NOVA SCOTIA
Department of Education
English Program Services

A Closer Look:
Using Microscopes

Science Grades 3–6

Curriculum Supplement

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Science Grades 3–6: A Curriculum Supplement

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A Closer Look: Using Microscopes, Science Grades 3–6: A Curriculum Supplement

Prepared by the Department of Education

Contents

Introduction

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/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 but 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. 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 with greater detail. Tools such as hand-held magnifiers, box magnifiers, microscopes, and optical microscope allow a variety of extensions of the sense of sight. These instruments allow observations that extend the senses, in this case, the naked eye. Students should use these tools.

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 the 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, context, 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 here. Teachers should use operational questions that allow students to continue to explain and support their observations and inferences. Some questions might be

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. Using the computer, students might create word processing documents that include images of what they saw, create slide shows, or make PowerPoint types of presentations. Different groups might report their findings in ways appropriate to their understandings and learning styles.

The Intel Play QX3 Computer Microscope

The Microscope as a Tool

The Intel Play QX3 Computer Microscope is a tool that lends itself easily to use in grades 3–6 classrooms. It provides several advantages when magnifying items for students.

The image viewed on the computer screen can be saved and exported to a file. This saved file can be used in other documents (made for such applications as word processing, HyperStudio, Inspiration, PowerPoint, and multimedia presentations such as digital video), so students may use the image when they report on their observation.

If the image is saved on the computer system, students who may have missed the opportunity to do the activity or see the results may still look at the images at a later date, and make their own observations of the image.

The software provides the option for students to add captions and labels to the image after it has been captured and before it is saved or used. They may capture still images or short video clips of moving organisms. The program can be set to make time lapse images at specific set times (up to an hour apart) over a longer period of time. The software also has the ability for students to create slide shows of their images, with captions, labels, and titling.

Use and Parts

The microscope can be lighted either from below (causing it to act as a normal optical microscope) or from above (acting as a dissecting microscope). In the optical format, very thinly sliced objects may be viewed in much the same way as students have done for many years in schools. When the microscope is being used in its dissecting format, objects which are opaque, or cannot be sliced thinly, can still be viewed, In this way, students may observe the characteristics of different types of paper, or the scratches on a coin.

The base stand allows the microscope to be used in the traditional way. It contains a built-in light which shines upward through the items being examined. Items to be examined are placed on the sample platform. The microscope comes with a slide clip which fastens here, to hold traditional glass slides for examination. The focus now allows the images to be focussed. It may take a short time for the image to redraw on the computer screen. The magnification ring allows changes in magnification levels. The choices are similar to 10X, 60X, and 200X on a traditional microscope. Always start with the microscope set at the lowest magnification. If you are going to change

to a higher magnification, move the item around so that it is in the centre of the circle, then turn the ring to the next highest magnification, and focus the image. When you press the capture button, a picture is taken. Click and hold the button to capture a short video. This should only be used if you cannot access the buttons from the software on the computer screen. Pressing this button, will cause the image to shake.

Your Activity Book that comes with the microscope, pages 2 to 16, has more information.

Microscope Set-Up

Equipment Requirements: PC Platform, Windows 98 or higher, USB port

NOTE: *If the computers in your school have been set up with DeepFreeze, a technician or the technology leader at the school must install this software.*

1. Insert the Intel Play QX3 Computer Microscope CD.
2. Wait for the autoplay to start.
3. Click Install. (If your computer does not have the requirements listed above, the installation program will tell you this, and you will not be able to install the software.)
4. Follow the steps by clicking the appropriate buttons. If you are in doubt about any of the choices offered, use the settings and choices provided by the installer.
5. Registration may be done online, or you may click Cancel and proceed to the next step.
6. You will be asked if you wish to look at the Read Me file. It may be useful to read this information. The setup guide in the Parent Quick Start Guide gives instructions for finding this file at any time.
7. The computer must be restarted before the microscope can be used.
8. When the computer is running again, plug the microscope cable into the USB port on your computer.
9. Click on the QX3 icon to launch the software.
10. If you have any problems, check the information on pages 3 and 10 of the Parent Quick Start Guide.

Science Learning Activities

Overview

Learning to be a successful young scientist is contingent upon doing hands-on, minds-on science experiences that are framed in meaningful contexts. Science learning experiences use tools to enhance and support scientific literacy in the classroom. Links to the arts, reading, writing, mathematics, health education, and other curriculum areas provide a range of contexts for the processes in learning science. For all students who are becoming young scientists, guiding, sharing, encouraging independence, and assessing learning are all necessary to support scientific literacy.

Frequent opportunities must be provided for the young scientist to develop and express scientific understandings before, during, and after science activities. Science learning is inherently linked to an inquiring attitude, communicating, patterning, decoding, collaborating, problem solving, and decision making. The ability to interpret and use images is essential for all learners.

Students may use a variety of methods to communicate their learning from use of the computer and microscope.

Suggestions for Activities

The following pages suggest activities with microscopes for grades 3, 4, 5, and 6. Curriculum guides provide more suggestions that are appropriate for these grade levels.

Grade 3

Investigating Soil Composition
Looking at Plants

Grade 4

Life in a Drop of Water
Properties of Rocks and Minerals

Grade 5

Skin Investigations

Grade 6

Microorganisms
Arthropods

Science links are naturally made in the following activities. Language arts, arts education, mathematics, health education, social studies all have outcomes that link in a variety of ways with science. Teachers and young scientists make these links in various ways to help support their understandings. Scientific literacy—inquiry, problem solving, and decision making— is fundamental to learning.

Grade 3: Investigating Soil 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 an initial question or problem and draw simple conclusions based on observations or research (202-7)

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?

Assessment

- Prepare questions to test about soils. Do an investigation based on the question. Report the findings.
- 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

Different samples of soils; magnifying tools which may include hand-held magnifiers, two-way microscopes, dissecting microscopes, and/or Intel Play QX3 Computer Microscope.

Procedures

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

Students should record their investigations in their science logs, including observations, questions, notes, activity, pictures, measurements, and explanations. Sorting activities with pictures and explanations are 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 the particles. Magnifying glasses could be used to explore these soils. Other tools such as sieves and filters may be useful.

Using the 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 by the 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 Vocabulary

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

Grade 3: Looking at Plants

Outcomes

Students will be expected to

- identify and describe parts of plants and their general function (100-28, 203-2)
- identify and suggest explanations for patterns and discrepancies in the growth rate of similar plants grown in varying conditions (202-5)
- ask questions to investigate related to growing conditions for plants (200-1)

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?
- 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

Various plants; possibly prepared slides of plant parts; magnifying tools which may include hand-held magnifiers, two-way microscopes, dissecting microscopes, and/or Intel Play QX3 Computer Microscope.

Procedure

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 might 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 plant 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 Vocabulary

Plant, roots, stem, seed, flower, trunk, bark, leaves, observation, inferences, patterns, variables, conditions, and controls.

Grade 4: Life in a Drop of Water

Outcomes

Students will be expected to

- identify various methods for finding answers to questions related to their local habitat, and select one that is appropriate (204-6)
- make observations and collect information related to local habitats and their associated populations of plants and animals (205-5, 302-1)

Questions

- What does the habitat look like?
- Are there animals in the habitat? What do they look like?
- What are the characteristics of the organism?
- Are there organisms that can be seen without a magnifier?
- Are the organisms like you? Explain.

Assessment

- Make a table with your observations from your habitat study. Include diagrams and descriptions.
- Describe the characteristics of the habitats and the organisms that occupy it.
- Explain the habitat for the living things that can be seen through the microscope.
- When using the Intel Play QX3 Computer Microscope for part of this activity, save images of the organisms moving around.
- If yeast is being studied, time lapse shots of the yeast as it develops can be set up. For example, a sample of yeast in sugar water could be set up on the microscope, and the time lapse set for one hour, with the computer left running all night. The next morning, over 12 slides of the developing yeast population should be available to examine and report on. Create a slide show to present the population changes.
- The questions that I would like answered are ...

Materials

Microscopic habitats such as pond water, yeast in sugar water, ocean water from a rocky shore; magnifying tools which may include hand-held magnifiers, two-way microscopes, dissecting microscopes, and/or Intel Play QX3 Computer Microscope.

Background Information

Field studies are essential in the study of habitats and populations. Students should develop a plan to investigate the area of study. Collecting and recording of relevant data, habitat conditions, presentation of data results, and equipment needed should be included.

Life in a drop of water explores habitats of microorganisms.

Procedure

Students should view microscopic habitats, looking to see some of the organisms that occupy them. Different groups of students might be assigned a different microscopic habitat to study. The information each group collects could then be presented to the rest of the class, or a class chart could be created to compile the information from each group.

Students should make careful observations, make inferences about the existence of organisms from the observations, and record details about the habitat.

Extension

Were there any differences in the results of various habitat studies? If so, what were the differences? Suggest reasons for these differences.

Science Vocabulary

Habitat, population, community, interact, plants, animals, shelter, flowers, trees, landscape, soil, observations, inferences, data, equipment, slide, cover slip, and eyedropper.

Note that data is a plural noun.

Grade 4: Properties of Rocks and Minerals

Outcomes

Students will be expected to

- using appropriate tools make observations and collect information in order to describe rocks and minerals according to physical properties (204-8, 205-5, 300-6)
- record observations of their rocks and minerals in chart form and/or using notes in point form (205-7)
- classify rocks and minerals according to several properties and create a chart or diagram that show then method of classifying (206-1, 207-2)

Questions

- What is a property?
- What properties do the rocks have? What properties do minerals have?
- Which samples are similar in their properties? Identify the property.
- Which samples have different properties? Identify these.
- Do the rocks and/or minerals have more particles in them? Explain.

Assessment

- Classify a set of rocks according to properties of colour, texture, breaking qualities, and shape/size of particles.
- Classify a set of minerals according to properties of colour, streak colour, hardness, breaking qualities, fracture/cleavage, shape/size of particles, and lustre.
- Compare rocks and minerals. Record your observations in a chart.
- Write a story, with pictures, that describes where a smooth rock may have come from. Write a story, with pictures, about a jagged and angular rock.
- Display your rocks and minerals. Include information about your samples.

Materials

Different samples of rock; magnifying tools which may include hand-held magnifiers, two-way microscopes, dissecting microscopes, and/or Intel Play QX3 Computer Microscope.

Background Information

Students may have collections of rocks and minerals that they have gathered from their home or from the school. Students may use field guides and other geology resources to help them collect information about their samples.

Procedure

Students view various types of rock and minerals looking to see similarities and differences among them. Observations of the types, colours, and appearance of different particles that may compose the rocks could also be made carefully. Properties of the rocks and

minerals could include hardness, lustre, colour, shape, and any other suggested properties.

Using the Intel Play QX3 Computer Microscope, students should save labelled images of the different rocks. They could use magnified images of rock particles to illustrate the idea that rocks are composed of at least two different materials. Comparisons between types of rock are easier to make with printed images.

Extension

Prepare your own field guide to rocks. Try to classify rocks into categories of how they were formed.

Science Vocabulary

Properties, rocks, hardness, scratch test, minerals, lustre, observation, inference, classification, crystals, metals, ores, fracture, cleavage, streak colour, streak plate, and particles.

Grade 5: Skin Investigations

Outcomes

Students will be expected to

- describe the body's defences against infections (302-8)
- describe the role of the skin (302-7)
- select and use tools in building models of organs or body systems (205-2)
- identify problems and work co-operatively with other students to refine their design of a model of an organ or system (207-5)

Questions

- What does my fingerprint look like?
- Does my skin have other parts that have prints like fingerprints?
- Can unknown fingerprints be identified if a group of prints is available?
- From the fingerprint observations, make some inferences.
- Can inferences about a person's age or sex be made from looking at a set of fingerprints?
- Can fingerprints be changed?

Assessment

- Prepare a class chart of fingerprints that look the same.
- Compare fingerprints by age, by sex.
- Compare your set of fingerprints. Do these have a pattern?
- Does skin make prints? How? Can I observe the prints easily?
- What other prints can the skin make, besides fingerprints?

Materials

Transparent tape; pencil shavings; fingerprints; magnifying tools which may include hand-held magnifiers, two-way microscopes, dissecting microscopes, and/or Intel Play QX3 Computer Microscope.

Background Information

The skin is one of the body's organs. Discussion of its use and function can be connected with the health education. Focus on maintaining a healthy body. After students look at prints from the skin (such as fingerprints discussion), tears, saliva, and certain blood cells might be discussed. This will lead to body systems, a unit that links with health education outcomes.

Procedure

Students rub one of their fingers with pencil to cover the top portion. Then they press this print on the sticky side of a piece of transparent tape and stick the tape on a piece of paper. The fingerprints can be studied, using hand magnifiers or the Intel Play QX3 Computer Microscope.

Students could use the Intel Play QX3 Computer Microscope to print the images of the fingerprints, and use the printouts to compare fingerprints. They could classify the shapes according to various

characteristics, such as arches and whorls. Tally charts and bar graphs could be created from the results.

Extension

Connections with other areas might be explored such as the following:

- A "mystery story" surrounding an unknown fingerprint could be developed to find the "suspect."
- Carry out classification activities with fingerprints.
- Research the latest breakthroughs in identification of individuals, such as retinal patterns. Answer the question: "Would retinal patterns be more accurate than fingerprints as a method of identifying people?" Explain your answer.
- Is the skin used as a natural defence mechanism against diseases and illnesses? Explain.
- Research one of the following topics to find out how it affects the growth and development of your body: tobacco, alcohol, steroids, junk food, tanning in a salon.

Science Vocabulary

Skin, prints, observations, inferences, body systems, organs, defence, and infection.

Grade 6: Microorganisms

Outcomes

Students will be expected to

- identify and use correctly appropriate tools to examine and describe some living things that cannot be seen with the naked eye (204-8, 300-19)
- describe how microorganisms meet their basic needs, including obtaining food, water, and air, and moving around (302-12)
- provide examples of how science and technology have been involved in identifying and controlling the growth of microorganisms (107-6)

Questions

- How does a microscope work?
- Are there living things that cannot be seen with the naked eye?
- How do microorganisms meet their needs for food, water, air, and movement?
- What do the microorganisms look like? Are there any structures that help with survival?
- Are microorganisms helpful? Harmful?

Assessment

- Describe and draw what you see on the slide.
- What are the parts of the microscope?
- What structures do microorganisms have that help them survive and meet their basic needs?
- Prepare a poster showing pictures of magnified objects. Identify the object, the instrument used, and the magnification level.
- Using a prepared slide and various viewers, draw what is seen and record the magnification. Using a chart, compare the results.
- Write a paragraph about two microorganisms—one that can be harmful to humans and one that can be helpful to humans. Include a picture and the features that help movement and feeding.

Materials

Packets of yeast; glass microscope slides; cover slips; sugar, water; magnifying tools which may include hand-held magnifiers, two-way microscopes, dissecting microscopes, and/or Intel Play QX3 Computer Microscope.

Background Information

Various magnifying devices should be available. Magnification levels can be compared for the organisms. Samples of water, compost material, aquarium glass scrapings, or prepared slides can provide specimens for study. Features of the microorganisms that meet their basic needs, such as cilia, can be shown.

Procedure

Yeast can be grown in warm water with sugar added. Yeast grows quickly (within a couple of hours). The population develops until the sugar is exhausted, at which time the population will collapse.

Students could use the Intel Play QX3 Computer Microscope to carry out simple activities such as basic examination of yeast, including doing simple population estimates and observing structures such as yeast buds.

A more detailed activity might include setting up the microscope and software so that a slide containing yeast is on the stage, and setting the time lapse to take photographs every hour overnight. Students could create a slide show which shows the development and changes in the population of yeast.

Extension

An in-depth activity, that is an experiment, might include a set-up of different groups with different combinations. The three major variables in the environment of yeast–sugar, water, and temperature–can be used. Keeping two variables constant, the third students can watch. As an example, one group may be experimenting with cold, room temperature, and warm water. Their containers would all have the same kind of sugar and tap water. Another group may test white sugar, brown sugar, and corn syrup; their tap water and room temperature would all be the same. A third group might use water, vinegar, and rubbing alcohol; their sugar and room temperature would be held the same. At the same time, other groups may experiment with different "control sets," such as just yeast and water, just yeast and sugar, just sugar and water.

Each group should do its version of the experiment at least three times and gather the results of each trial as images taken through the Intel Play QX3 Computer Microscope. At the end of the experiment, students identify and explain the conditions required for yeast to grow effectively.

Science Vocabulary

Microorganisms, yeast, control, variable, magnifiers, test, experiment, independent variable, dependent variable, and microscope.

Grade 6: Arthropods

Outcomes

Students will be expected to

- record observations while investigating common arthropods (205-7)
- compare characteristics of common arthropods (300-18)

Questions

- What do arthropods have in common?
- What are arthropods?

Assessment

- Record the similarities and differences of the arthropods on a chart.
- Present your information about your arthropod as a display. Include image(s).
- Examine specimens of arthropods. Investigate the relationship(s) between arthropod's mouth parts and feeding behaviour. Record your findings.
- How does the arthropod's mouth parts help it feed?

Background Information

Arthropods have a hard cuticle made mostly of chitin and proteins that form an exoskeleton that may or may not be stiffened with calcium carbonate. They have segmented bodies and distinctive jointed appendages.

Some examples are beetles, millipedes, centipedes, lobsters, crabs, shrimp, barnacles, krill, brine shrimp, and spiders.

Arthropods range in distribution from the deep sea to mountain peaks. Their sizes can be microscopic to the king crab. They have varied tastes like chocolate-covered ants to lobster Newburg. The diversity is large, but the basic body plan is constant.

Procedure

Groups of students could work with different combinations of arthropods. They could use two different types of insects or compare an insect to another type of arthropod, such as a spider. Students should record results on a chart.

Students could use the Intel Play QX3 Computer Microscope to create presentations using images exported from the microscope incorporated into software such as PowerPoint. They could show the similarities and the differences between different species of arthropods. They could examine prepared slides on arthropod body parts, such as a bee's leg, in order to recognize the specialized structures that help the organism survive.

Science Vocabulary

Vertebrates, invertebrates, observations, arthropods, specimens, characteristics, inferences, and phylum.

Appendices

Appendix A: Soil Composition

Investigating Soil Composition	
What I know about soils	**What I would like to find out about soils**
What I found out	

Appendix B: Soil Sample

My Soil Sample	
Observations **Inferences**	**Diagram**

Properties	**What is it like?**
Definition	**What is it unlike?**

Appendix C: Soil Types

Definition	Word	Diagram
	Example	

Definition	Word	Diagram
	Example	

Definition	Word	Diagram
	Example	

Definition	Word	Diagram
	Example	

Appendix D: Plant Parts

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

What I have learned (list)	**Final drawing**

Appendix E: Plant Study Log

A Plant Study	
Date **Observations/Diagrams**	**Date** **Observations/Diagrams**

Date **Observations/Diagrams**	**Date** **Observations/Diagrams**

Date	**Summary/Comments**

Appendix F: 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?**

Appendix G: Tracking Plant Growth

<table>
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<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>
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Appendix H: Life in a Drop of Water

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Science Log</th></tr>
<tr><td rowspan="2">My Habitat</td><td>Questions I Explored</td></tr>
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Appendix I: My Rock Collection

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<tr><td rowspan="2">My Classifying System</td><td>Properties I Observed</td></tr>
<tr><td>Diagrams</td></tr>
<tr><td>Examples</td><td>Words I Have Learned</td></tr>
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Appendix J: My Mineral Collection

<table>
<tr><th colspan="3">My Mineral Collection</th></tr>
<tr><td colspan="2">My Classifying System</td><td>Properties I Observed</td></tr>
<tr><td colspan="2"></td><td rowspan="2">Diagrams</td></tr>
<tr><td>What is it like?</td><td>What is it unlike?</td></tr>
<tr><td colspan="2">Examples</td><td>Words I Have Learned</td></tr>
</table>

Appendix K: My Rock's Story

My Rock's Story	
Information for My Story	**The Story**
Create an analogy.	
Draw a figurative representation.	
Words I Have Learned	

Appendix L: My Fingerprints

Left Hand	Questions	Right Hand
Thumb		**Thumb**
Index	**Observations**	**Index**
Middle		**Middle**
Ring		**Ring**
Little	**Inferences**	**Little**

Appendix M: Microorganisms

Microorganisms Log	
Observations	**Procedure**
Inferences	**Variables**
More Questions	**Equipment I Used**
	Words I Have Learned

Appendix N: Arthropods

Arthropods **My arthropod is_____.**	
Body Plan—Parts and Diagrams	**Observations**
	Inferences
	What other arthropods may be like mine?
	Questions to Explore

References

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Hands-On Grossology: The Science of Really Gross Experiments. Branzei, Sylvia. Planet Dexter, New York, 1999.