Exploring Your World

One Square Meter

National Science Education Standards

- Standard C: *Life Sciences* — Populations and ecosystems.
- Standard C: *Life Sciences* — Diversity and adaptations of organisms.
- Standard E: *Science and Technology*— Understandings about science and technology.
- Standard F: *Science in Personal and Social Perspectives* — Populations, resources, and environments.
- Standard F: *Science in Personal and Social Perspectives* — Science and technology in society
- Standard G: *History and Nature of Science* — Nature of science.

OVERVIEW

This series of activiies will introduce the student to the concept of a quadrat study. Students will discover the various components of their environment by carefully studying a small, delineated sample area. These activities will allow students to use the science process skills of observation, data collection and recording.

OBJECTIVES

Students will:

1. Understand the importance of sampling in science.
2. Learn how to set up a quadrat.
3. Improve their observation skills.
4. Understand how to make a chart quadrat.
5. Understand the concept of species diversity.

SUBJECTS

Science, Language Arts

VOCABULARY

Quadrat, sample, study site, replication, meter

TIME

This entire project can be completed in 1 week of 50 minute periods. For more indepth study, It can be extended and enhanced to cover a longer period. Alternatively, you can choose to do just one portion of the activity.
Activity 1&1a - Selecting and investigating a site - 50 minutes
Activity 2 - Surveying along a transect - 50 minutes
Activity 3 - Quadrat survey and analysis - 50 -100 minutes

MATERIALS

Field work: rulers, string, tape, scissors, popsicle sticks (4 / student group), small magnifiying glasses, baggies, plastic gloves, small notebooks, pencils, 10-meter tape (or rope), 10-cm guide
Classwork: magnifying glasses, rulers, baggies, plastic gloves, graph paper, reference books, computer with spreasheet software.

BACKGROUND

You have just been given the task of finding out how many dandelions or how many blades of grass are on your school grounds. How would you go about finding out? Your problem is similar to the problems scientists face all the time. How many whooping cranes are in existence? How many deer in a forest preserve? How many compass plants are in a section of prairie? You might solve your problem by getting down on your hands and knees and counting every dandelion on the school grounds. This might take you a very long time but if done carefully would give you a precise answer.

It is often unrealistic for a scientist to count every organism in her/his research area. What scientists often do is to work with a sample, a small section or plot of their research area. From their sample the scientist can then estimate many things about their research area without having spent all the time necessary to count each organism.

Selection of a **study site** is the first step in a field investigation of the forest environment. Obviously, scientists establish study sites in areas with properties they want to study. It is recommended that you select more than one site in order to replicate the study. A choice of several sites of different management history or successional stage will allow you to compare differences in what the students sample. You can consult with the US Forest Service, the state department of forestry, certified foresters, or university scientists about appropriate locations for your study site. If you work at a private site make sure your obtain appropriate permits for use. If possible, choose a site that is close to the road for easy access. This can come handy in case of an emergency or if you want to visit the site more often to resample your plots. Students can build and post a simple sign at their study site to notify visitors of an ongoing investigation.

When scientists investigate a forest it is not feasible to take measurements (**sample**) from the entire area. For example, it would expensive and time-consuming and often unnecessary to measure all trees in a 50-acre forest to estimate the average diameter or age of trees in this area. Instead, scientist select **sample plots** or **points**. These are locations uniformly or randomly distributed throughout the study area. Scientists then take measurements or sample these areas and extrapolate their results to the entire study site and other similar areas. Study plots can be square, rectangular or circular in shape. Sometimes, scientists do not establish permanent plots but instead they sample along a transect line. For example, in vegetation studies, they may want to count the number of plants that touch a sampling line stretched for many meters through the forest. Keep in mind several basic rules that scientists use to obtain a more representative characterization of the vegetation they sample:

- ✿ Two-dimensional plots such as squares and circles give you a better information about the plant community at each point of observation than linear transect plots.
- ✿ You are better off if you sample several smaller plots than one large plot at your study site.
- ✿ If you want to increase the accuracy of your sampling then increase the number, not the size of your sample plots.

BACKGROUND (continued)

Generally, the more samples you collect, the more confident you can be about the results you find. By taking measurements in several or many study plots (**replicating**), and averaging your results, you can account for the effect of natural variation (**heterogeneity**) present in the forest. This natural variation of the environment can be very misleading if you are not aware of it! For example, if you use only one quadrat to estimate fine woody debris and this plot happens to have an unusually low content of woody debris, you would be tempted to conclude that that your study site is generally low in woody debris. This, however, may not be correct — a few feet away you could find huge amounts of woody debris that you never sampled. Remember, however, there is a trade off between the precision of the study and the cost of conducting an experiment. Working with more study plots requires more time, money and effort.

BEFORE THE ACTIVITY

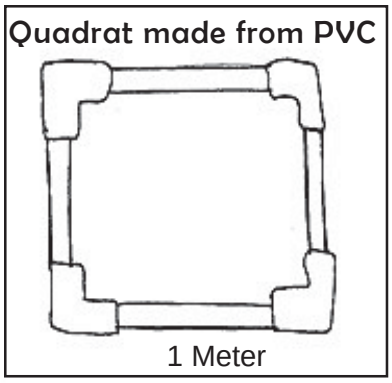
Scan the school grounds and local surrounds for a suitable area to study biodiversity. Select a site that supports a significant variety of life. It will assist the learning process if the survey area contains clearly defined and stable ecosystems. The area you select needs to be able to tolerate the disturbance of a class of students surveying it.

Helpful hints

The most interesting sites are found in environmental gradients, that is, where there is a change in environmental conditions over the distance surveyed. Useful areas include:

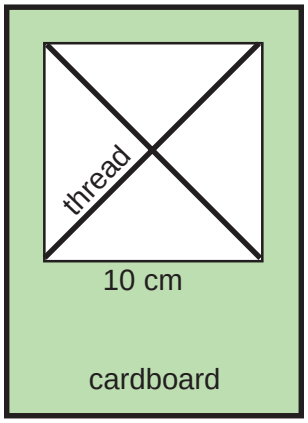
- ✿ a grassland with a treed area and a creek
- ✿ in semi-arid locations, adjacent areas, one with full exposure to the wind and sun and the other with some protection from them
- ✿ an area with cultivated land adjacent to natural bush.

You will want to make a 1 meter-square quadrat in preparation of your sampling. To make this, you can use a four-meter rope and mark it at 1, 2 and 3 meter intervals. Then arrange the rope around four pegs to form a square. Alternatively, you can use one-meter lengths of light wood or plastic rods joined at the corners to enclose a one-meter area.



Also, you will need a 10-centimetre-square guide made of cardboard. This is fitted with threads across the diagonals of the inner square – these form the 'cross-hairs'. Students will use the 10-centimeter-square guide to locate specific plants to record.

Each group of students should have a quadrat and a 10-centimter-square guide to use. If desired, your students can make these items before the activity.



Science Safety!

It is both fun and educational to learn science by doing science—but experiments and field trips are no fun if you get hurt. Read and follow the safety tips on this page.

Good experimental procedure always includes carefully following basic safety rules. Things can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. There will be no time after the fact to protect yourself.

Always prepare for unexpected dangers by following basic safety guidelines the entire time you are performing the experiment, whether or not something seems dangerous to you at a given moment.

We assume you will read the safety precautions that follow, as well as the ones that appear with each activity and that you will remember them and follow the recommendations. You must use good judgment and pay attention when you are doing your experiment or activity.

If you have any questions about whether or not a procedure or material is dangerous, wait until you find out for sure that it is safe.

BEFORE YOU BEGIN

- Read the entire experiment before you begin.
- Clear a workspace.

PROTECT YOURSELF

- Follow the directions, step-by-step.
- Make sure you know where there is a first-aid kit and eyewash.
- Concentrate on what you are doing; do not roughhouse.
- Wear something to protect your clothes, like a smock or apron.
- Clean up spills immediately.
- Tie back your hair; do not wear loose clothing or open-toed shoes.
- Keep your workspace neat and dry.
- Do not eat or drink in your workspace.
- Do not light matches.
- Do not eat or drink any experimental substances without express permission from a responsible adult.
- Wear goggles or protective eyewear when working with sand, etc.

USE EQUIPMENT WITH CARE

- Use caution when working with scissors, knives, or other sharp objects.
- Set up your experiments far away from the edge of your work surface as practicable.
- Use care when working with glass.
- Clean up broken glass immediately.
- Be careful when using stepstools, chairs, or ladders.

GOING ON FIELD TRIPS

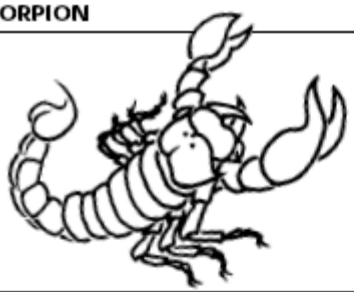
- Never go on a field trip by yourself; use the buddy system.
- Tell a responsible adult where you are going.
- Know where you are going and gather information about any danger, such as poisonous plants, that may be present there.
- Dress appropriately for the weather (rain, sun)
- Bring along a first aid kit.
- Never eat or drink anything you find in the wild.

FINISHING UP

- Thoroughly clean your work area and equipment.
- Don't dispose of materials down the sink, unless you are told to do so by a responsible adult.
- Wash your hands.

Science Safety! WATCH OUT for these critters

SCORPION



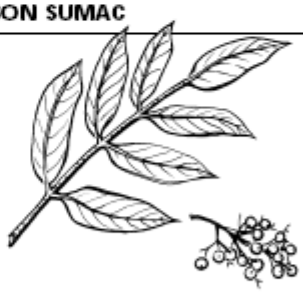
FIRE ANT

AFRICAN BEE

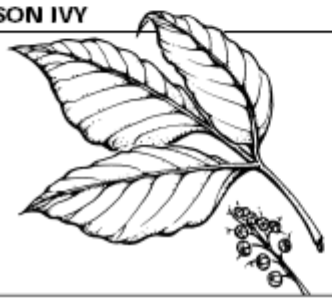
BLACK WIDOW

BROWN RECLUSE

POISON SUMAC



POISON IVY



POISON OAK

ACTIVITY 1 — Select a Site

1. Select a site—Select a survey site where there is varied vegetation and an opportunity to observe wildlife.

Observations of wildlife might be direct or indirect. Direct observations include sightings of birds, animals, lizards or insects as well as listening to bird calls. Indirect observations involve looking for evidence of the presence of wildlife. Evidence includes droppings, scats, claw marks, gnawed food, nests, or bones.

You may want to return to the site each year to observe changes in the area and make comparisons. Consider this when selecting the site.

2. Identify a marker—Identify a suitable marker as a reference point. You might choose the school gate, a monument, a large tree (with a vegetation protection order) or a road intersection. Record the marker's location on the data recording sheet to use it as a reference point for future surveys.

3. Plot the site's location—Once the marker is established, the exact location of the site for the detailed survey needs to be measured from this point and documented. The scientific reason for this is because the biodiversity within an area changes from point to point and over time (with the seasons and passing years).

4. Create a reference chart of living things in the area—Before students do any of the field activities, prepare a reference chart of the living things in the selected survey area. Students can refer to this when they are recording the data. The more identification that happens before the activity, the less sorting and renaming that needs to be done after the field activity.

To create a reference chart:

- ✿ Photograph, draw or take samples of the living things common in the area.
- ✿ Identify each different living thing in some way. For example, grass #1, grass #2, grass #3, grass #4, tree #1, tree #2, bush #1, bush #2, fungus #1, moss #1, insect #1, insect #2, spider #1 and so on.

5. Prepare data collection sheets —You can modify and copy the data recording sheets for students from the templates provided.

ACTIVITY 1B—BIG Picture Data

You selected the site for doing a quadrat sample in the previous step.This activity will acquaint students with the site as they collect 'big picture' data about it. 'Big picture' data helps to build a general profile of the area. This is useful to do before you begin detailed sampling of the site.

Preparation

To collect 'big picture' data, you will need:

- ✿ Compass
- ✿ Wind gauge
- ✿ Tape measure
- ✿ Binoculars
- ✿ Camera
- ✿ Pencils
- ✿ Student Page 1 data recording sheets.

ACTIVITY 1B—BIG Picture Data (continued)

Helpful hints

Eyes, ears, nose and sense of touch all have a role to play in gathering initial data.

When you encounter something related to the survey that cannot be adequately explained or named at the time, take a photograph so you can ask an expert later or consult a reference book.

Wash your hands after handling fungi and insects and before eating or drinking. Do not eat fungi from the natural environment. Cultivated mushrooms are an entirely different species.

Process

1. Gather 'big picture' data—To create a profile of the site, answer the following questions:

- ✿ What are the obvious living and non-living features of the study area?
- ✿ Is it on a flat plain, a slope or undulating ground?
- ✿ Is the soil rocky, sandy or loamy?
- ✿ Is it protected by trees and/or buildings or exposed to wind?
- ✿ Is it a grassy and/or treed area?
- ✿ Is it near water?
- ✿ Is it subject to heavy use?
- ✿ Is it quiet or noisy?
- ✿ What's the nature of the adjacent neighborhood? Is it an urban, rural, coastal or arid area?
- ✿ What are the weather and seasonal conditions?

2. Use a compass to identify the aspect—What's the aspect of the study area? Is it exposed to north, south, east or west?

Take a compass to the reference point, that is, the suitable marker you chose in 'Setting up for success'. Identify the site's aspect. Students can mark the compass points on their site maps.

3. Be alert for mobile species—During your observations, be alert for mobile species, such as birds, butterflies and bats as well as the larger mammals, reptiles and amphibians. Most animals will leave the area once people approach. This can give an incomplete picture of the site. You can minimise the disturbance of wildlife by being quiet and slow in your approach.

Reporting

Students draw a map of the area to be surveyed and write their observations on the Student Page.

ACTIVITY 2—Sampling Along a Transect!

In this activity, students use transects to collect detailed data about the variety of living things in the study area. A transect is a 10-meter-long straight line across the study area. At one-meter intervals, whatever living thing is under (or above) the tagged mark is recorded. For example, at the start of the transect line, there's grass; at 1 meter, there's soil; at 2 meters, there's a magpie in an elm tree, and so on. Using transects allows you to collect random data about the distribution and abundance of living things in an area.

ACTIVITY 2—Sampling Along a Transect! (continued)

Preparation

You will need:

- ✿ A 10-meter-long transect marker. To make this, you can use rope or cord or a tape measure. Mark one-meter intervals with knots or pegs or colored ties.
- ✿ A reference chart of living things in the area. You prepared this in Activity 1a.
- ✿ Pencils
- ✿ Student Page 2—Transect data recording sheet.

Helpful hints

During the class survey, it might be easier to identify living things by a code and take time later to name them if it's necessary. For example, at 0 metres on the transect, the first grass from the reference chart is noted. This can be recorded as G1 (as it is in the reference chart). At 1 metre, a different grass is found. This grass has not been listed in the reference chart and so can be recorded as Ga. The letter 'a' shows that it hasn't been entered in the reference chart yet. Similarly, a protocol of bush B#, tree T#, insect I# or fungus F# can be used to record living things listed in the reference chart.

Process

1. Set up the transect line for sampling— Working in groups of two-four, students choose a line for sampling in the study area. They extend the 10-meter rope between two points, starting in one kind of ecosystem and finishing in another. The rope can be secured with pegs at each end to minimize movement.

2. Mark the transect on the map—Each group of students plots the length and direction of their transect line on the map of the study area.

3. Record living things found at one-metre intervals—At each one-meter interval, observe the living thing(s) immediately under or above the tagged mark. Note this information on the data recording sheet. Collect a sample, take a photograph or do a drawing of each living thing so that you can identify it later.

4. Compare data—When each group has finished sampling along their transect line, compare the data collected by all the groups. Discuss common data, unique data and the variety in biodiversity.

Biodiversity varies from place to place – this is called 'variation over distance'. Variations between years or seasons are called 'variations over time'. Biodiversity changes over distance and time.

5. Identify new specimens—Identify any new specimens that were found. Give them a code and then enter them in the reference chart.

Reporting

Prepare a large map of the site on which to plot the results of all the transects. Use a bar graph to show the numbers of each species found. Comparisons between data from different transects can be discussed and reasons for variations suggested.

When data from earlier surveys is available for comparison, changes over time can be discussed and explanations offered. Is the area biologically stable? Or is it changing over time into a different type of ecosystem?

ACTIVITY 3—Sampling a Quadrat! (continued)

In this activity, students use quadrats to gather random data about biodiversity in small sections of the study area. A quadrat is a one-meter square measuring device. Students peg the quadrat on the ground. Then they use a 10-centimeter-square guide to record all the living things found within the quadrat's perimeter. The guide is fitted with 'cross-hairs' and the living things directly under the cross-hairs are recorded. The quadrat is sampled randomly and students gather 10 sets of data.

Preparation

You will need:

- ✿ A one-meter-square quadrat. To make this, you can use a four-meter rope and mark it at 1, 2 and 3 meter intervals. Then arrange the rope around four pegs to form a square. Alternatively, you can use one-meter lengths of light wood or plastic rods joined at the corners to enclose a one-meter area.
- ✿ A 10-centimeter-square guide made of cardboard. This is fitted with threads across the diagonals of the inner square – these form the 'cross-hairs'.
- ✿ A reference chart of living things in the area.
- ✿ Pencils
- ✿ Student Page 3-Quadrat data recording sheets.

Helpful hints

A quadrat is likely to provide considerably more data than a transect. Data collection sheets need to be able to accommodate a large quantity of data. Identifying living things by a code makes recording data quick and easy.

Process

1. Set up the quadrat for sampling—Working in groups of two-four, students randomly place a one-metre quadrat on the ground somewhere in the study area. The quadrat can be secured with pegs at each corner to minimize movement.

2. Random sampling for 10 sets of data—Randomly place the 10-centimeter square guide in ten places within the quadrat. Mark each place with a brightly coloured marker so that it is not repeatedly sampled. Record the living things found beneath the cross-hairs on Student Page 3. Collect a sample, take a photograph or do a drawing of each living thing so that you can identify it later.

3. Compare data —After each quadrat has been catalogued, compare the data collected by all the groups. Discuss common data, unique data and the variety in biodiversity.

4. Identify new specimens—Identify any new specimens that were found. Give them a code and then enter them in the reference chart.

Reporting

Data can be processed in a frequency distribution table. A bar graph can be generated and

percentages calculated. A written report could identify patterns in the frequencies, provide explanations for these patterns and include predictions.

Research the status of the living things cataloged in the survey. Identify which are native, which are introduced and which behave as pests or weeds.

EXTENSIONS

1. Complete a more rigorous sampling of your site. You can modify the Quadrat sample activity to record 100 sets of information.

To accomplish this, starting in the top left corner, place the 10-centimeter square guide within the quadrat. Record the living thing directly beneath the cross-hairs. Progress across and down the quadrat as if reading, until all the living things found beneath the cross-hairs are recorded on the data sheet. Collect a sample, take a photograph or do a drawing of each living thing so that you can identify it later.

2. Have your students complete the on-line plotting exercise at *http://www.eco-online.qld.edu.au/novascotia/resources/plot.html .*

In this online activity, you will record data about the biodiversity found in a survey plot. Students record data by entering the correct code for each species found in each of the 25 quadrats.

3. Analyze your survey data in your math lessons; prepare simple statistical analyses such as percentage distribution and relative frequency.

3. Challenge other classes to survey other environments. Share the data collected through class presentations, bulletin boards, reports or websites.

4. Develop a 'pen-pal' relationship with a school in a different region or state. Use the "One Small Square" activity to compare and contrast your different environments. Pen-pal schools can be found through the "America's Rain Forests" project.

ASSESSMENT

1. Have student teams present their survey findings in a class presentation.

2. Have teams prepare a site report that documents there findings, their process and ways to improve their survey methods.

CREDIT

This activity is adapted from the Eco-Online-Nova Scotia program. Visit *http://www.eco-online.qld.edu.au/novascotia/index.html* for more information and resources.

Name _____

Student Page 1

Big Picture Data

Surveyor's name _____

Location _____ Time _____

Date _____ Reference point _____

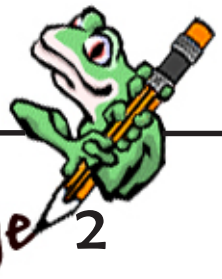
Compass heading _____ Distance from ref. point _____

Ecosystem types _____

Global position: North/South _____ East _____ Season _____

Map of study area

Features of the ecosystem _____



Name _____

Student Page 2

One Square Meter

Data Recording Sheet - Transect Survey

Distance in Meters	Specimen	Description
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Name _____

Student Page 3

One Square Meter

Data Recording Sheet - Quadrat Survey

Sample	Specimen	Description
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		