Science Unit: ***Plants and Animals Through the Stages of Ecological Life***

Lesson 1: ***The Scientists' Way***

School year:	2007/2008
Developed for:	Mount Pleasant Elementary School, Vancouver School District
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Grade level:	Presented to grades 6 - 7; appropriate for grades 3 – 7 with age appropriate modifications
Duration of lesson:	1 hour and 20 minutes (revise as needed)

Objectives

1. Learn the scientific method of conducting experiments
2. Practice the scientific process

Background Information

All scientific experiments must follow a logic sequence to be informative and valid. Every experiment start with the formulation of a hypothesis, then an experiment is conducted and conclusions are drawn. This approach of 'predict, observe, explain' is essential for a good experiment. All experiments should also aim to isolate only one testing variable, and to be valid replicates and controls should also be used. The variation of only 1 variable ensures that an experiment will assess the effects of various testing conditions without the doubt whether another variable is causing the result seen. In short, everything else remains constant, so any effects seen can be traced to the one variable that was changed. Experiment replicates are also important to ensure that the result seen was not a random event, simply 'luck'. Controls also show that a result observed was not due to luck, since it provides a clear comparison to demonstrate the change seen under various testing conditions.

Vocabulary

Word:	Brief definition.
Hypothesis	An educated guess, a prediction.
Variable	A factor or condition that is subject to change
Control	A parallel experiment or comparison to a known standard to verify or regulate a scientific experiment
Replicates	Extra experiment sets in identical conditions to verify and strengthen an experiment's results and conclusion

Materials

- Marbles
- Toilet paper tubes
- Soil
- Sand
- 7 measuring cups
- Many disposable cups
- 5 large containers
- Pennies
- Droppers
- Toilet paper; toothpicks
- Paper towels
- Scrubbing surface
- Canola/ mineral/ olive oil
- Coffee filters
- 2 Funnels
- Black film canisters
- various small objects
- Food colouring

In the Classroom

Introductory Discussion

1. Assess the students' prior knowledge of:
    - What do you think is science?
    - What do you think is to be a scientist?
    - How do you think scientists' discover things? (by observing the natural world)
    - Who do you think can be a scientist? (anyone that can observe the world in any way!)

Hook – Run an 'obvious' experiment

- Make holes in a disposable cup
- Show the students a jar full of water
- Ask them to predict what will happen when you pour water in the cup
- Do the actual pouring and have them observe and conclude

2. Introduce the idea of Scientific Process
    - How exactly do you think scientists' learn about the world?
    - Predict = hypothesis = educated guess (connection with vocabulary)
    - Observe = experiment
    - Explain = conclude

Discuss the idea of controls and replicates

- Use another identical container and leave it intact (control)
- Use another 4 identical container and make the same number of holes (replicates)
- Ask why are these important? (we can be sure that it is the holes that are causing the water to leave because the intact container is keeping the water; we know it has nothing to do with the specific first container because other identical containers with holes behave the same way)

Provide instructions for the rest of the lesson and the safety guidelines

- Students will form groups and will go to a station, where each student should have a turn at doing the experiment in that station (if simple) or work together (if complex).
- Students should record their hypothesis, results and conclusion for the station's experiment in the station's corresponding space in worksheet provided.
- Nothing should be eaten!

Science Activity: Mini Experiments

Practicing the scientific method

Specific instructions on how to conduct the experiments in each station can be found as an attachment. (Lesson 1 – Stations Instructions)

Worksheet can also be found as an attachment. (Lesson 1 - The Scientists way_student worksheet)

Station 1: How many marbles can a toilet paper tube hold?

Using a toilet paper tube and marbles (or any solid object) have the students guess based on the size of the tube and the marbles how many can be fit into the tube. They should then add the marbles and conclude.

Station 2: Does sand absorb water better than soil?

Provide cups with holes at the bottom filled with sand, soil and empty and a measuring cup. Have the students guess how much water they think will drip from each cup.

Station 3: Do all oils behave the same way as canola oil when mixed with water?

Predict whether all types of oil behave the same way when mixed with water. Mix the different types of oil (mineral oil, olive oil, canola oil) with water.

Station 4: How many drops of water can a penny hold?

Estimate the number of water drops that can be fit on a penny, add the water by droplet counting until overflow.

Station 5: Is toilet paper good for wet scrubbing?

Predict which material is better for scrubbing when wet; then thoroughly wet the same area of a paper towel and toilet paper, scrub the scrubbing surface and count until the material ruptures.

Station 6: Does food colouring affect the speed with which water moves through a paper filter?

Add food colouring to a given small amount of water and filter it through a section of paper filter. How does it compare with the rate at which only water gets through the filter?

Station 7: What is the average height of this population of plants?

Measure the height of a population of plants. Students should guess the average height. This station is optional, because when done in the classroom, students got bored with the many measurements.

Closure Discussion

1. What was your favourite experiment?
2. What was common between all stations? (only 1 variable was tested)
3. Pick two groups that liked the same station and ask them to compare their findings
4. Pass a closed film canister with random objects inside
    - Have the students shake it and try to guess what is inside based on the sound (tally on the board)
    - When the canister is handed back to you shake it and add your guess to the board
    - Explain that we won't open the canister – have them guess why. (some experiments we don't know the 'real' answer, so all we can do is guess.)

References

1. <http://www.thefreedictionary.com/Dictionary.htm> Farlex, Inc. The Free Dictionary by Farlex. Web site hosted by Farlex Inc. Accessed Jan. 9, 2008.

Extension of Lesson Plan

1. Take the class outside for 10 minutes and have them come up with their own hypothesis and how they would test something in the school grounds.
2. Have the students analyze each others' experiment ideas and come up with possible flaws and solutions, i.e. controls, replications, how many variables are being tested?
3. Give the class an idea or a problem and let them decide how they would test it. Time, facilities and money permitting carry out the class's project.

Station 1

Research Question: **How many marbles fit in a toilet paper tube?**

Instructions:

Prediction

1. Make a prediction of how many marbles you think will fit inside the toilet paper tube.
2. Explain why you predicted that number.

Experiment / Results

3. Hold the toilet paper tube on the table
4. Add and count the number of marbles that fit inside the tube
5. Record the number of marbles under replicate #1
6. Repeat another four times and record your observations under replicate #2, replicate #3, replicate #4 and replicate #5.

In this experiment what is the…

Variable?

Conclusion

7. Decide on an explanation for the results you obtained

Station 2

Research Question: **Does sand absorb water better than soil?**

Instructions:

Prediction

1. Make a prediction:
   Do you think sand absorbs water better than soil?
2. Explain why you think that.

Experiment / Results

3. Make 10 holes at the bottom of 3 cups
4. Add 50 grams of sand to one cup
5. Use toothpicks to prop the cup on top of a water collection container
6. Add 50 grams of soil to another cup
7. Use toothpicks to prop the cup on top of a water collection container
8. Leave one cup empty
9. Use toothpick to prop the cup on top of a water collection container
10. Pour 100 ml of water in each of the 3 cups
11. Measure how much water dripped out of each cup
12. Record the amount of water that dripped out under replicate #1
13. Repeat the same procedure another four times and record the results of each try under replicate #2, replicate #3, replicate #4 and replicate #5.

In this experiment what is the…

Control?
Variable?

Conclusion

14. Come up with an explanation for your results

Station 3

Research Question: **Do other oils behave the same way as canola oil when mixed with water?**

Instructions:

Prediction

1. Make a prediction
   Do you think all oils behave the same way when mixed with water?
2. Explain why you think that.

Experiment / Results

3. Add 20 ml of canola oil to the measuring cup labelled 'canola'
4. Add 20 ml of mineral oil to the measuring cup labelled 'mineral'
5. Add 20 ml of olive oil to the measuring cup labelled 'olive'
6. Measure 50 ml of water using the measuring cup labelled 'water'
7. Add 50 ml to each measuring cup containing oil
8. Wait 10 seconds
9. Observe and record your observations under replicate #1
10. Dump all mixtures in the waste bucket and wipe cups with paper towel
11. Repeat the same procedure another 4 times, and record under replicate #2, replicate #3, replicate #4 and replicate #5.

In this experiment what is the…

Control?
Variable?

Conclusion

12. Think of a reason to explain why olive oil and mineral oil behaved or did not behave the same way as canola oil when mixed with water.

Station 4

Research Question: **How many drops of water can a penny hold?**

Instructions:

Prediction

1. Make a prediction
2. Explain why you think that.

Experiment / Results

3. Take a penny and slowly add drops of water until it overflows
4. Record you measurement under replicate #1
5. Repeat another 4 times with four different pennies and record your observations under replicate #2, replicate #3, replicate #4 and replicate #5.

In this experiment what is the…

Variable?

Conclusion

6. Attempt to explain why you think the pennies held the number of drops you observed.

Station 5

Research Question: **Is toilet paper good for scrubbing?**

Instructions:

Prediction

1. Make a prediction: Is toilet paper better than paper towel for scrubbing?
2. Explain why you think that.

Experiment / Results

3. Cut the paper towel to the same size as 1 sheet of toilet paper
4. Separate 5 sheets of paper towel and 5 sheets of toilet paper
5. Take one toilet paper sheet and wet it with half a dropper full
6. Fold the paper in half and scrub the surface. Use the stopwatch to see how long it takes for the paper to tear.
7. Record results under toilet paper replicate #1.
8. Take one sheet of paper towel and wet with half a dropper full
9. Scrub the surface and use the stopwatch to see how long it takes for the paper to tear
10. Record results under paper towel replicate #1.
11. Repeat another 4 times and record your observations under replicate #2, replicate #3, replicate #4 and replicate #5.

In this experiment what is the…

Control?
Variable?

Conclusion

12. Come up with an explanation for your results. Why is paper towel better / worse than toilet paper?

Station 6

Research Question: **Does food colouring affect water filtering?**

Instructions:

Prediction

1. Make a prediction:

Do you think food colouring changes the speed at which water gets filtered?

2. Explain why you think that.

Experiment / Results

3. Fill two cups with water
4. Add 1 ml of food colouring to the water in one cup
5. Place 1 coffee filter on each funnel and place funnel on top of a water collection container
6. Filter plain water and count how many seconds the filtering takes
7. Record your observation under Plain water replicate #1.
8. Filter coloured water and count how many seconds the filtering takes
9. Record your observation under Colour water replicate #1
10. Repeat the experiment another 4 times and record under replicate #2, replicate #3, replicate #4 and replicate #5.

In this experiment what is the…

Control?
Variable?

Conclusion

11. Come up with an explanation for you results.

Station 7 (optional)

Research Question: **What is the average height of these plants?**

Instructions:

Prediction

1. Make a prediction of the average height of this population of plants
2. Explain why you predicted that number.

Experiment / Results

3. Measure the height of each plant in the population.
4. Write down the measurement and calculate the average.

$$\text{Average} = \frac{(\text{plant 1} + \text{plant 2} + \text{plant 3} + \text{plant 4} + \ldots)}{\text{Number of plants in the population}}$$

5. Repeat the measurement of the plants another 4 times, and calculate the average.
6. Calculate the average of all averages.

$$\text{Average} = \frac{(\text{average 1} + \text{average 2} + \text{average 3} + \text{average 4} + \text{average 5})}{5}$$

In this experiment what is the…

Variable?

Conclusion

7. Explain why you think the average height of this population is what you found.

Student scientist: _____

Scientific Method Worksheet

Station 1

Research Question: _____

Hypothesis:

_____

_____

Results:

	Number of marbles
replicate #1	
replicate #2	
replicate #3	
replicate #4	
replicate #5	

Variable:

_____

_____

Conclusion:

_____

_____

_____

Station 2

Research Question: _____

Hypothesis:

_____

_____

Results:

	Amount of dripped water		
	empty	sand	soil
replicate #1			
replicate #2			
replicate #3			
replicate #4			
replicate #5			

Variable:

_____

_____

Control:

_____

_____

Conclusion:

_____

_____

_____

Station 3
Research Question: _____

Hypothesis:

_____
_____

Results:

	Observation of oil / water mix		
	canola	Mineral	olive
replicate #1			
replicate #2			
replicate #3			
replicate #4			
replicate #5			

Variable:

Control:

Conclusion:

_____
_____
_____

Station 4
Research Question: _____

Hypothesis:

_____
_____

Results:

	Number of drops of water
replicate #1	
replicate #2	
replicate #3	
replicate #4	
replicate #5	

Variable:

Conclusion:

_____
_____
_____

Station 5
Research Question: _____

Hypothesis:

_____
_____

Results:

	Time for tearing	
	paper towel	toilet paper
replicate #1		
replicate #2		
replicate #3		
replicate #4		
replicate #5		

Variable:

Control:

Conclusion:

_____
_____
_____

Station 6
Research Question: _____

Hypothesis:

_____
_____

Results:

	Filtering time	
	plain water	colour water
replicate #1		
replicate #2		
replicate #3		
replicate #4		
replicate #5		

Variable:

Control:

Conclusion:

_____
_____
_____