## Washing Water Lesson Plan

### **SOL Standards - Elementary**

- 3.8 The student will investigate and understand that natural events and humans influence ecosystems
- 5.9 The student will investigate and understand that the conservation of energy resources is important.
- 6.6 The student will investigate and understand that water has unique physical properties and has a role in the natural and human-made environment. Key
- 6.8 The student will investigate and understand that land and water have roles in watershed systems.
- 6.9 The student will investigate and understand that humans impact the environment and individuals can influence public policy decisions related to energy and the environment.
- ES.6 The student will investigate and understand that resource use is complex.
- ES.8 The student will investigate and understand that freshwater resources influence and are influenced by geologic processes and human activity.

### Overview

Working in small groups, students will design, construct, and test a filter to change the quality of water treated at a local wastewater treatment plant. Before starting the activity. Have students watch <u>Beyond the</u> <u>Drain</u> and <u>Wastewater Treatment For Kids</u> (please note this video is for the Mississippi River, but the general wastewater treatment process is the same for us here in Hampton Roads)

## **Essential Questions (for discussion before the activity)**

- 1. Why is it important to treat water before sending it into our local waterways?
- 2. What are some ways a filter can improve water quality?
- 3. What do pH, turbidity, and chlorine tell us about water quality?

## Follow-Up Questions (for discussion after the activity)

- 1. Did your filtered water look different from your "dirty" sample?
- 2. Were you able to successfully meet all of the water quality criteria? Is there anything you would do differently?
- 3. How are planning, trial-and-error, and budgeting important?

#### **Examples:**







### **Materials**

Filter material:

- Coarse sand
- Fine sand
- Large gravel
- Small gravel
- Mesh Cotton
- Activated charcoal
- Baking soda
- Carbon filter
- Screen
- ¼ cup measurers
- Filter material labels (included in this download to label each container filled with filter media. Please see example photo for reference.

#### Filter apparatus:

- Empty 1L soda bottles
- Rubber bands
- Weed block fabric

### Polluted source water:

- Empty plastic container (2L soda bottle, milk jug)
- Water (2L)
- Dirt, mulch and/or leaves
- Bleach
- Salt
- Lemon juice

Water quality monitoring tools:

- turbidity meter
- pH strips
- Chlorine test strips

Miscellaneous:

- Paper towels
- Small clear cups
- Stirring sticks



#### Procedure

Preparation:

- 1) Prepare the filter apparatus. Cut a 1L bottle in half- the top portion will become the filter and the bottom portion will become the base. Remove the cap from the top portion. Wrap weed block fabric around the spout and secure it with a rubber band. Place the top portion into the base spout-side-down.
  - a) You have created one filter apparatus. This step should be repeated based on class size and should be done ahead of time. The apparatus can be rinsed and reused for future classes.
- 2) Set up multiple testing stations accommodating three to four students each. Include paper towels, one filter apparatus, 3-4 handouts, one small clear cup, a stirring stick, a turbidity meter, pH strips, and chlorine test strips.
- 3) Set up a filter material "bar" in a centralized location. Separate the materials into individual containers and place a label in front of each.
- 4) Prepare the "dirty water." Add one drop of bleach, ¼ cup of lemon juice, a handful of crushed brown leaves/dirt/mulch, and 1 tsp of salt to an empty 2L plastic container. Fill the remainder of the bottle with water and shake vigorously.

Classroom Procedure:

- 1. After completing the questions on the Washing Water Worksheet, instruct each group to design a water filter using the filter materials provided.
- 2. Once students have designed their filters, allow representatives from each group to build them at the material "bar". You may allow students to pour and measure the materials themselves, or an instructor may assist to avoid time delays and spills.
- 3. Provide each group with one cupful of "dirty" water. Shake vigorously prior to pouring. Instruct students to place their filters into their bases and pour the water on top. After all of the water has flowed through, they may analyze their finished water using the test strips at their stations.
- 4. If time permits, allow students who have not met the water quality criteria, to add more materials to their filters in Trial 2 and repeat Step 3.
- 5. Complete the worksheet follow-up questions.



## Washing Water Handout for Students

You work at a local **wastewater** treatment plant and are discharging final effluent into the Atlantic Ocean. In order to meet state guidelines the **pH**, **turbidity**, and **residual chlorine** of your **effluent** (treated water flowing out into water sources in the environment) must fall within a pre-determined water quality range. The wastewater **influent** (water flowing into the wastewater treatment plant) does not fall into this acceptable criteria range and it is your job to create a filter to solve the issue.

### **Preliminary Questions:**

- 1. Why is it important for wastewater treatment plants to clean water before sending it back into the environment?
- 2. What are some ways a filter can help clean water? Do you use filters in your daily life and if so, what do you use them for?

3. What do pH, turbidity and chlorine tell us about water quality?

### **Follow-Up Questions:**

1. Did your filtered water look different from your "dirty" sample?

2. Were you able to successfully meet all of the water quality criteria? Is there anything you would do differently?

3. How are planning and trial-and-error important?

#### Directions:

Fill out the tables below as you're designing and testing your filter

## Trial 1:

Filter Material Used	Quantity (amount added)	

Total Cost: \_\_\_\_\_

Post	Pre-filtration value	Post-filtration value	Water Quality Criteria
рН			6.5 – 8.5
Turbidity			< 20 ntu
Residual Chlorine			< 0.7 mg/L

## Trial 2:

Filter Material Used	Quantity (amount added)	

Post	Pre-filtration value (Trial 1 post-filtration value)	Post-filtration value	Water Quality Criteria
рН			6.5 - 8.5
Turbidity			< 20 ntu
Residual Chlorine			< 0.7 mg/L

## Trial 3:

Filter Material Used	Quantity (amount added)	

Post	Pre-filtration value (Trial 2 post-filtration value)	Post-filtration value	Water Quality Criteria
рН			6.5 - 8.5
Turbidity			< 20 ntu
Residual Chlorine			< 0.7 mg/L

### WASHING WATER FILTER MEDIA LABELS

Ways to print and display filter labels:

1.) Print on cardstock, cut out each label, and fold to place in front of each container holding your filter media.

2.) Print on cardstock or regular printer paper, laminate and cut each label into a square to place in front of each container



## SAND

## COTTON BALLS

# CARBON FILTERS

## COURSE SAND

## FINE SAND

## LARGE GRAVEL

## SMALL GRAVEL

## BAKING SODA