

**2008
Winning Lesson Plan
from Seattle, Washington**

Clean Water Challenge

by Jessica C. Levine
Eckstein Middle School

Grade Level: 6th (Can be
adapted 5th to High School)

Duration: Five 50-Minute
Class Periods

Overview and Purpose

The purpose of this activity is to engage in a meaningful challenge to clean a sample of “foul” water in order to apply knowledge of mixtures and solubility. I wanted students to learn that they have the science knowledge to complete a challenge, to protect water quality, and to make a difference in their local and global community.

This is an innovative lab activity because too often students do not have the opportunity to apply their knowledge to make a difference in the world. The district-provided kit suggests a culminating assessment to identify the components of and separate a mixture. Yet, it does this without context. What is innovative about my lesson is that the Clean Water Challenge connects science to current events, local environmental issues, and citizen action. Relevance in the science classroom is critical, important, and innovative.

The Clean Water Challenge also includes a lesson on sustainability and social justice. I walk around the room with 1,000mL of water, colored blue for added effect, in a huge Erlenmeyer flask. This represents the entire world’s water, I tell students. Then, I divide the water up into various graduated cylinders: 970mL is salty. 30mL is fresh. Of the world’s water, 2% is frozen and less than 1% is available for us to use. After students help me generate a list of how we use water I hold the graduated cylinder containing only 1mL of water up before them and pause. “How can we survive on that!” one student exclaimed. Imagine then if it was polluted, I further engage them. Having cleaned the water themselves students are keenly aware of the amount of time, energy, and cost needed to clean just one small sample of water. If clean water is a resource available to only those who can afford it, imagine what the world may be like. Many students shake their heads; they too, do not care to live in this inequitable possibility. Thus, students can quickly make the connections about protecting the water from pollution, and conserving the precious resources that we have.

**2008
Winning Lesson Plan
from Seattle, Washington**

Clean Water Challenge

by Jessica C. Levine
Eckstein Middle School

Grade Level: 6th (Can be
adapted 5th to High School)

Duration: Five 50-Minute
Class Periods

Goals

The larger context for this mini-unit is the Chemical science concept of MIXTURES. This concept of mixtures, including solubility, fits into the broader context of understanding properties of matter—an essential aspect of the middle school physical science curriculum. Learning about physical properties of matter at the early adolescent level is developmentally appropriate in order to prepare students for a deeper understanding of chemical properties and the nature of matter in high school. Above all, this particular concept is pivotal to a contextual understanding of science viewed through the lens of social, technological, and personal connections. As I teacher in a city nearly surrounded by water, these instructional activities are grounded in current and local events regarding water quality. The water quality challenge is the capstone activity of the unit.

The activities in this sequence offer students a balanced mix of experiences: hands-on lab investigations, making quantitative and qualitative observations, conclusion writing, and independent note-taking for more extensive written reflections. Students conclude that water is the universal solvent by mixing substances with water and alcohol. Students make saturated solutions in order to calculate and compare the solubility of three substances. Students investigate the conservation of mass when dissolving and discover that volume is not conserved. Students separate mixtures and solutions through a variety of techniques, including chromatography, filtration, and evaporation/distillation.

**2008
Winning Lesson Plan
from Seattle, Washington**

Clean Water Challenge

by Jessica C. Levine
Eckstein Middle School

Grade Level: 6th (Can be
adapted 5th to High School)

Duration: Five 50-Minute
Class Periods

Educational Standards Addressed

Washington State EALRs and GLEs (for the middle school level):

1. SYSTEMS: The student knows and applies scientific concepts and principles to understand the properties, structures, and changes in physical, earth/space, and living systems. Component: 1.1. Properties: Understand how properties are used to identify, describe, and categorize substances, materials, and objects and how characteristics are used to categorize living things.

1.1.1. Understand how to use physical and chemical properties to sort and identify substances.

1.3. Changes: Understand how interactions within and among systems cause changes in matter and energy.

1.3.3. Understand that matter is conserved during physical and chemical changes.

1.3.4. Understand the processes that continually change the surface of the Earth.

2. INQUIRY: The student knows and applies the skills, processes, and nature of scientific inquiry.

2.1. Investigating Systems: Develop the knowledge and skills necessary to do scientific inquiry.

2.1.4. Analyze how models are used to investigate objects, events, systems, and processes.

2.1.5. Apply understanding of how to report investigations and explanations of objects, events, systems, and processes.

2.2. Nature of Science: Understand the nature of scientific inquiry.

2.2.5. Understand that increased comprehension of systems leads to new inquiry.

3. APPLICATION: The student knows and applies science concepts and skills to develop solutions to human problems in societal contexts.

3.1. Designing Solutions: Apply knowledge and skills of science and technology to design solutions to human problems or meet challenges.

3.1.1. Analyze common problems or challenges in which scientific design can be or has been used to design solutions.

3.1.2. Apply the scientific design process to develop and implement solutions to problems or challenges.

3.2. Science, Technology, and Society: Analyze how science and technology are human endeavors, interrelated to each other, society, the workplace, and the environment.

3.2.4. Analyze how human societies' use of natural resources affects the quality of life and the health of ecosystems.

**2008
Winning Lesson Plan
from Seattle, Washington**

Clean Water Challenge

by Jessica C. Levine
Eckstein Middle School

Grade Level: 6th (Can be
adapted 5th to High School)

Duration: Five 50-Minute
Class Periods

Objectives

First students will make detailed scientific observations about the water sample, including scientific illustrations. Students will brainstorm ways they might clean the water, looking back through their Science Journals for evidence and techniques that may apply to this new situation. Then over the course of 3 or 4 laboratory sessions, students work to clean the water. They demonstrate their understanding of density in order to remove the oil layer. They demonstrate their understanding of solubility in order to filter the insoluble components and use a water cycle simulation (distillation) in order to remove any soluble Impurities. Students are amazed that they can accomplish this challenge and yield clean drinkable water! In fact, students can accomplish any challenge, when given the right tools: academic, emotional, and technological.

Materials

- “foul” water sample and stir stick
- funnel with rubber tube and pinch clamp
- paper clip, Styrofoam cup with sand and gravel
- filter paper, ground activated charcoal pieces
- ring stand apparatus

2008
Winning Lesson Plan
from Seattle, Washington

Clean Water Challenge

by Jessica C. Levine
Eckstein Middle School

Grade Level: 6th (Can be
adapted 5th to High School)

Duration: Five 50-Minute
Class Periods

Procedure

Before You Begin

1. Prepare your data table in your science journal as shown on the bottom of the next page.
2. Obtain a sample of foul water from your teacher. Make a scientific illustration of your sample.
3. Examine the physical properties of your sample: color, clarity, and odor, presence of oil and presence of solid. Record all observations in your data table.

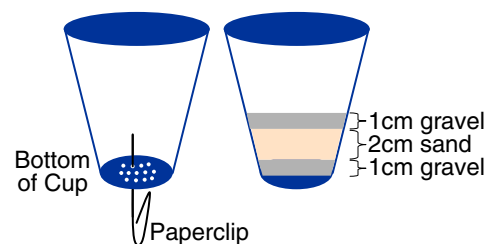
Part 1: Oil-Water Separation

1. Stir the mixture with your stir stick.
2. Using the ring stand set up and funnel and tube, clamp the tube closed and gently pour some of your sample into the funnel.
3. Allow the mixture to form distinct layers.
4. Slowly release the water mixture into a clean container. STOP the clamp before the oil layer is released.
5. Place the oil waste container below the funnel, tube, and clamp. Release the oil. **POUR USED OIL IN A WASTE BEAKER—NOT IN THE SINK!**
6. Conduct this process for the remainder of your sample; until you are satisfied you've removed most of the oil.
7. Observe the properties of your water sample. Record all results in your table. Make a scientific illustration of your sample.

Part 2: Sand Filtration

8. Using a paperclip or pushpin, poke several small holes in the bottom of a paper cup. Using a ruler, add pre-moistened gravel and sand layers to the cup as follows: (make a sand sandwich!)
 - a. First layer: 1cm of gravel
 - b. Second layer: 2cm of sand
 - c. Third layer 1cm of gravel

(The bottom layer of gravel prevents the sand from washing through the holes. The top layer of gravel keeps the sand from churning up when the water sample is poured in.)



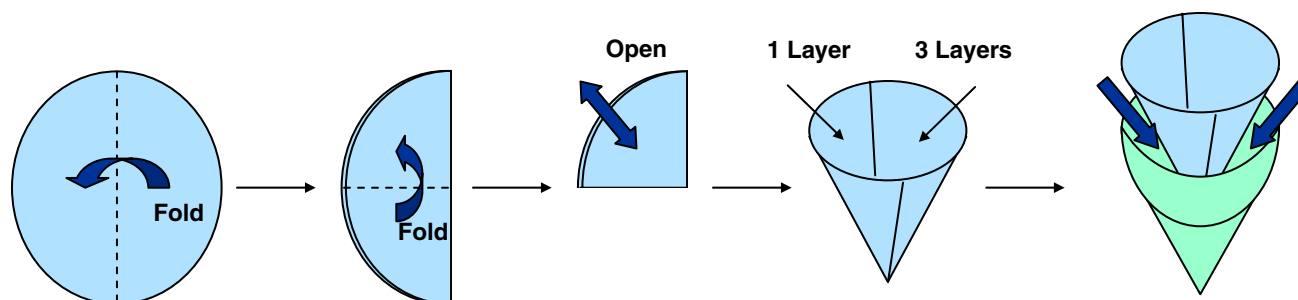
Procedure (Cont'd)

Part 2: Sand Filtration (Cont'd)

- Place your sand filter on top of a clean 100mL beaker. Gently pour the foul water through the filter. Catch the filtrate (filtered water) in the beaker as it drains through.
- Dispose of the used sand and gravel according to your teacher's instructions. Do not pour any sand or gravel into the sink!
- Observe the properties of your water sample. Record all results in your table. Make a scientific illustration of your sample.
- Label your beaker with your group name, Save the filtered water sample for the next procedure.

Part 3: Charcoal Adsorption/Filtration

- Obtain a 250 mL Erlenmeyer flask and add small spoonful of charcoal.
- Pour the water sample into the flask and swirl vigorously for 20–30 seconds.
- Fold a piece of filter paper as shown in the diagram below. Place the folded filter paper in a funnel.



2008
Winning Lesson Plan
from Seattle, Washington

Clean Water Challenge

by Jessica C. Levine
Eckstein Middle School

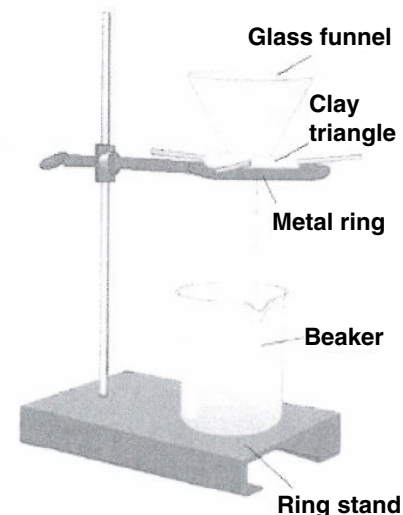
Grade Level: 6th (Can be
adapted 5th to High School)

Duration: Five 50-Minute
Class Periods

Procedure (Cont'd)

Part 3: Charcoal Adsorption/Filtration (Cont'd)

- Place the funnel in a clay triangle supported by a ring clamp. Lower the ring clamp so the funnel stem extends a few centimeters inside a 100 mL beaker. (see diagram)
- Then gently pour the water sample (with charcoal) through the filter paper. Keep the liquid level below the top of the filter paper. Liquid should not flow through the space between the filter paper and the funnel.
- If the filtrate is darkened by small charcoal particles, re-filter the liquid through a clean piece of moistened filter paper,
- Observe the properties of your water sample. Record all results in your table. Make a scientific illustration of your sample.
- Pour the used charcoal in the container provided by your teacher.
- Pour your water sample into a clean 100 mL beaker and label it with your name(s) and class period.
- Wash all glassware, return all materials, and wipe down your lab table. Be sure to wash your hands before you leave class.



Data: (in your science journal)

	Color	Odor	Clarity	Presence of Oil	Presence of Solids
Before Treatment					
After oil					
After					
After charcoal					

Part 4: Distillation (see lab sheet next page)

NAME:	DATE:	PERIOD:
-------	-------	---------

DISTILLATION AND WATER CYCLE LAB

2008
Winning Lesson Plan
from Seattle, Washington

Clean Water Challenge

by Jessica C. Levine
Eckstein Middle School

Grade Level: 6th (Can be adapted 5th to High School)

Duration: Five 50-Minute Class Periods

<p>Materials:</p> <table style="width: 100%;"> <tr> <td>1 ring stand</td> <td>1 burner</td> </tr> <tr> <td>1 ring</td> <td>1 wire screen</td> </tr> <tr> <td>1 clamp</td> <td>ice</td> </tr> <tr> <td>2 250 mL flasks</td> <td>water sample</td> </tr> <tr> <td>1 600 mL beaker</td> <td>graduated cylinder</td> </tr> <tr> <td>hose with stopper</td> <td>tin foil</td> </tr> </table>	1 ring stand	1 burner	1 ring	1 wire screen	1 clamp	ice	2 250 mL flasks	water sample	1 600 mL beaker	graduated cylinder	hose with stopper	tin foil	<p><i>Draw a labeled diagram in the space above following the set up shown in class.</i></p>
1 ring stand	1 burner												
1 ring	1 wire screen												
1 clamp	ice												
2 250 mL flasks	water sample												
1 600 mL beaker	graduated cylinder												
hose with stopper	tin foil												

Procedure:

1. Add 100 mL of tap water to the beaker. Get a few ice cubes from the teacher to put in this water. This is called an ice bath.
2. Put flask B in this ice bath.
3. Pour 15 ml of your water sample into the other flask (flask A). Set flask A, with your water sample, on the ring and secure with the ring clamp.
4. Put the stopper and hose in flask A.
5. Put the loose end of the hose in flask B. Wrap the foil around the opening of flask B and the hose.
6. Ignite the burner under your water sample in flask A.
7. Begin the Before section of the data table.
8. Answer the questions while you wait.
9. When the last drop of water leaves flask A, tell the teacher and then blow out the flame.

(Continued next page.)

NAME:	DATE:	PERIOD:
-------	-------	---------

DISTILLATION AND WATER CYCLE LAB

Observations:

Before	After
Contents of flask A?	Contents of flask A?
Clarity of water in flask A?	Describe:
mL of flask A:	mL of flask A:
What are the contents of flask B?	What are the contents of flask B?
mL of flask B:	Clarity:
	mL of flask B:
What kinds of impurities are removed by distillation?	
How does this set up illustrate the Hydrogen Cycle (the Water cycle)? Use words like precipitation, condensation, evaporation, etc. You may draw a picture of this set up and compare to the real thing.	
Minerals dissolved in water cause what is known as "hard water". Could you use the distillation process for "softening" hard water? Explain.	
Was there any residue left on any of the flasks? If so, describe what it looked like and what you think it might be.	
Which water was cleaner? Explain.	

**2008
Winning Lesson Plan
from Seattle, Washington**

Clean Water Challenge

by Jessica C. Levine
Eckstein Middle School

Grade Level: 6th (Can be
adapted 5th to High School)

Duration: Five 50-Minute
Class Periods

**2008
Winning Lesson Plan
from Seattle, Washington**

Clean Water Challenge

by Jessica C. Levine
Eckstein Middle School

Grade Level: 6th (Can be
adapted 5th to High School)

Duration: Five 50-Minute
Class Periods

Extensions Beyond the Classroom

Students have numerous opportunities to engage in the world of science and community. Our classroom is a model of conservation practices. There are “CONSERVE WATER” signs on each sink that engage and remind students. Where water is needed for lab activities, I provide a “sink supply” for each table team in a small container to minimize waste at the faucets. In partnership with Puget Sound Energy and the Powerful Choices for the Environment Program, students calculate shower math and play a water conservation game to support earlier concepts.