



Science Unit: *Ecosystem Models*

Lesson 1: *Measurement of Biotic and Abiotic Objects*

School year: 2006/2007

Developed for: Nootka Elementary School, Vancouver School District

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Grade level: Presented to grades 6-7; Appropriate for grades 4-7 with appropriate modifications.

Duration of lesson: 1 hour and 15 minutes

Notes: Complete reflections during the week.

Objectives

1. Identify biotic and abiotic factors in the environment
2. Identify the difference between a qualitative and quantitative measurement
3. Make accurate and repeatable measurements of biotic and abiotic objects
4. Understand that scientists must follow rules to make measurements and record changes over time

Background Information

This lesson is based around activity stations that the students will rotate through and involves the students practicing, discussing and developing rules about how to make quantitative measurements of objects found in the natural environment eg, plants, soil, etc.

1. The **environment** is everything around us. Environments can be natural or human made e.g., a forest or a city. Environments can have different sizes depending on the scale you are focussing upon e.g., the environment inside a bottle or the environment around a river or the environment on planet Jupiter. Teachers should make students aware that when they hear or see the term "THE environment" in the media, it usually refers to nature, but environments may be urban, human made and natural. Some examples of environments you can demonstrate to students are; the classroom, the school yard, their home/house, a stream, pond, beach or lake, a garden or forest, a town or farm, a lunchbox.
2. An **ecosystem** is the interaction of living things with their environment. The most important element of an ecosystem is that everything in it is reliant upon everything else, nothing can exist alone. An ecosystem is made up of biotic (living) and abiotic (non-living) things – see below. For example, the classroom is an ecosystem. It is made of desks, floor, lights, pencils and paper (all abiotic things). It also contains living (biotic) things such as students, a teacher and maybe a pet or ants etc. All of these things depend on one another – there can be no class without a teacher, the teacher cannot function if there are no students. The students and teacher need light and pencils and desks to function and so on.
3. Living things are called **biotic** e.g., animals, plants, bacteria, insects, etc. Non-living things are called **abiotic** (the opposite of biotic) e.g., sunshine, water, rock, etc. Soil is an example of something that is both biotic and abiotic: i.e. it contains both living things (such as decomposing bacteria, microscopic plants and insects) and non living thing (such as sand and rock)
4. Measurements can be **qualitative** or **quantitative**. A qualitative measurement is usually described with words and is not exact or repeatable, so if many different people make a qualitative measurement of something you might receive many different answers. A quantitative measurement is often described with numbers (not always) and is objective and repeatable. If many different



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people make a quantitative measurement of something you would expect everyone to have the same answer. Some examples of qualitative vs quantitative measures are:

- How many marbles in a jar – lots vs. 119
- Temperature of the water – cold vs. 10°C
- Colour of the soil – purple vs. dark lavender (the latter matched to a painters chip colour card)

Vocabulary

<u>Word:</u>	Brief definition.
Biotic	A living organism and things produced or caused by organisms. Biotic factors in an environment include plants, animals, wood, oxygen and soil.
Abiotic	A non-living thing and things that are not made by living things. Abiotic factors in an environment include such items as sunlight, temperature, wind, metal, and precipitation.
Environment	Everything around us, can be natural or human made e.g., classroom
Ecosystem	Interaction between biotic things and their environment
Measure	To determine the size, colour or capacity of an object e.g., height, weight, area, colour
Quantitative	To describe something by quantity using specific, exact and repeatable descriptions
Qualitative	To describe something by quality e.g., by character, attribute, feeling
Repeatable	To measure something the same way every time
Accurate	The ability of a measurement to match the actual value of the quantity being measured. To measure something exactly or precisely.

Introduction

- In this class we introduced all of the students as doctors of science (Doctors do not always study medicine) and gave them name tags with e.g., Dr Samuel, Dr Tania and so on.
- This lesson can act as a precursor to future lessons that examine or describe the environment and changes in the environment which is the way we approached it. We introduced the class by explaining that over the next couple of months we will study our environment and look at some of the changes in our environment. First, we need to know what is in the environment and how to describe and measure it.
- Review vocabulary
- Abiotic/ Biotic
What type of environment are you in? Natural, urban, school, home
Give a few examples of biotic and abiotic objects around the room (and why biotic/abiotic)
 - Paper is biotic because...
 - Light from the sun is abiotic because
 - Plants and animals are biotic because
 - Plastic toys are abiotic becauseIdentify all the objects on the board and make a tally of the number of students who labelled it biotic and abiotic. Go through their reasons why and help them explain the logic to re-emphasize the difference between biotic & abiotic.
- Before students begin to rotate among the activity stations explain to them that students should discuss among themselves the best way to measure the object they have in front of them. We want to lead them to the point where they realize that there are many different ways to measure something and that different people may obtain different results eg, for a plant where do you call the base of the plant and the top of the plant – do you extend branches or not? In the end students will need to



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agree on a set of rules about how to measure the objects and adhere to those rules. Make students aware that they are doing this process.

Materials & Station Set-Up

- Record sheet for measurements – see corresponding file for the worksheet.
- Instruction sign for each station – see below. Instructions are also described on the students worksheets (see corresponding file)
- Decide how many stations students will have time to rotate through (each station should take about 10-15 min for students to complete). Suggestions for seven stations are provided. It is also necessary to allow time for class discussion at the beginning and the end of the lesson.
- See below for equipment details related to each station.

Station 1 (water temperature):

- 3 large beakers/buckets or bowls, one filled with hot, one with ice-cold and one with warm water.
- One thermometer.
- One stopwatch or clock with second hand.

Approximate measure

- i) Put your left hand in the left hand bucket and your right hand in the right hand bucket – how do they feel?
- ii) Keep your hands in the water for 40 seconds
- iii) Now put both hands in the middle bucket at the same time
- iv) Write down the temperature of the water in the middle bucket?
(teacher's note – each hand will feel a different temperature!)

Accurate Measure

Use thermometer

Station 2 (plant height):

- 2 plants in pots, preferably one tall and straight and one amorphous.
- One long ruler or measuring tape.

Approximate measure

- i) How tall each plant?
- ii) Discuss with each other how you made your decision
- iii) Write the answer in your book

Accurate Measure

Use tape measure; measure plant from base

Station 3 (liquid meniscus):

- One tall narrow cylinder (e.g., measuring cylinder) filled part way with water. Cover measurements

Approximate measure

- i) *ABOUT* how much water is in the cylinder?
- ii) *Each student must write their own answer*
- iii) *Does your answer match everyone else's? If not, discuss why.*

Accurate Measure

Measure the water level using cylinder measurements. Remember to measure at eye level.

Station 4 (soil colour):

- a small tray of uniform coloured soil.
- A graded colour chart from a paint store on which one of the colours matches that of the soil.

Approximate measure

- i) *What colour is the soil?*
- ii) *Write down your answer*
- iii) *Is your answer the same as other people in your group?*

Accurate Measure



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Use colour cards to give precise colour

Station 5 (surface area coverage):

Cover part of a table in rocks-on an unlabelled square of paper; then on a labelled (grid) square Cover the labelled square, then uncover for the 2nd part of the activity (accurate measurement) Both scatters should be similar. Ensure some of the rocks cover the table completely, and others are scattered wide apart over the table.

- A large piece unlabelled square of paper
- A large labelled square

	A	B	C	D
1				
2				
3				
4				

Approximate measure

- How much of the table is covered in rocks?*
- Did you have the same answer as everyone else?*
- How did you make your decision?*

Accurate Measure

What percent of the square is covered in rock?

Station 6 (weight of sand or water or marbles in the bottle):

- A pop bottle or jar half filled with sand/water/marbles.
- A weighing balance or scale

Approximate measure

- How much sand/water/marbles is in the bottle?*
- Are there different ways you can measure this?*
- Write down your answer*

Accurate Measure

Use a scale

Station 7 (identifying biotic and abiotic objects):

- 10 cardboard arrows numbered 1 to 10,
- 10 pieces of string or rubber bands or sticky tape to attach arrows to outs

In an outdoor are (preferably a natural area) attach the arrows to 10 objects, be sure to include a mix of biotic and abiotic objects. If outdoor is not possible, this activity can be conducted indoors. It is good to include a few tricky ones like soil and wood, and to choose things of different size or scale. Examples of possible objects are:

Biotic objects

Plants
 Animals (e.g., termites, humans, bugs)
 Soil (degraded rock mixed with detritus) rock
 leaves
 fungus

Abiotic objects

water
 air (can be an empty bottle with wood arrow enclosed)
 metal
 concrete

In-Class Summary

Bring the class together at the end for an overview and summary (time required is 15min)

1. Review the difference between biotic and abiotic, especially objects like soil that have components of both.



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2. Review what is a standardized/quantitative measurement: Make a table on the board to compare the measurements taken by each group at each of the stations. Were they all the same? If not, why were the measurements different? This should highlight the need to agree upon rules to make measurements and the need for everyone to do things the same way. Emphasize the importance of having a set of rules for measurements if we want to record changes in an environment over time.
3. Explain that scientists have agreed on a set of rules they must follow to ensure that the measurements are repeatable and accurate.

#2 Plant height	1 st Measurement (No tools)	2 nd measurement (With tools)
<ul style="list-style-type: none"> • How tall is each plant? • Write your answer on your own • Discuss with each other how you made your decision • Write the answer 		Tape measure
<p>Reflections: How did the measurements differ the first & second time? What did you learn? Anything surprise you? Any connections with other events in your experience?</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <p>Is the thing that you are measuring biotic or abiotic? _____</p>		

#3 Liquid Meniscus	1 st Measurement (No tools)	2 nd measurement (With tools)
: <ul style="list-style-type: none"> ● EXACTLY how much water is in the cylinder? ● Write your answer on your own ● Does your answer match everyone else's? If not, discuss why. 		Measuring beakers
<p>Reflections: How did the measurements differ the first & second time? What did you learn? Anything surprise you? Any connections with other events in your experience?</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <p>Is the thing that you are measuring biotic or abiotic? _____</p>		

#4 Soil Colour	1 st Measurement (No tools)	2 nd measurement (With tools)
<p style="text-align: center;">○</p> <ul style="list-style-type: none"> • What colour is the soil? • On your own, write down your answer • Is your answer the same as other people in your group? 		<p>Colour cards</p>
<p>Reflections: How did the measurements differ the first & second time? What did you learn? Anything surprise you? Any connections with other events in your experience?</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <p>Is the thing that you are measuring biotic or abiotic? _____</p>		

#6 Amount of marbles	1 st Measurement (No tools)	2 nd measurement (With tools)
<ul style="list-style-type: none"> • On your own: How much marbles are in the bottle? • Are there different ways you can measure this? • Write down your answer 		Scale
<p>Reflections: How did the measurements differ the first & second time? What did you learn? Anything surprise you? Any connections with other events in your experience?</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <p>Is the thing that you are measuring biotic or abiotic? _____</p>		

Station #7: Biotic or Abiotic

What type of environment are you in? Is it natural, urban, school, home?

Object#	Name of object	Is it biotic or abiotic?	Why?
1			
2			
3			
4			
5			
6			

Choose one more object in the environment that is not on the list above.

Name of the object: _____

Is it biotic or abiotic? _____

Why? _____

Draw and label the objects that you observed.

#1	#2	#3
#4	#5	#6