Science Unit: ***Plastics***

Lesson 3: ***Introduction to the Scientific Method – Part 2***

School year:	2008/2009
Developed for:	Tyee Elementary School, Vancouver School District
Developed by:	Linda Hanson (scientist), Debbie Adams and Sharon Ghuman (teachers)
Grade level:	Presented to grades 4, 5, & 6; appropriate for grades 3 – 7 with age appropriate modifications.
Duration of lesson:	1 hour and 15 minutes
Notes:	A 1 cm grid is included with the worksheets for use with the station 1 worksheet. It should be photocopied or printed onto clear acetate.

Objectives

1. Students will practice making accurate quantitative measurements.
2. To reinforce the idea that accurate observations are vital to a good experiment.

Background Information

The Scientific Method is an investigative approach in which a problem or question of interest is methodically investigated. The investigator first formulates a testable hypothesis or hypotheses and then must design an unbiased experiment to test each hypothesis. The experiment should be based on objective, unbiased observations and repeatable. This is a companion lesson to "Introduction to the Scientific Method" and focuses on making accurate, repeatable measurements.

Vocabulary

Accurate measurement:	A measurement which comes close to the true value.
Qualitative observation:	A qualitative observation is a non-numerical, subjective observation or measurement. For example, a box of coins is **heavier** than a box of feathers.
Quantitative observation:	A quantitative observation is a numerical, objective observation or measurement. For example, this box of coins weighs 235 grams more than this box of feathers.

Materials

- clear acetate sheets printed with a 1 cm grid
- masking tape (to affix grids or worksheets to desk if desired)
- objects of various lengths (for station 2)
- rulers with mm markings
- Ziploc bag of damp soil (one per group)
- several scales (and printed instructions for each scale)
- weigh boats or weigh paper (to keep scales clean)
- sponge pieces (one per group)
- dish of water
- carrot pieces (one per group)
- tissues or paper towel for drying samples and scales
- small paint brushes (to clean dirt from carrots)
- power supply (for scales)
- worksheets for all three stations
- pencils

In the Classroom

Introductory Discussion

1. Review the 10 steps of the Scientific Method from the previous week's lesson. Let the students know that this lesson will focus on step 6: Recording observations.
    - Review qualitative versus quantitative observations. Have students offer up examples of each and have some of your own examples to ask them.
    - Let the students know that this lesson will focus on making accurate, quantitative measurements. Ask them why they think accurate measurements are important.
    - Discuss how scientists must follow an agreed upon set of rules to ensure that everyone is making measurements in the same fashion. Use the fish measuring activity from last week's lesson as an example.
    - Reiterate that there are many ways to measure something and that all of them are correct but if scientists do not agree on one method they will not get the same results.
2. Short description of other items to discuss or review.
    - Students should be familiar with pictorial fractions prior to the lesson. They will need to understand how to add up partially filled in squares to get surface area totals for station 1.
    - Review the concept of cm^2.
    - Review how to tare/zero the scale in order to weigh an object using a weigh boat.
3. Briefly describe science experiment/activity.
    - Students will rotate through 3 different stations. Each station will allow them to practice making a different type of quantitative observation.
4. This lesson will focus on making and recording observations.
5. Briefly describe safety guidelines.
    - Ensure that students are familiar with the proper operation of the scales.
    - Remind students to wash their hands when they are finished station 3 (they may get dirt on their hands).

Science Activity/Experiment

Activity Title: Making Accurate Measurements

Purpose of Activity: to allow students to practice making and recording quantitative measurements.

Methods and Instructions:

Set-up prior to experiment:

- Make sure there are plugs and extension cords available for the weighing activity.
- Collect objects for students to measure for Station 2. The objects should pose different challenges (i.e. they may be flexible or it may not be clear which direction is the "length." Possible objects include: a plastic tray, a small pop bottle, a piece of flexible tubing, a piece of PVC pipe, etc.

The students will work in groups of 4-6 students. There will be three stations but each station will be set up in duplicate.

1. Station 1: How big is it?
    a. Students will individually measure and record the surface area of each object.
    b. Students will start with regularly shaped (and thus easily measured) objects and progress to irregularly shaped objects.
    c. By the end of the activity students should recognize the difficulty in obtaining accurate surface area measurements for the irregularly shaped objects.
2. Station 2: How accurately can we measure it?
    a. Students will individually measure and record the lengths of various objects
    b. By the end of the activity students should feel confident in their ability to obtain accurate measurements.
3. Station 3: How much does it weigh?
4. The students will work in groups and each student will take a turn using the scale.
5. By the end of the activity the students will have discovered some of the challenges associated with obtaining accurate weights. This activity will enforce the idea that scientists must follow a consistent, agreed upon set of rules.

Closure Discussion

1. Have the students return to their desks and lead a class discussion of the answers.
2. If you were designing an experiment that involved measuring the surface area of leaves how could you make your measurements easier? (Cut the leaves into regular shapes beforehand) Would your new method have any additional problems associated with it? (The leaves may breakdown faster on the cut edges, may be hard to cut the leaves into shapes, etc.)
3. Do you think measuring length is the best way to determine the size of a bottle? What is a better way of determining the size?
4. How long was the piece of stretchy tubing? How did you measure it? Why didn't we all get the same answer? What could we do differently next time to ensure a more accurate measurement?
5. What problems did you encounter when weighing the wet sponge? Can you ever get it to weigh the same as the dry sponge? How might this be a problem for a scientist doing an experiment involving decomposition? (objects may absorb soil moisture)
6. How did you clean the carrot? Did it weigh the same as before? How might each method affect the results of an experiment?

Extension of Lesson Plan

1. Have students design (and carry out, if the teachers are interested) a simple decomposition experiment. They should pay particular attention to determining how they will make and record all of their observations.

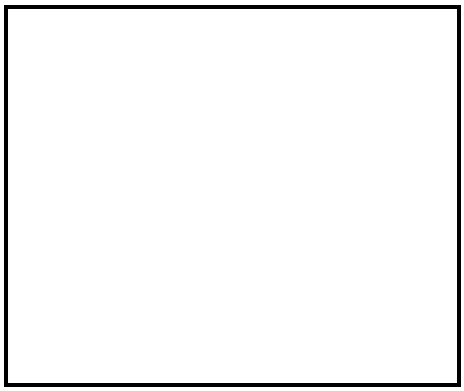
Name: _____

HOW SHOULD WE MEASURE IT?

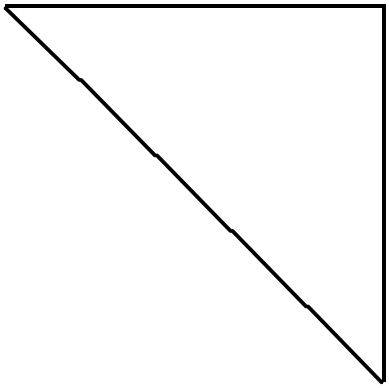
Station 1 – How big is it?

Instructions: Use the grid to calculate the size of each object. Record your observations in the spaces provided on the worksheet.

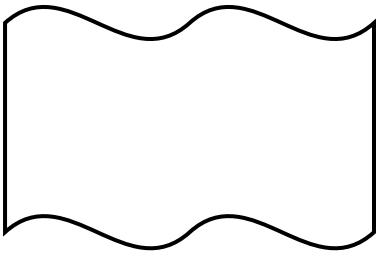
Place the grid over each object and count how many squares it covers. Use the tape to help you keep the grid still.



Object 1 is _____cm^2



Object 2 is _____cm^2



Object 3 is _____cm^2

Name: _____

Which object did you find the most difficult to measure?

Why?

If you were designing an experiment where you wanted to measure leaf size what could you do to make your measurements easier? Would your new method have any other problems?

Name: _____

HOW SHOULD WE MEASURE IT?

Station 2 – How accurately can we measure it?

Instructions: Use your ruler to measure each object to the nearest mm.

Object 1

Object 1 is _____mm long

Object 2 is _____mm long

Object 3 is _____mm long

Object 4 is _____mm long

Object 5 is _____mm long

Which object was easiest to measure?

Which object was most difficult to measure?

Why?

Name: _____

Do you think measuring the length is the best way to determine the size of the pop bottle? Why or why not?

What other ways could you use to measure the size of a pop bottle?

Name: _____

HOW SHOULD WE MEASURE IT?

Station 3 – How much does it weigh?

Instructions

Each group member will take turns using the scale and weigh one object. Weigh each object as instructed. Remember to clean and dry the scale between objects if it gets dirty.

REMEMBER TO TARE THE BALANCE BEFORE WEIGHING!!

Watch the demonstration of how to use the scale and write down how much the sponge weighs. Record all of your answers to one decimal place (eg. 5.2 grams).

The dry sponge weighs _____grams

The first group member will place the piece of sponge in the dish of water, put a weigh boat on the scale, tare the scale and weigh the wet sponge. (Don't squeeze it out!)

The wet sponge weighs _____grams

The second group member will squeeze as much water out of the sponge as possible (back into the dish), get a dry weigh boat, tare the scale and weigh the sponge again.

The sponge now weighs _____grams

Does it weigh the same as it did before it got wet? Why not?

Name: _____

(Station 3 continued)

The third group member will get a dry weigh boat, tare the scale and weigh the carrot.

The carrot weighs _____grams

The third group member will put the piece of carrot into the bag of soil, seal the bag and shake it around.

The fourth group member will get a clean weigh boat ready, tare the scale, take the carrot out of the bag and weigh it.

The dirty carrot weighs _____grams

Does the carrot weigh the same as before? Why?

What are some ways you could clean the carrot? Will they affect the weight? How?

Method	Potential Problems