected from different areas in and around the schoolyard. Samples taken from different locations will provide a better comparison of soil composition—the focus of Activity 5. If students are involved in the collection of the samples, they should be reminded to look for any living creatures in the soil as they dig. Since this same soil sample will be dried and used later in Activity 5, this is the only collection of soil that the teacher or students will have to collect.

Gathering about 750 mL of each soil sample will ensure that there is plenty for use in other activities as well as this one. For best results, the samples should be taken from about 10 cm below the surface.

Air dry the samples by spreading them out on newspaper for two–three days. When they are dry they can be stored in plastic milk jugs or other airtight containers. Have the students label the samples with their names and the location from which the sample was taken.

Brainstorm about students' perceptions about the composition of soil, and its importance. Questions that can be posed include the following:

- What would life be like without soil?
- Who/what needs soil?
- What things wouldn't we have if we did not have soil?

Have students complete Activity Sheet 2.1.

Consider what lives in soil.

- What are the needs of the plants and animals that live in soil?
- How does soil provide for the needs of plants and animals?

Assessment:

- Draw a web that illustrates the dependence of plants and animals on soil. Start with the word "soil" in the middle. You may illustrate what is directly connected to soil and then make connections between them and from them.
- Use a chart to tell what happens when water is absorbed by different soils.
- Illustrate how moving water works on different soils.

Materials:

- Activity Sheet 2.1: Who Needs Soil Anyway?
- Activity Sheet 2.2: All about My Soil
- magnifying lenses
- newspapers
- plastic bags (1 for each group)
- Sample Soil Web Rubric
- trowels or small shovels to collect soil samples
- water

Extension Activities:

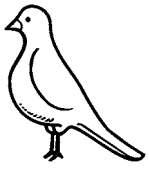
- Students can trace what they had for breakfast back to the soil (e.g., cereal with milk, a glass of orange juice).
  - cereal–grains–soil
  - milk–cow–grass–soil
  - orange juice–oranges–orange trees–soil
- Students can trace the items used in class back to the soil (e.g., pencil–wood–trees–soil).
- Students may observe and describe the activities of an earthworm.
  - Explain how the body parts of an earthworm enable it to live in soil.
  - Explore how earthworms help to recycle and transform nutrients in the soil.
- Students can use Plasticine to create models of animals found in the topsoil.

Science Terms:

dirt, feel test, habitat, nutrients, ribbon test, soil

Student Name: _____

Activity Sheet 2.1: Who Needs Soil Anyway?

Why is soil important to ...
a farmer 
a construction worker 
an earthworm 
a maple tree 
a bird 

me
What lives in soil?
What do living things like plants and animals need to survive?
Does soil have these things?

Student Name: _____

Activity Sheet 2.2: All About My Soil

1. I got my soil sample from _____

2. The colour of my soil is ...
- ○ black ○ dark brown ○ light brown ○ grey

3. My soil looks ...
- ○ lumpy ○ smooth

4. When I rub my dry soil between my fingertips, it feels ...
- ○ powdery ○ grainy ○ hard

5. The Feel Test—When I put a few drops of water on some soil in my hand it feels ...
- ○ soapy (silt) ○ gritty (sand) ○ sticky (clay)

6. The Ribbon Test—If I add a little water to my soil I can make ...
- ○ a long ribbon (clay) ○ a short ribbon (loam)
- ○ nothing–it won't make a ribbon (sand)

7. I can see objects in my soil sample like ...
- ○ twigs ○ leaves ○ roots
- ○ stems ○ stones ○ large, hard lumps of soil

8. There are many living things in my soil sample. I can see ...
- ○ earthworms ○ insects ○ plants
- ○ other things like _____

9. My soil smells like _____

10. Other things I see in my soil are ... _____

_____

Activity 3: Soil Parts and Particles

Outcomes:

Students will be expected to

100-36/100-37/201-3/201-5 investigate, describe, and record a variety of soils and their components using words and diagrams

200-1/200-3 ask questions and make predictions that lead to exploration and investigation about the composition of soil

203-3 communicate procedures and results of investigations related to water absorption of soils using drawings, demonstrations, and/or written and oral descriptions

Background:

Students will describe the components of soil (sand, silt, clay, organic matter) through an analysis of the texture, water holding capacity, and other properties. In the second part of the activity, students will classify mystery soils as either predominantly sand, clay, or loam.

There are four main components of soil—classified according to their texture (feeling) or particle size. These components are sand, silt, clay, and organic matter.

Soil Parts and Particles

Component	Particle Size	Appearance	Feel	Comments
Sand	large	individual grains can be seen	grains can be felt	does not hold water or nutrients well
Silt	medium	individual grains cannot be seen without a magnifier	feels like powder or flour	holds water (minimally)
Clay	small	individual grains cannot be seen	grains cannot be felt; feels sticky when wet	holds water and nutrients well; is hard when dry
Organic Matter	varies	varies	sticky when wet	holds water and nutrients well; should be mixed with other soil components for effective plant growth; rich in nutrients

In nature, most soils contain a combination of these types. Soils with a mixture of sand, silt, and clay are called loam. Loam is often referred to as the "ideal soil" as it is found to be the best for growing many plants. It contains a range of particle sizes—small particles for holding water and larger particles to allow air movement. Loam holds nutrients well. However, we can classify soils by the component that is most predominant. For example, a soil that has mostly sand (large particles) is called sandy soil, a soil that has mostly clay (smaller particles) is called clayey soil, and a soil with a combination of these is called loamy soil. Organic matter is part of every soil; when organic matter is the main ingredient of the soil, it can be called an organic soil.

Students will investigate the properties of the four components of soil, sand, silt, clay, organic matter, and classify three mystery soils based on their predominant characteristics, clayey, sandy, and loamy. Make four stations for activities. Students in groups of two or three will rotate through the stations. Depending on class size and dynamics, the teacher may wish to double the number of stations.

Assessment:

- Do Activity 3.1: Soil Parts and Particles.
- Do Activity 3.2: Oh! What a Mystery!!!
- Do Activity 3.3: It's a Match!
- Orally describe each of the soil components.

Materials:

Soil Classification

- Activity Sheet 3.1: Soil Parts and Particles
- paper towel
- soil sample (e.g., sand)
- water
- water filtering apparatus (construct with funnel, coffee filter, and glass or a beaker)

Mystery Soils

- Activity 3.2: Oh! What a Mystery!!! and Activity 3.3: It's a Match!
- mystery soil (one is sandy, one is clayey, and one is loamy)

Teacher Procedure:

Set up the four water filtering apparatuses (see materials list). Place a small sample of the soil type into a coffee filter inside a funnel. Place the funnel over the glass jar or beaker. Pour a small amount of water into the funnel to observe how well the water flows through the soil sample. Repeat for three different soil samples.

Procedure:

Part 1: Soil Components

- Have students rotate through the four soil stations: sand, loam, clay, and organic matter and record their observations on Activity Sheet 3.1. Allow 10–15 minutes per station.
- After students have completed the four stations, review the four components of soil and list the properties on chart paper for referral throughout the rest of the activity and for other unit activities.

- Explain that most soils are actually a combination of these soil components and introduce the terms sandy, clayey, and loamy.

Part 2: Mystery Soils

- Have students rotate through the three mystery soil stations. Their task with each of the mystery soils is to classify the sample as either sandy, clayey, or loamy using the colour of the soil, the texture, the grain, or lumps.
- Students can record their observations about the mystery soils in Activity Sheet 3.2. Compare the soil sample properties with the chart established in the activity (above) to make a classification.
- Distribute Activity Sheet 3.3: It's a Match! as a summary and read the creepy crawly facts aloud. Have the students create poems or a book of stories or jokes about worms.

Extension Activities:

- Ask students to describe where they might find soils with dominant characteristics in their neighbourhood or region (e.g., sandy soil is found near the beach, clayey soil could be found on a construction site, loamy soil might be found on a farmer's field). Teachers should note that sometimes sandy soil may be found many kilometres from an existing beach; this may be an indication of a beach location in the past.
- What's in the sock? Take peat-type or compostable cups and fill each cup with a different textured material, e.g., sand, pebbles, flour (which feels like dry silt), organic matter and garden soil. Place each cup in an old sock and pass the cups around. Have students place their hands inside each sock to feel each material, then describe the feel of the material (e.g., gritty, smooth).

Science Terms: clay, loam, nutrients, organic matter, sand, silts

Student Name: _____

Activity Sheet 3.1: Soil Parts and Particles

Observations	Sand	Loam	Clay	Organic Matter
The dry soil feels … (powdery, grainy, hard)				
The colour is				
I can see each grain	yes no	yes no	yes no	yes no
The Feel Test: The wet soil feels … (soapy, gritty, sticky)				
The Ribbon Test: I can make a long ribbon	yes somewhat no	yes somewhat no	yes somewhat no	yes somewhat no
Water goes through the sample …	very well not very well	very well not very well	very well not very well	very well not very well
I think this would be good for growing plants	yes no	yes no	yes no	yes no

Student Name: _____

Activity Sheet 3.2: Oh! What a Mystery!!!

Soils can be grouped by the kind of soil that makes up most of the sample. For example, soils with lots of sand are called **sandy** soils, soils with lots of clay are called **clayey** soils, and soils with lots of every kind of soil are called **loamy** soils.

Be a soils detective and give the three mystery soils a name! Are they sandy, clayey, or loamy? You decide!

	Mystery Soil A	Mystery Soil B	Mystery Soil C
What I notice about the soil ... (e.g., colour, feeling, grain size)			
I think this soil is made up mostly of ... (sand, clay, loam) (Use the feel or ribbon test to help.)			
I would name this soil ... (sandy, clayey, loamy)			

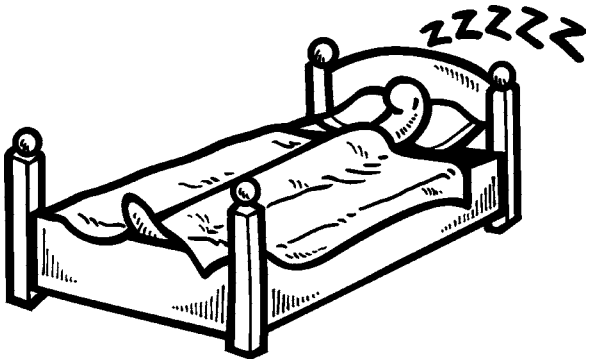
Student Name: _____

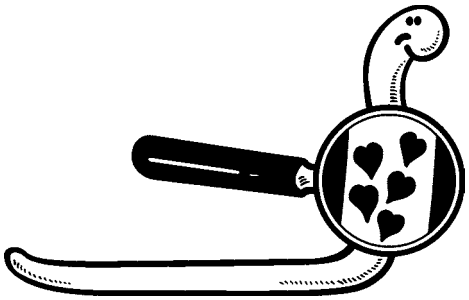
Activity Sheet 3.3: It's a Match!

Match the soil type with the best description given:

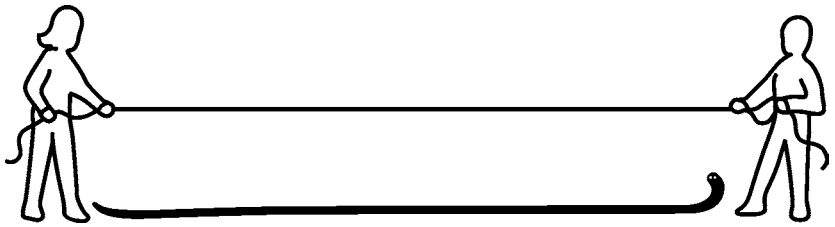
Soil Type	Soil Description
_____ sand	**A.** dark and spongy
_____ silt	**B.** holds water
_____ clay	**C.** largest particle size
_____ organic matter	**D.** feels like powder

Did You Know These Creepy Crawly Facts?





- Earthworms hibernate in the winter. What other animals hibernate?
- Earthworms turn rotting plants and animals into rich plant food.
- An earthworm has five hearts!
- Many earthworms can grow a new head if the front quarter of its body is broken off!
- An earthworm is both male and female, so it can reproduce without ever meeting another worm!
- The world's longest earthworm, found in South Africa, measured 6.7 m. Identify an object in the school that is approximately the same length as the longest earthworm.



Sample: Rubric for Mystery Soils

	Level 4	Level 3	Level 2	Level 1
Performing a variety of soil tests to determine soil type	knows which test to perform and when; performs test carefully	knows soil tests; performs test carefully	needs to be told which tests to perform; should work more carefully	does not understand soil tests; does not work carefully
Listing properties of various soils	knows characteristics of soil; easily lists all properties	knows characteristics of soil; can list most properties	knows some characteristics of soil; can list some properties	does not know any characteristics of soil; cannot list properties
Identifying mystery soils	easily identifies as sandy, clayey, or loamy	will eventually identify as sandy, clayey, or loamy	needs help identifying as sandy, clayey, or loamy	does not understand the terms sandy, clayey, or loamy
Matching soil characteristics with location	easily matches soils with locations	makes one or two mistakes in matching	makes a few mistakes in matching	cannot match soil with location
Group work skills	always shares ideas, respects and helps others, and stays on task	usually shares ideas, respects and helps others, and stays on task	seldom shares ideas, respects and helps others, and stays on task	never shares ideas, respects and helps others, and stays on task
Problem solving and application skills	efficient at problem solving; easily applies knowledge to problems	can problem solve as well as apply knowledge to problems	has difficulty problem solving and applying knowledge to problems	shows few or no problem solving skills or application skills

Activity 4: Texture of Moistened Soil

Outcomes:

Students will be expected to

100-38/200-3 describe, predict, and compare the absorption of water by different types of soil

Questions:

- How did the texture of the soil sample change when it was moistened?
- How did the soil sample's ability to hold together change when it was moistened?

Assessment:

- Distinguish the difference between dry soil and moist soil through observation and touch.
- Record the differences in the soil sample textures after they have been moistened.
- Use the descriptions of soils to distinguish the differences between mystery soils and to help identify soils in future activities.

Materials:

- soil samples (clay, sandy soil, loamy soil—mixture of sand, silt, and clay)
- water
- metric measuring spoons
- medicine droppers
- Activity Sheet 4.1: Texture of Moistened Soil

Procedure:

- A variety of soil samples may be purchased from a local gardening centre or from around the school. Only a small amount (2 mL) needs to be used. Have students describe the texture of each sample of soil prior to moistening it. Have them record how it felt and the properties it had (gritty, fine, would not hold together, rough, colour).
- Next have the students add a drop or two of water to their soil samples. Have them describe their soil sample (colour, texture, how well it compacts, thickness, density). Discuss with the students how it is important for farmers to know the various properties of soil in order to help living things and determine what types of plants to grow on their farm.

Teacher Note: *Students should wash their hands thoroughly after completing this activity*.

Science Terms:

agriculture, farm, soil, soil texture

Student Name: _____

Activity Sheet 4.1: Texture of Moistened Soil

Other Characteristics				
Texture				
Colour				
Dry/Moist				
Type of Soil Sample				

Activity 5: Let's Settle This!

Outcomes:

Students will be expected to

100-39 observe and describe the effects of moving water on different types of soil

100-38/200-3 describe, predict, and compare the absorption of water by different types of soil

Questions:

- How does soil settle?
- What happens to different soils as they separate?
- Do all soils settle the same way?
- Students will investigate the components in their soil samples by separating them using a sedimentation activity.

Background:

In this activity the soil will "settle out" in layers. The sand will sink to the bottom and the clay particles remain in suspension. The organic matter may be so light that it will float on the water's surface. The particles settle at different rates because they are different in size and mass. The heavier particles settle first while the smallest and lightest particles settle last. Layers of coarse (sand), medium (silt), and fine (clay) particles will be seen.

Students will find that different soils have differing amounts of sand, silt, clay, and organic matter. They should conclude that all soils are different in composition.

Caution: Using any random sample of soil will not necessarily yield effective layers. The activity has been designed to show the separation. Experiments can be conducted using samples collected by the teacher or the students. Students should be able to see some layering in all soil samples; however, whether they will be pure sand, silt, and clay layers is questionable.

Procedure:

Half fill a glass jar with a soil sample without compacting the soil. Add water until the jar is 2/3 full and add a few drops of liquid detergent, which serves as a wetting agent. Tighten the lid and shake the sample, mixing the soil, water, and wetting agent. Mix the sample thoroughly for five minutes.

Have the students repeat the procedure using their own soil sample. Allow the sample to stand to settle the particles. Observe the sample as it settles at five minutes and after 24 hours. Students can draw and label what they observe in Activity Sheet 5.1.

Students may hypothesize what soil component is on the bottom, middle, and top layers and suggest reasons for the separation. They may again classify their soil as sandy, clayey, or loamy. Students can then compare their soil compositions with others in the class.

Ask students to suggest how the soil make-up might vary for different areas, e.g., forest, beach, marsh, field, flower bed, construction site, roadway. Students can draw what they think these different soils will look like in Activity Sheet 5.2.

For example, beach soil will have mostly sand, forest soil will have lots of organic matter like sticks and leaves, a construction site may be clayey with more fine particles, or a flower bed may be quite loamy (a mixture of all parts).

Assessment:

- Compare your completed Activity Sheet 5.1 with the jars to see if done correctly and to verify identification of the settled layers.
- Use Activity Sheet 5.2 to determine if you can identify the layers as they have settled out in the jars.

Materials:

- Activity Sheet 5.1: Let's Settle This!
- Activity Sheet 5.2: Let's Settle Our Differences
- clear jar with tight fitting lid—approx. 750 mL pasta sauce jars or wide mouth canning jars work well (1 per group)
- distilled water (can be purchased from a grocery store)
- dried soil sample from Activity 2 and the sample labelled "LOAM"
- liquid detergent

Extension Activities:

- Bring in samples from very different areas, e.g., beach, flower bed, etc. and perform the same experiment. Have students hypothesize what the soil composition will be before performing the experiment and suggest reasons for the differences among them.
- Discuss and show other uses for soils like sand and clay, e.g., clay pottery and sculptures, sandstone carvings.
- Use clay to make objects like beads or models in art class

Science Terms:

clay, humus, loam, organic matter, sand, silt, soil

Student Name: _____

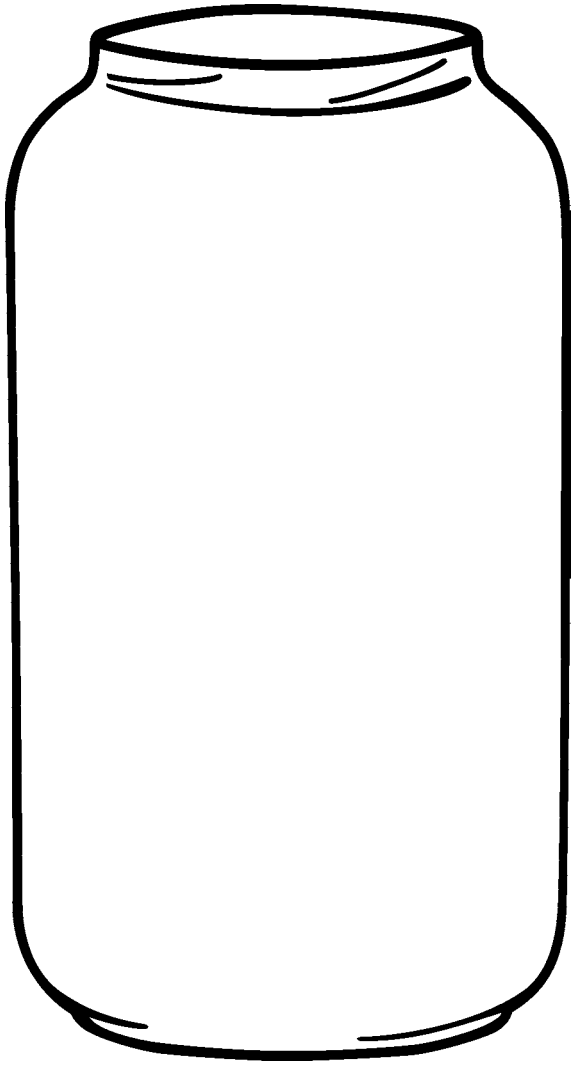
Activity Sheet 5.1: Let's Settle This!

My soil sample was taken from _____

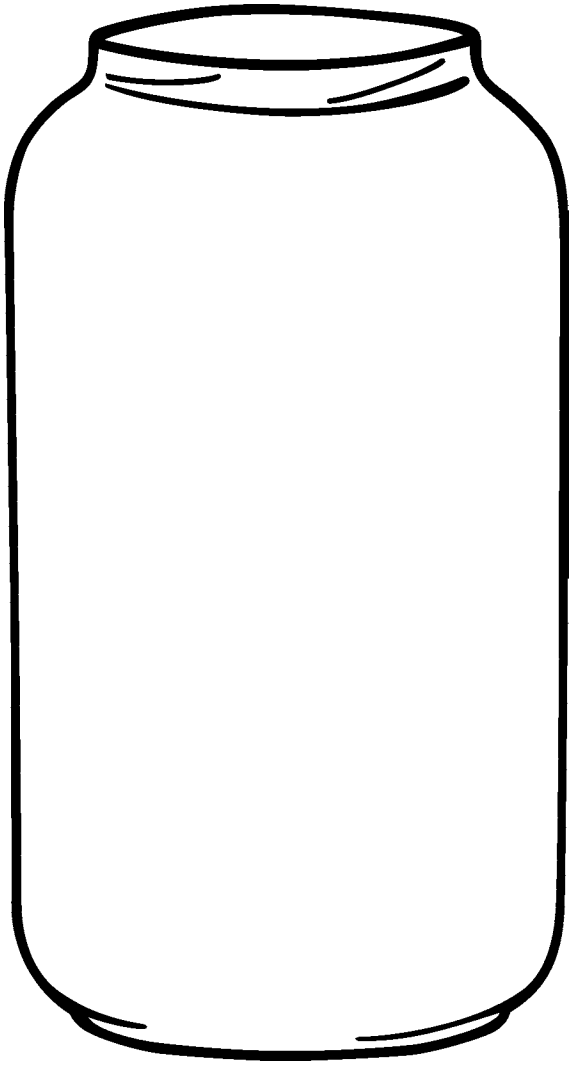
Draw how your jar looked after 5 minutes of settling and after 24 hours.

Label the layers found in your jar.

After 5 minutes



After 24 hours



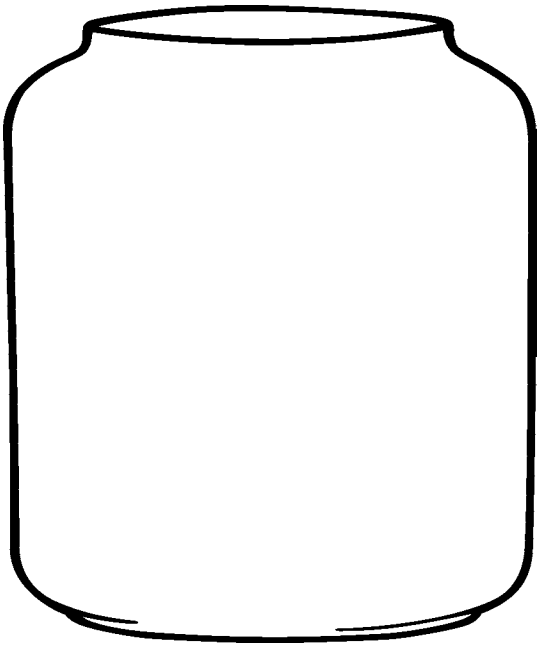
Student Name: _____

Activity Sheet 5.2: Let's Settle Our Differences

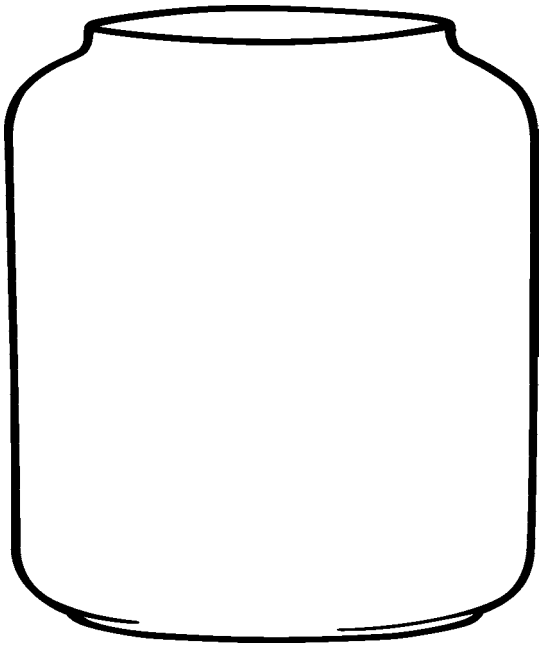
Different areas of Nova Scotia and the world will have different soil types.

Draw and label the soil layers you think you might find in the different soils.

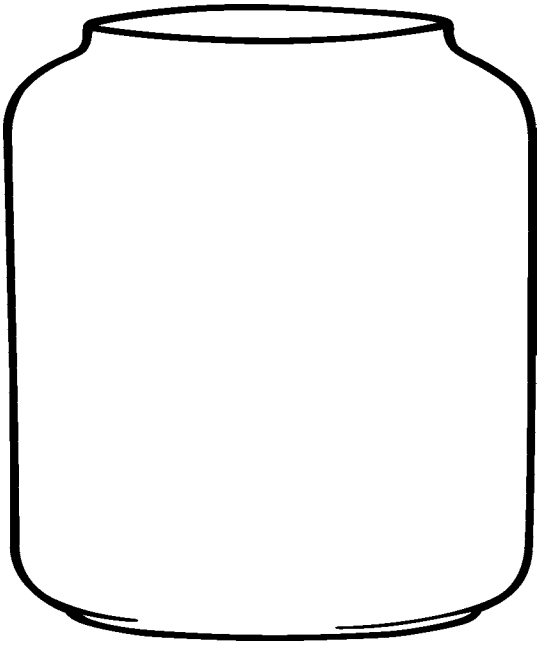
Beach



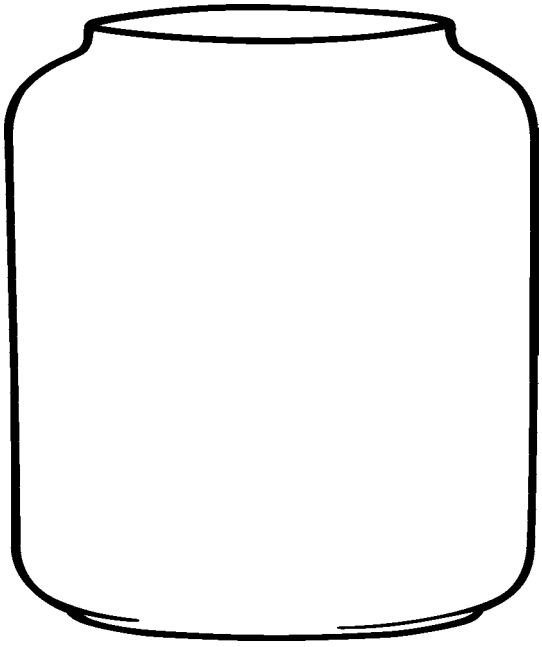
Forest



Construction Site



Flower Bed



Activity 6: Moving Water and Different Types of Soil

Outcomes:

Students will be expected to

100-39 observe and describe the effects of moving water on different types of soil

Questions:

- What types of soil did you use?
- Was there a difference in the effects of moving water on the different types of soil?
- What type of soil appeared to cause the least erosion.
- What would farmers do to help prevent erosion? (sloped and flat surface)

Assessment:

- Draw a picture of the soil before and after erosion happens.
- Draw how moving water looks on various types of soil.

Materials:

- Activity Sheet 6.1: Moving Water and Different Types of Soil
- aluminum cake pans—one for each type of soil (from a dollar store)
- metric measuring containers for water and soil
- various types of soil (e.g., clay, sand, planting soil)
- water

Procedure:

- This activity is designed to simulate the effects of moving water on different types of soil.
- Have the students work in groups. Before they try the experiment, have the students decide if the soil they will use should be moist or dry, packed down or loose—students can try to determine which would be best for using in the experiment. To start, students should be told to put the same amount of soil in each pan. Then have the students place the pans on a slope. The slope should be the same for different types of soil being tested. Have the students pour the same amount of water at the top of each pan in order to observe what happens as the water runs down. Have students record their observations through illustrations and written description (see Activity Sheet 6.1).
- Have each group share their findings with the class. Discuss with students if this is a realistic way to see what the effects of moving water has on soil.

Science Terms:

cultivating, environment, erosion, farm, harrow

Student Name: _____

Activity Sheet 6.1: Moving Water and Different Types of Soil

Type of soil: _____

Amount of water used: _____

Illustration of what happened:

Description of what I observed:

_____

_____

_____

_____

_____

Activity 7: Moving Water/Soils/Plants

Outcomes:

Students will be expected to

100-39 observe and describe the effects of moving water on different types of soil

Questions:

- What effect did the plants have on the soil when moving water was placed on it?
- How do plants help prevent erosion?
- Does the type of soil have anything to do with the kinds of homes that are built around the world?
- How would farmers use plants to help prevent erosion in all seasons?

Assessment:

- What happens when water moves on soil that is covered with plants?

Materials:

- Activity Sheet 7.1: Moving Water/Soil/Plants
- aluminum cake pans—one for each type of soil
- metric measuring containers for water and soil
- various types of soil (clay, sand, planting soil with grass planted and growing in/on it)
- water

Procedure:

- This learning experience is designed to simulate the effects of moving water on different types of soil on which grass is growing. Students should be given the opportunity to grow the grass in advance for this activity. Otherwise, soil with grass could be brought in.
- Have students place their pans on a slope. Have them pour the same amount of water on each sample and record what they observed on the activity sheet.
- Students can discuss the difference between this activity and Activity 6 where the soil did not have grass. Students should also discuss how plants help prevent erosion and how farmers and areas around oceans and hillsides are protected against erosion. The impact of housing developments on lakes/rivers can be discussed, including how contractors are required to protect these areas.

Science Terms:

agriculture, erosion, fall, grass, habitat, plants, tillage, tractor

Student Name: _____

Activity Sheet 7.1: Moving Water/Soil/Plants

Type of soil: _____

Amount of water used: _____

Illustration of what happened:

Description of what I observed:

_____

_____

_____

_____

_____

Activity 8: Animals Underground

Outcomes:

Students will be expected to

100-35 investigate and describe how living things effect and are affected by soils

Questions:

- What types of animals live underground?
- How do they rely on soil to survive and protect them?
- What benefits are underground animals to the soil?

Assessment:

- Give an example of where animals live using soil as protection and a place to live.

Materials:

- brown paint
- dried soil
- green construction paper
- newspaper
- paper boxes (e.g., shoe boxes)
- pea gravel
- plaster of Paris
- plastic utility knife
- sawdust (to represent soil layers)
- scissors
- small plastic animals/insects
- sponges
- spoons
- toilet tissue rolls (cut in half length wise)
- utility knife for teacher use
- water container to mix in
- white glue

Extension Activities:

Visual Arts: Students will be expected to

- express through art-making personal feelings, ideas, and understandings
- work individually and with others in the creative art-making process
- explore images using technology
- demonstrate sensitivity toward the natural and built environment

English Language Arts: Have students write a description or give an oral explanation of their model, their animal/insect, where it lives, and how living things affect and are affected by soils.

1. Prior to doing this activity, students should be given the opportunity to do research on the types of animals that live underground. From this research they can then make an example of the animal's habitat. Students may wish to select a type of insect instead of an animal.
2. To begin constructing the model habitat, remove any flaps from the box. Glue scrunched up balls of newspaper to the back of the box. Cut toilet tissue rolls length wise, glue the rounded sides together, and then glue them among the newspaper balls to create tunnels for the animal.
3. Mix up plaster of Paris and spread over newspaper. Quickly press the earth materials (any three different types) in layers, into the plaster of Paris. After the plaster of Paris has dried, set the box upright on its longest side. Paint the outside of the box brown, using a sponge. Use green construction paper to make a row of grass on the top of the box. Add the plastic animal/insect.

Science Terms: animal, habitat, insect

Activity 9: The Compost Heap

Outcomes:

Students will be expected to

200-1/200-3 ask questions and make predictions that lead to exploration and investigation about the composition of soil

203-3 communicate procedures and results of investigations related to water absorption of soils using drawings, demonstrations, and/or written and oral descriptions

Questions:

- What does "soil composition mean?
- How does composting work?

Background:

This activity demonstrates the importance of recycling organic materials in soils by using a composter.

Per capita, Canadians are among the largest producers of garbage in the world. Through composting, some garbage can be transformed into a valuable resource. Kitchen and yard wastes that are turned into compost return nutrients and organic matter to the soil and will improve plant growth. This activity describes how to make miniature composters. (For more information about compost dos and don'ts, contact your local municipality.)

Assessment:

- Use the Student's Self-Evaluation: Observation Checklist for Composting to observe your composting behaviour and environmental attitude.
- Explain the purpose of a composter.
- List questions to explore soil composition.
- Make predictions based on your questions.
- Plan and do an investigation on water absorption of soils.
- Report on your investigation.

Procedure:

Students can make their own composters (using 2 L plastic pop bottles, cut in half) in groups. The ingredients to add to the composter can be fruit and vegetable scraps, sawdust, coffee grounds, tea bags, egg shells, hedge and lawn clippings, weeds, leaves, etc. Students can also collect fruit and vegetable scraps from their lunches to add to the compost (for this activity do not put meat, bones, grease, or other fatty substances into the composter). The container should be filled with compost ingredients with enough room to mix in three–four handfuls of garden soil. The compost material should be damp. Turn the material once every two–three days and do not allow it to dry out. If the compost material begins to dry out, add a sprinkle of water to keep it moist.

The transformation into compost is complete when the material becomes black and crumbly, usually in three to four weeks. At that time, students can decide what to do with the compost, such as add it to their own gardens or to school flower beds.

Materials:

- 3–4 handfuls of garden soil
- Activity Sheet 9.1: Compost Crazzeee!
- containers made from 2 L plastic pop bottle cut in half
- ingredients shredded into pieces (suggested items—fruit and vegetable scraps)
- lids for the container (e.g., plastic or foil wrap)
- spoons
- Student Self-Evaluation: Observation Checklist for Composting
- water

Extension Activities:

- Set up a class vermicomposter with worms. This can be a year-long project that students can monitor. The worms help decompose the ingredients much faster. Teachers may wish to look for information on vermicomposters.
- Set up different composters with different conditions and compare which one works the fastest, e.g., don't shred the ingredients in one, allow one to dry out, place one in a warmer location, don't turn the compost in another one.
- Try to obtain a school composter for outside. Have students make compost announcements to get the whole school involved in composting. Assign compost monitors to collect scraps and turn the compost throughout the year.
- Explore recycling and composting on Nova Scotia farms.

Science Terms: agriculture, compost, environment, nutrients, organic matter

Student Name: _____

Activity Sheet 9.1: Compost Crazzeee!

Draw a picture of your composter and list the materials you used to make it.

materials used

_____

_____

_____

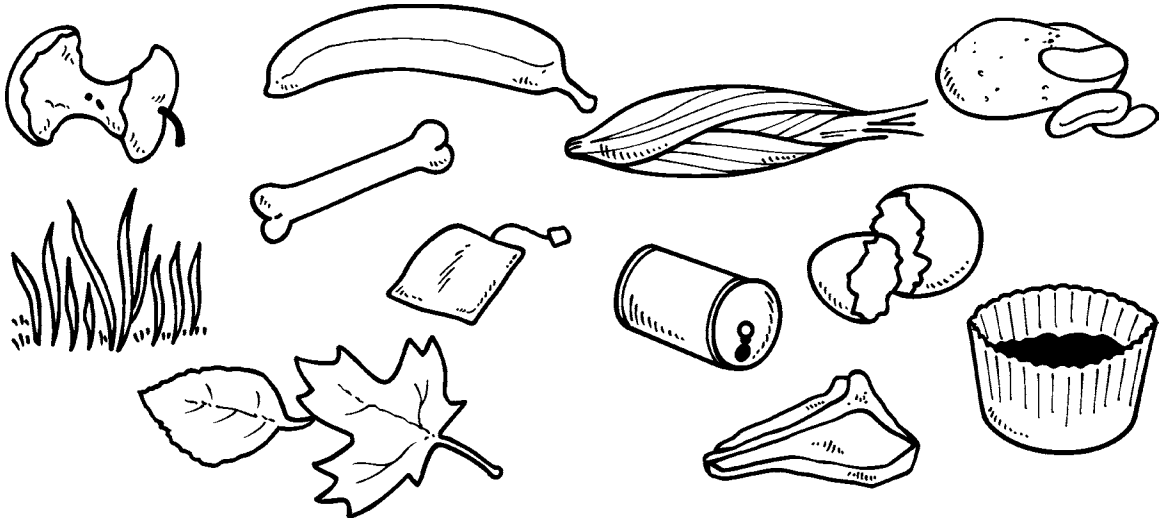
_____

_____

_____

_____

Label the things that you could put into your composter.

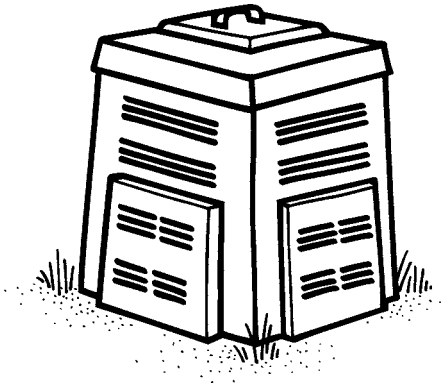


Composting is good for the environment because _____

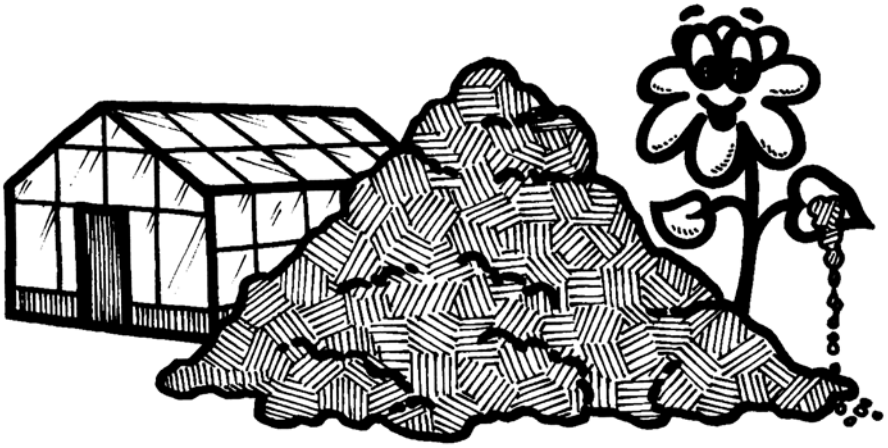
_____

_____

Student's Self-Evaluation: Observation Checklist for Composting



I ...	Always	Sometimes	Never
selects appropriate materials for composting			
adds materials to composter			
mixes material with garden soil			
turns compost pile			
explains clearly the purpose of composting			



Activity 10: Living Things in Soil—Animals

Outcomes:

Students will be expected to

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

Questions:

- How does soil help protect animals?
- How do certain animals use soil to provide protection for them?
- How do animals provide nutrients to soil?
- What are some of the animals and plants that live in soil?

Assessment:

- Observe living things in soil and explain how they are interdependent on each other.
- Describe the role of animals and insects in providing nutrients to soil.
- Illustrate how soil is a home to many different types of animals and insects.

Materials:

- Activity Sheet 10.1: Living Things in Soil—Animals
- ant farm
- clear jars
- magnifiers
- rubber gloves (per student)
- shovels
- soil
- trowels

Procedure:

- A lot of what can be observed first hand in this learning experience depends on the location of your school and the availability of soil that can be dug up. If soil is not easily available, arrangements could be made to take a field trip to a local farm or area where permission is given to dig up soil to observe living things. If this is not possible, videos, books, and in-class simulated environments could be used (ants or worms added to purchased soil and placed in a glass jar for observation).
- When students are digging in an area outdoors, remind them to be respectful of the living things they find. After students have observed animals in the soil they should draw what they observed. Students should be given the opportunity to discuss what they found, where they found them, and the number they found. These should be recorded for future reference.

Science Terms:

animals, farm, insects, nutrients, plants, soil

Student Name: _____

Activity Sheet 10.1: Living Things in Soil—Animals

Illustration of my soil sample:

Illustration of what I found:

Description of what I found:

_____

_____

_____

Type of soil:

_____

_____

Activity 11: Soils P. I.—The Mystery of the Stolen Clay Vase, A Student Demonstration Activity

Outcomes:

Students will be expected to

200-1/200-3 ask questions and make predictions that lead to exploration and investigation about the composition of soil

101-12/203-1 demonstrate and describe earth materials while exploring objects made from them

Question:

- Do soil types make a difference?

Assessment:

- In a group, discuss the observations and notes that the detectives used.

Materials:

- soil samples labelled A, B, C, and D

Procedure:

Read the story of the case from Activity Sheet 11.1. It may be read aloud, together, or individually. This will set the challenge for the mystery.

The story is about a millionaire who has a precious clay vase stolen. Students should be in groups of three to four depending on the number of soil samples available. The nature of the soil samples collected by the teacher should be as obvious as possible. Sandy soil can be taken from a beach or sandbox or bought at a store, loamy soil can be taken from a forest or flower bed, and clayey soil can be taken from a construction site or bought at a store.

Distribute the soil samples A, B, C, and D to each group and allow them to perform the various soil tests to determine the soil classification. For example, students should look at the sample for colour and grain size and feel the samples for texture. Students can refer back to activity sheets 2.2 and 3.1 for help, as well as the chart paper comparison of the soil components.

Students can record their "detective notes" on Activity Sheet 11.2.

Students can then match the soil samples given to them with the sites on the map of the estate, Activity Sheet 11.3.

Students can then match the soil types on the estate with those found on the boot of the burglar and determine the route the burglar took. The burglar's boot can be found on Activity Sheet 11.4.

Science Terms:

soil, sand, clay, loam, silt, organic, soil components, soil texture

Activity Sheet 11.1: The Mystery of the Stolen Clay Vase

Ms. Sandy Loam is a very wealthy lady who lives on a large estate in the country. Ms. Loam loves to collect precious vases made from clay and other materials from around the world. In order to keep her vases safe, Ms. Loam keeps guard dogs on her estate to protect herself and her fortune. Ms. Loam is well known and her vases are often the talk of the town.

Late one rainy night, while Ms. Loam was sleeping, a man by the name of Dusty Dirt decided to try to steal a clay vase from Ms. Loam. He had always been a very fast runner and he thought he could run faster than any guard dog. He jumped the fence into the estate and went to a window in Ms. Loam's living room. There it was! The Vase of India sparkled in the light from the moon.

"Just wait till I get my hands on that vase," whispered Dusty. "I'm going to be rich!"

Dusty opened the window and entered the house. He grabbed the vase and jumped back out the window. "That was easy!" Dusty chuckled.

Just then, Dusty heard a low growl. Then he heard another low growl. Grrrr! "Oh no!" shouted Dusty "It's the guard dogs!" Dusty took off running as fast as he could and the dogs took chase.

Ms. Loam was awakened by Dusty's shouts. She quickly ran to the phone to call the police. The police were there in minutes.

"What seems to be the problem, Ma'am?" asked the police officer when he got to her door.

"Someone has stolen the Vase of India! My dogs are chasing the burglar right now but this is such a large estate ... I hope you can find him." stammered Ms. Loam.

"Don't worry, ma'am. We'll catch him." the police officer said reassuringly.

Just then, one of the dogs returned to the house with Dusty's boot in his mouth. He must have been able to get only the boot before the burglar got away. However, since the other dogs were still somewhere on the estate, the burglar must still have been hiding.

The police officer took one look at the boot and picked up the phone. This was a case for "Soils P. I." the best soil detectives in the province! The burglar's boot was layered with soil samples from the estate.

Your Mission as Soils P.I.:

You and your team arrive at the scene minutes later and look at the boot. You ask Ms. Loam for a map of the estate, which she quickly gives to you. Next, you instruct the police officer to collect soil samples from around the estate so that you can match them to the burglar's boot.

The police officer returns with four samples of soil, but he has somehow forgotten to label them! Now you really have to think.

You must first identify the soil samples, then match them to the sites on the map, then match them to the burglar's boot to find out where he is hiding. You also must trace the path the burglar took to get to his hiding spot in case he hid the vase along the way.

This is a big job, Soils P. I.; but if anyone can do it, you can! Good luck!

Student Name: _____

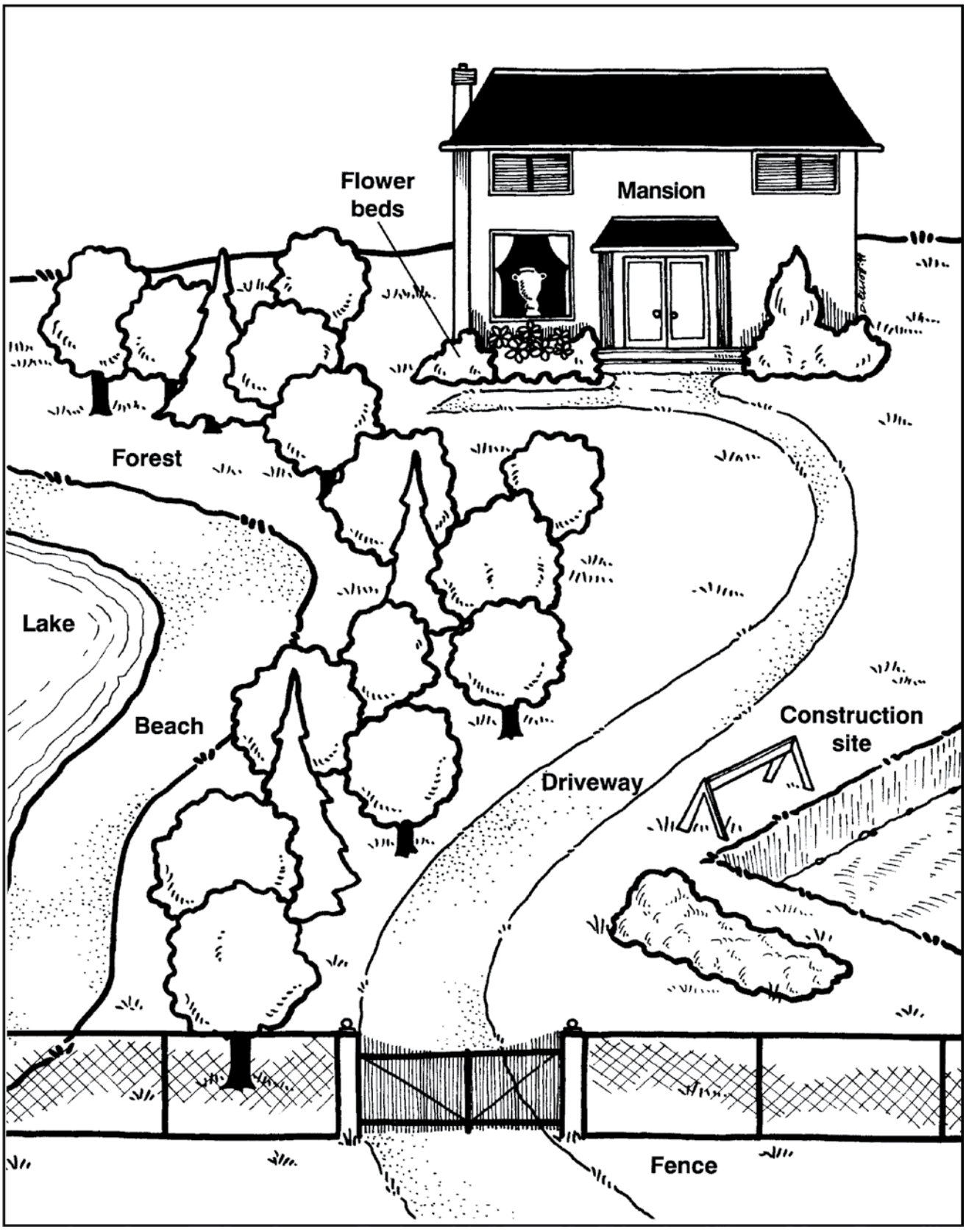
Activity Sheet 11.2: Detective's Notes

Add your notes about each type of soil in the boxes below.
Name the soil as either sandy, clayey, or loamy.
Write where you think the soil came from on the estate. Use the map to help you.

Soil A The name of the soil _____. This soil was probably found at _____.	Soil B The name of the soil _____. This soil was probably found at _____.
Soil C The name of the soil _____. This soil was probably found at _____.	Soil D The name of the soil _____. This soil was probably found at _____.

Student Name: _____

Activity Sheet 11.3: Ms. Loam's Estate Map



Student Name: _____

Activity Sheet 11.4: Dusty Dirt's Boot

The path that Dusty took was from the _____

to the _____

to the _____

to the _____.

Dusty is now hiding in the _____.

Sample Rubric for Student Demonstration Activity

	Level 4	Level 3	Level 2	Level 1
Performing a variety of soil tests to determine soil type	knows which test to perform and when; performs test carefully	knows soil tests; performs test carefully	needs to be told which tests to perform; should work more carefully	does not understand soil tests; does not work carefully
Listing properties of various soils	knows characteristics of soils; easily lists all properties	knows characteristics of soils; can list most properties	knows some characteristics of soils; can list some properties	does not know any characteristics of soils; cannot list properties
Identifying mystery soil types	easily identifies as sandy, clayey, or loamy	eventually identifies as sandy, clayey, or loamy	needs help identifying as sandy, clayey, or loamy	does not understand the terms sandy, clayey, or loamy
Matching soil types with location	easily matches soil type with locations	makes one or two mistakes in matching	makes a few mistakes in matching	cannot match soil type with location
Group work skills	always shares ideas, respects and helps others, and stays on task	usually shares ideas, respects and helps others, and stays on task	seldom shares ideas, respects and helps others, and stays on task	never shares ideas, respects and helps others, and stays on task
Problem solving and application skills	efficient at problem solving; easily applies knowledge to problems	can problem solve as well as apply knowledge to problems	has difficulty problem solving and applying knowledge to problems	shows few or no problem solving skills or application skills

Plant Growth and Changes

Curriculum Outcomes

These are the curriculum outcomes as presented in *Atlantic Canada Science Curriculum: Grade 3.* This document can be found in the Document Depot of the Nova Scotia Department of Education website, www.EDnet.ns.ca.

STSE/Knowledge	Skills
Students will be expected to	*Students will be expected to*
100-28 identify and describe parts of plants and their general function	**202-2** place seeds in groups according to one or more attributes
100-29 identify, investigate, and suggest explanations for life needs of plants and describe how plants are affected by the conditions in which they grow	**200-1, 200-3** ask questions and make predictions that lead to exploration and investigation about the composition of soil
100-30 observe and describe changes that occur through the life cycle of a flowering plant	**200-1, 201-5, 202-4** question and record relevant observations and measurements while investigating various growing conditions for plants
102-12, 102-13, 203-5 describe and respond to ways in which plants are important to living things and the environment and how the supply of useful plants is replenished	**201-3, 203-3, 202-4** observe, describe, and measure, using written language, pictures, charts, and graphs, changes that occur through the life cycle of a flowering plant

Activity 12: Seeds

Outcomes:

Students will be expected to

202-2 place seeds in groups according to one or more attributes

Questions:

- What do some or all of the seeds have in common?
- How do the size of the seeds vary?
- What types of plants do you think the seeds might come from?
- Why do you think it is important for seeds from a single crop to be a similar size?

Assessment:

- Describe the various attributes of the seeds.
- Explain the reasons for your sorting method(s).

Materials:

- Activity Sheet 12.1 (optional)
- various types of seeds (these can either be brought in by the students or by the teacher)

Procedure:

- Give each group of students a variety of seeds to sort.
- Have each group explain its sorting rule(s).
- Have students draw the seeds and write a description beside it. The description should include the texture, colour, size, smell, shape, etc.
- Discuss with the students what they think the purpose(s) of seeds are.
- Have them write their responses in their science log or journal.

Science Terms:

crop, plants, seed, sort, texture

Student Name: _____

Activity Sheet 12.1: Seeds

Drawing of the Seeds	Description of the Seeds

Activity 13: Parts of a Plant—The Seed

Outcomes:

Students will be expected to

100-28 identify and describe parts of plants and their general function

Questions:

- How are seeds important to the natural world?
- What function do seeds have in producing new plants?
- What are the various characteristics of seeds?
- Does the size of the seed always predict the size of the plant?
- What are the parts of the seed?
- Where does the seed growth occur?

Assessment:

- Record relevant observations about seeds and the plants they come from.
- Choose a plant and draw and label it.
- Observe and list the characteristics of various seeds.
- How, do you think, a seed grows?
- Do you think a bigger seed gives a bigger plant? What evidence do you have to support your answers?

Materials:

- an area to walk where students can observe seeds
- various seeds

Procedure:

- There are two times of the year when this activity can be most beneficial to students in observing the natural world. The spring is ideal to observe seeds from dandelions, strawberries, and maple trees. In the fall, students would be able to observe seeds from beans, peas, chestnuts, corn, pumpkins, marigolds, grapes, blueberries, raspberries, tomatoes, apples, etc.
- Seeds can also be purchased and used for discussion and observation. Various types of fruit and vegetables could be brought into the class for students to open up and observe their seeds. Students could try and grow plants from the seeds.
- Pumpkin seeds could be collected and students could roast them and taste them for flavour and consistency.

Science Terms:

fruit, seed, vegetable

Student Name: _____

Activity Sheet 13.1: Parts of a Plant—The Seed

Name of the Seed	Drawing of the Seed	Drawing of the Plant That the Seed Comes From

Activity 14: Let's Get to the Root of the Problem!

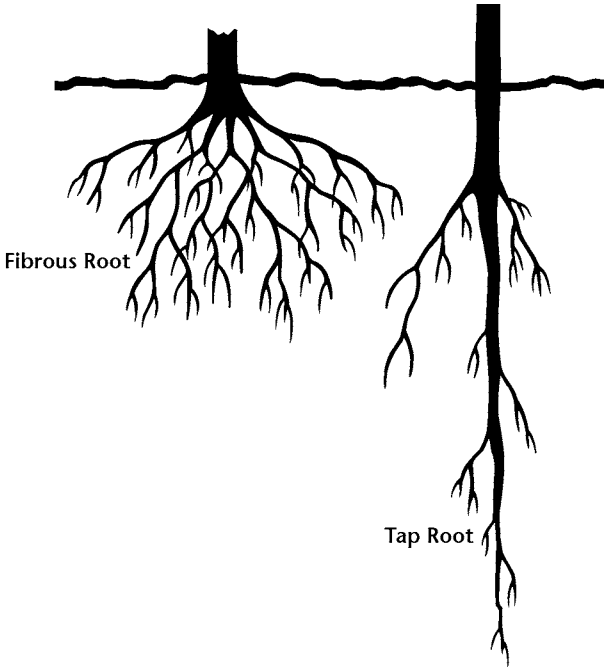
Outcomes:

Students will be expected to
100-28 identify and describe parts of plants and their general function

Background:

Roots are an important part of a plant. They are responsible for the anchorage of the plant, the uptake of water and nutrients, and the storage of the plant's food. We eat some roots, including potatoes, beets, radishes, and carrots.

There are two main types of roots: fibrous and tap. Fibrous roots are shorter, smaller, and branch out in all directions under the soil, e.g., tomato, corn, or wheat. Tap roots are longer, grown downwards into the soil, and have fewer extensions, e.g. carrots, soybeans, or dandelions.



Assessment:

- Using "mystery" roots provided by your teacher, write down whether they are fibrous or tap roots.
- Look at Activity Sheet 14.1 and check the similarities and differences in the chart. Use Activity Sheet 14.2: Assessment Checklist—Roots

Materials:

- Activity Sheet 14.1: Getting to the Root of It!
- Activity 14.2: Assessment Checklist—Roots
- samples of fibrous roots and tap roots (photos or actual roots)

Procedure:

- Discuss what roots are and their function in a plant (anchorage, uptake of water and nutrients, food storage).
- Show the students samples of each of the different types of roots without, at this point, identifying the names or types of roots.

- Have the students describe the characteristics of each type; organize the students' descriptions in order to identify the similarities and differences between the two types of roots.
- Introduce the terms fibrous root and tap root. Pass around the sample you have brought into class and have the students identify them as either fibrous or tap.
- Distribute Activity Sheet 14.1 and ask students to write down the similarities and differences between the roots.
- Students then draw a fibrous and tap root and suggest how they grow differently through the soil.

Extension Activities:

- Grow some seeds very close to the edge in a glass jar and watch the root development. Corn seeds make a nice fibrous root and soybeans will form a tap root.
- Ask the caretakers of the school if you can take your class outside to pull weeds around the schoolyard. As students pull weeds (hopefully with the root attached) ask students to identify them as fibrous or tap roots.

Science Terms: anchorage, fibrous root, nutrients, plant, roots, seeds, tap root, weeds

Student Name: _____

Activity Sheet 14.1: Getting to the Root of It!

Fibrous Roots Draw a picture of a fibrous root.	**Tap Roots** Draw a picture of a tap root.
Things that are the same between fibrous and tap roots.	Things that are different between fibrous and tap roots.

Arnold eats vegetables from his garden. What vegetables do you know that may have tap roots?

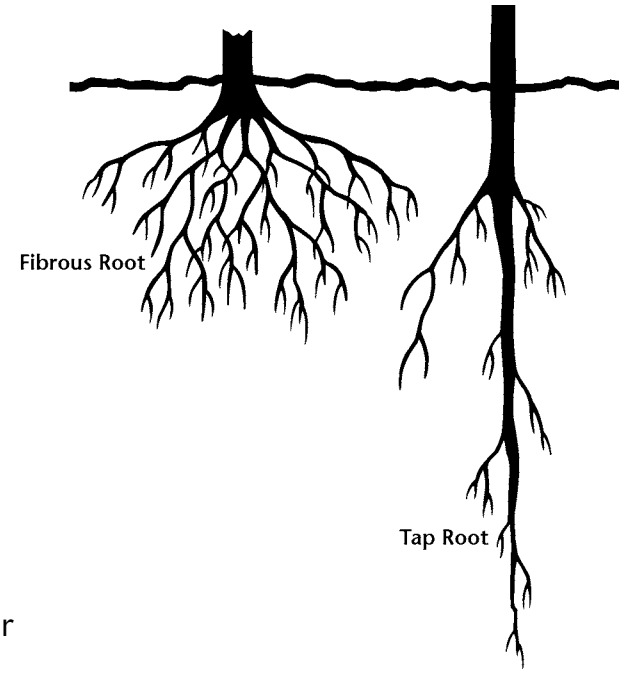
_____

Activity Sheet 14.2: Assessment Checklist—Roots

Check Activity Sheet 14.1 for the following information about roots:

Similarities

- ☐ plant anchorage
- ☐ uptake of water and nutrients
- ☐ food storage
- ☐ other ideas



Differences

- ☐ fibrous are shorter, tap are longer
- ☐ fibrous are smaller, tap are larger
- ☐ fibrous are more spread out, tap are compact

Examples of vegetables with tap roots from Arnold's garden:

- beans
- tomatoes
- carrots
- soybeans
- beets
- radishes
- turnip

Activity 15: Do Plants Really Need Soil?

Outcomes:

Students will be expected to

100-29 identify, investigate, and suggest explanations for life needs of plants and describe how plants are affected by the conditions in which they grow

Background:

Soil provides plants with nutrients, air, water, and anchorage. Without these basic needs, plants will not grow. However, soilless growing has been successful with some greenhouse crops and is called hydroponics. Greenhouse crops such as tomatoes, lettuce, and cucumbers are grown hydroponically. Hydroponics is the growing of plants in water that has air and nutrients added to it. The plants are anchored mechanically. The process requires elaborate equipment and maintenance and is difficult to simulate in a classroom setting.

Ask students if they think plants can grow without soil. Discuss with them what basic needs for plant life are provided by the soil (nutrients, air, water, anchorage). Suggest other ways to provide these basic needs.

Assessment:

- Write a story about the growth of your plants.
- Compare your plant journal with another student's journal.

Materials: (per group of 3–4 students)

- 3 seedlings (purchased or grown from seeds in class; seeds are provided in kit)
- 3 small flowerpots or Styrofoam cups (with a small hole in the bottom of each)
- Activity Sheet 15.1: Let's Experiment!
- gravel (as fine as is possible to find); provides anchorage only
- masking tape and markers
- potting soil to fill one pot, providing the plants with all its needs
- Sample: Self-Assessment Rubric—Experiments
- water for the third pot and for watering seedlings; provides water only

Procedure:

- In groups, have students label three small flower pots with masking tape as A: soil, B: gravel, and C: water. Fill each pot with the appropriate material. Prepare to plant the seedlings by carefully washing the roots and inserting them into a hole in the materials of each pot.
- **Note:** *The seedling put into water may need to be propped up or tied to a straw in the cup with string to keep it upright.*
- Measure the size of each seedling (cm) and record it under Day 1 for each pot on Activity Sheet 15.1.
- Ask students to hypothesize which plant will grow the best and suggest the reason for their hypothesis.
- Place the pots in a well lit location and watch them grow!
- Record measurements every three days.
- Water the seedlings in the soil and gravel slightly every two–three days or when soil looks dry.
- Save your plants for Activity 16.

Extension Activities:

- Research hydroponics.
- Bring in a guest speaker from a greenhouse to show pictures of a hydroponics system.
- Visit a grocery store to look for and list fruits and vegetables that are grown hydroponically.
- Take a class trip to a greenhouse.

Science Terms: anchorage, fibrous root, greenhouse, hydroponics, nutrients, roots, seedling, soil, tap root, water

Student Name: _____

Activity Sheet 15.1: Let's Experiment!

Record the height of each plant for two weeks. Before starting, hypothesize about what you think will happen.

Which plant do you think will grow best? _____

Drawing of Plant A	Drawing of Plant B	Drawing of Plant C
good soil–water–sunlight	poor soil–water–sunlight	no soil–water–sunlight
Day 1	**Day 8**	**Day 14**

Activity Sheet 15.1: Let's Experiment! *(continued)*

Record plant heights in the spaces below.		
A: Soil	**B: Gravel**	**C: Water**
Day 1	Day 1	Day 1
Day 4	Day 4	Day 4
Day 7	Day 7	Day 7
Day 11	Day 11	Day 11
Day 14	Day 14	Day 14

The plant that grew the best was _____

I think it grew the best because _____

The soil for Plant A is good because _____

The soil for Plant B is poor because _____

Sample Self-Assessment Rubric—Experiments

	Level 4	Level 3	Level 2	Level 1
Measuring and recording accurately	consistently records accurate measurements each day	usually records accurately and consistently; may have minor errors	rarely records accurately and consistently; shows errors in measurement	records are inconsistent and usually inaccurate
Articulating reasons for hypothesis	outlines thoughtful and reasoned argument for hypothesis	arguments are logical and reasonably clear	gives only a few reasons why hypothesis was chosen	does not explain why hypothesis was chosen
Analysing reasons for growth	describes all the reasons for good and poor growth	describes some of the reasons for plant growth	describes few reasons for plant growth	has little idea why plants grow
Interpreting the results	conclusion addresses original purpose accurately	conclusion reflects original purpose	conclusion shows some connection to original purpose	conclusion does not address original purpose

Activity 16: Looking at Plants

Outcomes:

Students will be expected to

100-28 identify and describe parts of plants and their general function

200-1/200-3 ask questions and make predictions that lead to exploration and investigation about the composition of soil

Questions:

- What are the parts of a plant? What is the use of each part of the plant?
- What questions can I investigate about plant growth?
- How do plants grow? What do plants need to grow?
- Do different variables affect the rate of plant growth?

Assessment:

- Draw and name the parts of the plant.
- What conditions affect the growth of plants?
- What do the roots do?
- Draw pictures of the plants that grew under different conditions.
- Which plants grew best? Give evidence to support your answer.

Materials:

- magnifying tools that may include hand-held magnifiers
- See Activity Sheets 16.1, 16.2, and 16.3.
- two-way microscopes, dissecting microscopes, and/or Intel Play QX3 Computer Microscope
- various plants; possibly prepared slides of plant parts

Procedure:

- Students have already grown plants in Activity 15.
- Students view various types of plants, looking to see similarities and differences between the various parts. Students examine the roots and root hairs, stems, flowers and their parts, seeds, bark or stem surface, and leaves.
- Different groups of students may be assigned a different plant part to study. Students could present the information or create a chart to compile the information.
- Using the Intel Play QX3 Computer Microscope, students should save images of the parts from different kinds of plants and create slides with labels. They could export these images for use in a word processing document to illustrate a report about the differences observed in the parts of different plants.

Science Terms:

bark, conditions, controls, flower, inferences, leaves, observation, patterns, plant, root hairs, roots, seed, stem, trunk, variables

Activity Sheet 16.1: Plant Parts

Plant Parts	
What I know now (draw):	What I know now (list):

What I have learned (list):	Final drawing:

Activity Sheet 16.2: Plant Study Log

A Plant Study	
Date: Observations/Diagrams	Date: Observations/Diagrams

Date: Observations/Diagrams	Date: Observations/Diagrams

Date: Summary/Comments

Activity Sheet 16.3: Different Plants

Different Plants		
Each plant has a number to help identify it. Put the number in one of the columns "Which have?" or "Which have not?"		
Characteristics	**Which have?**	**Which have not?**
leaves		
buds		
colour		
height		
smell		

Choose three other characteristics and fill in the chart.		
Characteristics	**Which have?**	**Which have not?**

Now look at two characteristics at the same time. Fill in the chart.		
Characteristics	**Which have?**	**Which have not?**

Activity Sheet 16.4: Tracking Plant Growth

<table>
<tr><th colspan="4">Tracking Plant Growth</th></tr>
<tr><td>Date</td><td>Height</td><td colspan="2">Observations</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>Plant Needs</td><td>A Change I Noticed</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">My Questions</td><td colspan="2">Diagram(s)</td></tr>
</table>

Activity 17: Sow What? Which Soil is Best for Growing?

Outcomes:

Students will be expected to

100-29 identify, investigate, and suggest explanations for life needs of plants and describe how plants are affected by the conditions in which they grow

Background:

Students will look at the different soil types and their ability to grow plants from seed. The sample that will promote the best growth will be a mixture of the various soil types—either the loam or the potting soil. A mixture of the soils provides the best combination of nutrient retention and water drainage. Students will observe the germination and growth of the seeds for at least two weeks to see any significant differences. The time can be extended, if needed, to produce differences in growth patterns.

Seeds may germinate without soil, but they need soil to grow into plants (unless grown in an intensive hydroponic system).

Assessment:

- Draw a picture of your plant and write about how your plant grew in one of the pots.

Materials:

- 5 soil samples: sandy, clayey, loamy, muck, and potting soil
- 5 small flower pots or cups
- 5 corn seeds
- Activity Sheet 17.1: Which Soil Is the Best?
- Sample: Self-Assessment Rubric—Experiments

Procedure:

- Label five pots as sand, clay, loam, muck, and potting soil. Fill pots with samples.
- Plant a corn seed in each of the jars so that it is slightly covered with the soil. Keep the soil moist. It must be watered gently when it starts looking dry.
- Distribute Activity Sheet 17.1 and have students hypothesize which seed will grow the best and the reasons for their hypothesis.
- Students record height measurements on Activity Sheet 17.1. After about two weeks, the students draw a conclusion as to which soil type is the best for growing plants indoors.
- Discuss reasons why some soil types are better for plant growth then others, i.e., nutrient retention and water drainage.

Extension Activities:

- Start a classroom garden by planting seeds in the preferred soil condition.
- Discuss what other factors are important for plant growth.
- Students design an experiment to see if sunlight or water is needed to grow plants.
- Discuss challenges farmers may face when growing crops for food.

Science Terms:

drainage, germinate, growth pattern, nutrient, retention, seed, soil

Student Name: _____

Activity Sheet 17.1: Which Soil Is the Best?

I think the soil type that will be best for growing seeds is _____.

Draw and colour the pots in the experiment under the name of the soil type.

Sandy	Clayey	Loamy	Muck	Potting Soil
Record plant heights in the spaces below				
day 1:	day 1:	day 1:	day 1:	day 1:
day 4:	day 4:	day 4:	day 4:	day 4:
day 7:	day 7:	day 7:	day 7:	day 7:
day 11:	day 11:	day 11:	day 11:	day 11:
day 14:	day 14:	day 14:	day 14:	day 14:
day 17:	day 17:	day 17:	day 17:	day 17:

The soil type that is best for growing seeds indoors is _____

I think this is because _____

_____

Sample Self-Assessment Rubric—Experiments

	Level 4	Level 3	Level 2	Level 1
Measuring and recording accurately	consistently records accurate measurements each day	usually records accurately and consistently; may have minor errors	rarely records accurately and consistently; shows errors in measurement	records are inconsistent and usually inaccurate
Articulating reasons for hypothesis	outlines thoughtful and reasoned argument for hypothesis	arguments are logical and reasonably clear	gives only a few reasons why hypothesis was chosen	does not explain why hypothesis was chosen
Analysing reasons for growth	describes all the reasons for good and poor growth	describes some of the reasons for plant growth	describes few reasons for plant growth	has little idea why plants grow
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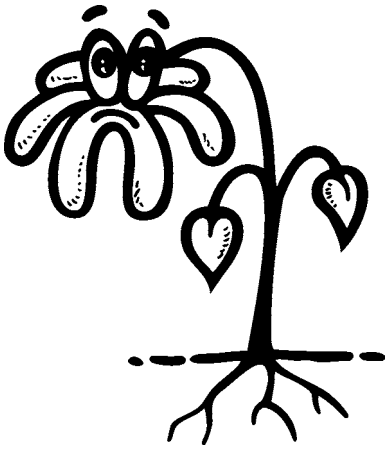

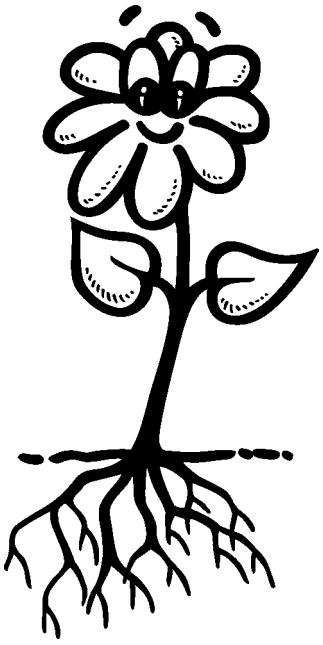

Activity 18: What Nutrients Do Plants Need?

Outcomes:

Students will be expected to

200-1/200-3 ask questions and make predictions that lead to exploration and investigation about the composition of soil

Background:

The first part of this activity introduces students to the three main plant nutrients: nitrogen (N), phosphorus (P), and potassium (K). The shorthand method of writing chemical names may be compared to nicknames.

Nitrogen is responsible for making plants healthy and green. Nitrogen is a key component of protein that is made by the plant.

Phosphorus is necessary for photosynthesis (converting light energy into food) and healthy roots. It is an "energy carrier" for the plant.

Potassium protects plants against diseases, cold, wilting, and dryness. It also helps to transfer food in the plant.

This activity is a demonstration of how farmers and gardeners determine whether or not soil has enough of these nutrients. Prior to class, the teacher may perform an N test on the soils. The supplies should be previously ordered.

Caution: The N test kit contains some materials that are not to be handled by students. The teacher should demonstrate this test for the students and then pass around the tester for observations.

Assessment:

- Suggest how people, especially farmers and gardeners, know if their soil has enough nutrients for growing plants.
- Rank the mystery soils from most to least nitrogen.
- Draw the plants and describe what they looked like before and after the addition of plant nutrients.

Materials:

- 3 mystery soils
- Activity Sheet 18.1: Plants Need Nutrients, Just Like Me! (2 pages)
- N test kit and instructions (purchased from a supplier)

Procedure:

- Develop a comparative chart to show the similarities between people and plants, e.g., both living things, some basic needs are the same like food and water, both grow.
- Discuss the term **nutrient** and why nutrients are needed to help all living things grow.
- Ask students where we get our nutrients (food) compared to where plants get their nutrients (soil). **Optional:** Just as we need three main nutrients (carbohydrates, fats, proteins) so do plants; their main nutrients are nitrogen (N), phosphorus (P), and potassium (K).
- Distribute Activity Sheet 18.1 (2 pages) that explore the plant nutrients and ask students to draw and colour plants.

Extension Activities:

- Suggest soil types that might have more nutrients than others, e.g., loam has more than sand.
- Perform the N test on student samples.
- How do farmers make soil good for growing? Ask a local farmer to come to the class to speak about how soil is treated.
- Where do the nutrients go? Place a stalk of celery with leaves attached into a glass with food colouring and water. Let it sit overnight. Observe the stalk and leaves, cut a cross section of the stalk and observe.

Science Terms: nitrogen, nutrients, phosphorus, photosynthesis, potassium, protein

Student Name: _____

Activity Sheet 18.1: Plants Need Nutrients, Just Like Me!

Fill in the blanks with the words in the word list.

Our _____ gives us nutrients to grow.

The _____ gives plants nutrients to grow.

We need _____ main nutrients from our food. They are carbohydrates, protein, and _____.

Plants also need _____ main _____ from the soil. They are nitrogen, phosphorus, and _____ .

Word list

soil

fat

food

three

potassium

nutrients

three

Nitrogen has a nickname. It is "N." Plants need N to be green and healthy. Plants without N look weak and yellow.

Draw a Plant with N

Draw a Plant without N

Activity Sheet 18.1: Plants Need Nutrients, Just Like Me!
(continued)

Phosphorus has a nickname. It is "P." Plants need P for healthy roots. Plants without P have unhealthy roots and do not grow strong.

Draw a Plant with P

Draw a Plant without P

Potassium has a nickname. It is "K." "K" comes from the Latin word for potassium–"Kalium." Plants need K to protect them from disease, cold, wilting, and dryness. Plants without K will wilt and fall over.

Draw a Plant with K

Draw a Plant without K

Activity 19: Light and Plants

Outcomes:

Students will be expected to

100-29 identify, investigate, and suggest explanations for life needs of plants and describe how plants are affected by the conditions in which they grow

Questions:

- What impact does the amount of light have on the growth of a plant?
- How does the amount of light affect the germination of a seed and its growth into a plant?
- What is a fair test?

Assessment:

- Determine the impact various amounts of light have on plants.
- Record your findings and report these to the class.
- Determine a question to investigate about plants.
- Do an investigation with plants.

Materials:

- Activity Sheet 19.1: Lights and Plants
- containers to hold plants
- plants
- seeds (bean, marigold)
- soil

Procedure:

- Students have had experiences with fair tests in previous grade levels. Review with students the term fair test. Brainstorm with students what they think the importance of light has on the growth of plants. Record their answers on chart paper for future reference.
- Tell students that they are now going to test their ideas. Have students develop a fair test for growing plants in various types of light.
- Guide students to consider that
  - the same type of soil should be used
  - the same amount of soil should be used
  - the same type of containers should be used
  - if planting seeds, the seeds should be planted at the same time
  - plants or soil should be watered at the same time of day, with the same amount of water
  - if purchasing plants for the test, they should be of the same size and condition
- Have students plant their seeds and put them in various types of light (dark cupboard, under fluorescent lights, under a grow light [a grow light is a special type of fluorescent light used for plant growth], in sunlight, under an incandescent bulb ...).
- Have students record their observations. Discuss with students their findings. Relate what they learned in class to real-life situations (greenhouses, plants in malls, plants in gardens, etc.).
- What impact does the amount of light have on a farmers crops? (i.e., a summer that is cloudy and rainy versus a bright, sunny summer)

Science Terms:

germination, light, plants

Student Name: _____

Activity Sheet 19.1: Lights and Plants

Type of Plant	When I Watered It	Type of Light	Observations/Date of Observations

Activity 20: Fruit or Vegetable Storage

Outcomes:

Students will be expected to

100-29 identify, investigate, and suggest explanations for life needs of plants and describe how plants are affected by the conditions in which they grow

102-12 describe and respond to ways in which plants are important to living things, and the environment and how the supply of useful plants is replenished

200-1/200-3 ask questions and make predictions that lead to exploration and investigation about the composition of soil (from Exploring Soils)

Background:

Temperature, moisture, and types of containers are some of the things that affect how well fruits and vegetables keep.

Question:

- What are the best conditions for storing certain fruits or vegetables?

Assessment:

- Make a list of how fruits are stored.
- Make a list of how vegetables are stored.
- What happens to fruits when they are left out on the kitchen counter? in a brown paper bag?

Materials:

- Activity Sheet 20.1: Fruit or Vegetable Storage
- breathable containers such as paper bags or baskets
- fruit or vegetables (these could be apples, potatoes, or any other readily available fruit or vegetable)
- sealable containers such as plastic containers or bags
- something to keep in moisture (sawdust or towel)

Procedure:

- As a class, discuss and find out how any of the following affect storage—light (dark, medium, or bright conditions); temperature (near a heater, in a fridge, room temperature); moisture (damp, dry); container (sealed or breathable material). Students can record their observations in Activity Sheet 20.1.
- Have the students tell what they think will happen if they alter the conditions listed above. Students can be divided into groups. Remember to change only one thing at a time and keep the others the same. For example, if you are checking to see if light has any affect on storage, keep the temperature, moisture, and type of container the same.
- Store the produce under different conditions. Record conditions and observations. Store the produce whole and cut up.
- Students should have a control fruit/vegetable and a test fruit/vegetable in order to observe one of the conditions above.

Analysis: Discuss what information students should record. Some things to consider are colour, smell, firmness, appearance. Record dates, observations, and labelled diagrams.

- Did the results agree with the hypothesis?
- Explore methods farmers use to store crops all year, e.g., apples are stored from October to August.
- Examine the differences in quality, taste, texture, and colour between fresh and stored fruits and vegetables. This can include canned, frozen, and whole fruit storage.

Science Terms: crop, moisture, storage, temperature

Student Name: _____

Activity Sheet 20.1: Fruit or Vegetable Storage

Date	Observations	Drawings

GLOSSARY

Glossary

agricultural: Anything having to do with farming (raising crops or livestock for food, fibre, or fur, or the agriculture industry that includes marketing, processing, and trade in these products).

baler: A machine used to compact and package roughage such as hay or straw.

canola: A crop whose seeds are used for making cooking oil; also, its meal is desirable as a livestock feed.

cash crop: Any crop that is considered easily marketable, such as wheat; a crop for direct sale in a market, as distinguished from a crop for use as livestock feed or for other purposes.

clay: Very fine soil particles, less than 0.002 mm in diameter, very sticky when wet, hard when dry.

cleaned seed: Seed that has been screened to remove weeds, seeds, and chaff.

compost: Organic material that has been piled and then allowed to undergo biological decomposition.

crop rotation: Planting different crops in fields than were planted there previously; a soil management and conservation method.

dirt: Loose material on the earth's surface that has no life-supporting properties.

environment: The immediate surroundings of a plant or animal that influence its well-being.

fair test: An experiment where all variables are controlled but one.

farm: An establishment or plot of land, usually with a house, barn, silo, etc., where food is produced by growing crops or raising livestock.

feel test: Describing the feel of soil after it has been moistened.

fertilizer: Any natural or synthetic material added to soil to supply plants with certain essential nutrients.

fibrous roots: Root structures that branch out in many directions with very fine extensions.

germination: The point at which a dormant seed begins to sprout, forming a new plant.

humus: Organic material in soil that has been subjected to bacterial decay to the point that the plant and/or animal residues have decomposed; plays an important role in soil fertility.

hydroponics: The technique of growing plants without soil, such as in a greenhouse. plants are anchored mechanically and receive nutrients and air through equipment.

loam: A soil mixture that is composed of equal amounts of sand, silt, and clay.

moisture (for germination)**:** The water required by a seed to sprout and later to sustain life.

nutrient: Any chemical element or compound that is essential to the growth and development of an organism.

organic matter: Dead plant and/or animal material.

plant: (1) A living, multicellular organism that usually has no locomotion, has roots, cellulose, cell walls, and has capacity for indefinite growth (noun). (2) To place seeds in the soil to produce plants (verb).

ribbon test: A test to determine the ability of a soil sample to form a ribbon when wet. this test helps to determine soil composition.

silt: Soil particles ranging in size from 0.002 to 0.05 mm in diameter; silt is smooth to the touch and does not become slick and sticky when wet.

soil: The naturally-occurring unconsolidated or loose material at the surface of the earth that is capable of supporting plant and animal life.

tap roots: Roots structures that grow downwards with few root extensions.