DRIP, DRIP, DRIP OR THE CASE OF THE LEAKY FAUCET

Student/Class Goal
The student will understand the importance of using water wisely from an ecological and financial standpoint.

Outcome (*lesson objective)*
Students will gather scientific data and be able to utilize the data to generalize the results over a long period of time.

Time Frame
Three 60 minute sessions

Standard *Use Math to Solve Problems and Communicate*

NRS EFL 3-6

COPS	**Activity Addresses Components of Performance**
Understand, interpret, and work with pictures, numbers, and symbolic information.	Students will use appropriate tools to measure quantities of liquids.
Apply knowledge of mathematical concepts and procedures to figure out how to answer a question, solve a problem, make a prediction, or carry out a task that has a mathematical dimension.	Students will analyze data to understand the cost of a leaky faucet.
Define and select data to be used in solving the problem.	Students will select data to use to calculate the total gallons of water lost from a drip.
Determine the degree of precision required by the situation.	Students will decide when it is appropriate to round off data when calculating water use over long periods of time (month, year).
Solve problem using appropriate quantitative procedures and verify that the results are reasonable.	Students will demonstrate the ability to calculate water usage.
Communicate results using a variety of mathematical representations, including graphs, chart, tables, and algebraic models.	Students will complete a table on water availability.

Materials
3 milk jugs, 3 catch containers (at least 1 gallon), stop watch or watch with sweep second hand, food coloring, graduated cylinder or metric measuring cup
Water - Where's It At? Activity Sheet
The Case of the Dripping Faucet Worksheet

Learner Prior Knowledge
Basic understanding of averages and measuring liquids required.

Instructional Activities
Step 1 - To introduce the students to the problem of limited water resources ask the students to respond to the general question: "What do you know about the water resources in Ohio? Does everyone have enough water? What about in other states and nations?" Complete a KWL activity recording (K) the knowledge the students currently have about our water resources. Next make a list of the questions the students wonder (W) about water.

Step 2 - To provide background info about the earth's water resources complete the activity on Worksheet 1. This activity could be done as a demonstration or as a small group activity.

TEACHER NOTE Classrooms without access to beakers, graduated cylinders, etc. could use a liter bottle of water and draw water lines on small glasses, etc.
Step 3 – After completing the previous activity and recording information in the "L" (Learned) column of the KWL chart, the students should have a good understanding of the reason for carefully managing water resources. The group will now do an experiment to simulate the water wasted with a leaky faucet or toilet.

Before the activity collect and prepare your supplies. In each of the 3 gallon milk jugs place a hole near (on the side not the bottom) the bottom of the jug. One jug should have a pin prick on the side (Jug #1), another should have a slightly larger hole (jug #2) and finally the last jug should have a hole made with a small nail (jug #3). Cover each hole with tape until you are ready to start the activity. Fill each jug with water and tint the water with food coloring. Each water jug should have a catch container to collect the water as it runs out. Arrange the jugs so the catch container will collect the drips when the tape is taken off each jug.

Step 4 - Divide the class into three groups. Large classes can have 2 or more groups study each jug. At a given signal have a student from each group remove the tape from the jug. Using a stop watch time 1 minute. Count the number of drops/drips of water that left the jug during one minute. Record this information. At the end of 1 minute, cover the hole in the jug and use a graduated cylinder to measure the amount of water that leaked out.

TEACHER NOTE Other amounts of time could be used. Record your results for this trial and repeat the activity for 2 more trials.

Step 5 - Share data with each of the other groups so everyone has the readings for all three trials for all three jugs. Now, each student should find the average number of drops per minute (total ÷ 3) for each jug and the average volume of water (ml) collected in 1 minute. Review how to calculate averages if necessary.

Step 6 - Next, use what you have learned from your 3 trials to estimate how long it will take to completely empty the gallon milk jug. Record the time it took for the jug to empty. Make sure students add in the 3 minutes that were spent during the earlier 3 trials. Use your data to answer the following questions for each milk jug:

How many milliliters are lost per hour?
How many milliliters are lost per day?
How many gallons are lost in a day? a week? a month?
How much money would the drip cost in a month? a year?

TEACHER NOTE *The Case of the Dripping Faucet* Worksheet provides a sample for recording data for this activity. To determine the cost for your area, study a water bill or contact the water department to find out the cost of the water. Cleveland water is measured in 1000 cubic foot units (1000 cubic feet = 7,500 gallons). The first unit of water costs $17.88 and additional units cost $38.96. Willoughby water is measured in 100 cubic foot units (HCF) (1 HCF = 748.05 gallons). Cost for water in Willoughby is a flat $31.41 for 0-900 cubic feet. For amounts over 900 cubic feet, the cost is $3.49 per HCF, plus a service charge of $6.75. Most communities bill the sewer charges based on the water used. Willoughby also adds a sewer charge of $1.95 per HCF to all water used. That is another cost of wasted water.

Step 7 – Revisit the KWL chart to determine what else the students have learned.

Assessment/Evidence (*based on outcome)*
Completed KWL chart
Data from activity on worksheet 1
Observations of students at work recording data, taking measurements, etc.
Calculation of averages
Completion of *The Case of the Dripping Faucet* Worksheet

Teacher Reflection/Lesson Evaluation
Not yet completed.

Next Steps
Have students brainstorm ways to save water around their homes and write an informational article for an ABLE student newspaper.

Technology Integration
K-W-L Instruction Strategy http://literacy.kent.edu/eureka/strategies/k_w_l.pdf

Purposeful/Transparent
The students will answer many of their W (wonder) questions from the KWL activity through the discussions and activities.

Contextual
Students will easily be able to relate this lesson to their household water use and how it affects the cost of their water.

Building Expertise
The lesson builds student knowledge on water conservation, and increases their ability to analyze data from and experiment.

Water – Where's It At?
Activity Sheet

Supplies – 1000 ml. beaker
100 ml. graduated cylinder
10 ml. graduated cylinder
Eye dropper, pipette or glass stirring stick
Metal bowl (to hear drop of water fall in)
Water
Coffee filters or cupcake papers
Markers
Calculators

Step 1 – Announce to the students that today they are going to estimate what proportion of the total water on the earth is usable (potable). Distribute to each person a small white coffee filter or cupcake paper to use to represent the water on the earth. When flattened, these papers can be folded easily to help students divide the earth's water into parts. Provide the students with markers so they can color code the fresh usable water and the unusable water. Discuss and post the various water usage models.

Step 2 – Pour 1000 ml (1 liter) water in the 1000 ml. beaker
"*This represents all the water on the earth. Where does most of the water on the earth exist?"* Show a world map or globe so students can see most of the earth's water is in the oceans.

Step 3 – Pour 30 ml. of water into the 100ml. graduated cylinder
Put salt in the 970 ml. left in the beaker to simulate water in oceans unfit for drinking. You might encourage the students to calculate how much water is left in the beaker after 30 ml. is removed. "*This* (water in 100 ml. graduated cylinder) *represents the earth's fresh water, about 3% of the earth's total."* Discuss with the students where most of the fresh water is located. You may need to ask, *"What is at the earth's poles?" (ice)* 80% of the earth's fresh water is frozen in ice caps and glaciers.

Step 4 – Pour 6 ml of fresh water into a small dish or 10 ml. cylinder.
Calculate the amount of water remaining in the 100 ml. graduated cylinder and label it frozen fresh water. Put it in a freezer or ice bucket. The 6 ml of water in the dish or 10 ml. graduated cylinder represents (about 0.6% of the total water on the earth) the non frozen fresh water. About 1.5 ml of this is surface water (the rest is underground).

Step 5 – Remove one drop (0.003 ml.) of water with an eyedropper or glass stirring rod. Release this small drop into a metal bowl or bucket so the students can hear the drop hit the metal. The drop (0.003 ml.) represents the clean, fresh, unpolluted water that is able to be used (potable water). Discuss why it is important to carefully manage this water.

Step 6 – To ensure that students don't panic about the availability of water, remind the students that the small drop of potable water is actually a large quantity of water. As a class or in small groups complete the following chart.

Water – Where's It At?

Quantity to be divided among people on earth	**Amount Available Liters/person (6 billion)**	**% of total water**
All the water on the earth	233.3 billion	100%
Only the fresh water (3% of above)		3%
Only the non-frozen fresh water (20% of above)		0.6%
Available fresh water that is not polluted, trapped in soil, too far below ground, etc. (0.5% of above)		.003%

Answer Key

Water – Where's It At?

Quantity to be divided among people on earth	**Amount Available Liters/person (6 billion)**	**% of total water**
All the water on the earth	233.3 billion	100%
Only the fresh water (3% of above)	7 billion	3%
Only the non-frozen fresh water (20% of above)	1.4 billion	0.6%
Available fresh water that is not polluted, trapped in soil, too far below ground, etc. (0.5% of above)	7 million	.003%

Step 7 – Discuss with the students the results of the above activity. Remind the students that this water must last for their entire life and the lives of the 6 billion people on the earth. Draw out there ideas about where their unborn grandchildren will get their water, etc.

Step 8 – Revisit the KWL chart and encourage students to add learned information where appropriate.

The Case of the Dripping Faucet
Worksheet 2

	Drops per minute			Volume of water (ml) in 1 min		
	Jug #1	**Jug #2**	**Jug #3**	**Jug #1**	**Jug #2**	**Jug #3**
Trial # 1						
Trial #2						
Trial #3						
Total						
Average (total ÷ 3)						

	Jug #1	**Jug #2**	**Jug #3**
Estimate / time to empty jug			
Actual Time To empty jug			
ml / hour			
Gallons / hour			
ml / day			
Gallons / day			
ml / week			
Gallons / week			
ml / month			
Gallons / month			
$$$ per month lost			