

## **Pre/Post Water Activity Test**

1. Where does clean drinking water come from?
2. How would you remove or separate oil and water?
3. What property of matter allows the separation of oil and water?
4. If water looks clean can you assume it is clean? Why or why not?
5. How can you get rid of the smell in dirty water?
6. If distillation is a way to really make clean water, why don't we use it more often?

## Pre/Post Water Activity Test **Teacher Answer Key**

1. Where does clean drinking water come from?

Clean water **may** come from:

- ✓ The ground
- ✓ Rivers
- ✓ Streams
- ✓ Lakes
- ✓ Rain

However, to make sure the water is safe to drink, one should boil the water before drinking.

2. How would you remove or separate oil and water?

Because oil and water do not mix, you can separate them by letting the oil float to the top and then skim it off.

3. What property of matter allows the separation of oil and water?

**Density**

4. If water looks clean can you assume it is clean? Why or why not?

**No! Because small things could be in the water**

5. How can you get rid of the smell in dirty water?

**Charcoal is added to the water**

6. If distillation is a way to really make clean water, why don't we use it more often?

**Because it is expensive.**

**Elem. Curriculum / Cleaning Water**  
Teachers Preparatory Guide  
By: David Mann

**Purpose** This teacher demonstration activity is designed to familiarize students with the process of water filtration to clean water for drinking.

**Level** Elementary school 5<sup>th</sup> grade

**Time Required** 30-45 min. as teacher demo. Or... 3-4 days as class activity.

**Safety Information** Do not allow students to drink the filtered water as there is no chlorination step in this filtration process.

**Advance Preparation** Be sure to request an educational discount or a bulk discount when placing orders with online suppliers. If a projector is unavailable for you to use the PowerPoint slides, photocopy images for distribution to students. Next, show the PowerPoint presentation explaining the need for clean water in developing countries or... use printed images of people in need of clean water.

**Materials for a school with laboratory equipment**

One 500mL and one 125- or 250-mL Erlenmeyer flask with stoppers. (A empty water bottle or 5 gallon bucket will also work for making the foul water sample).



1 tsp of used coffee grounds  
1 tsp of sifted garlic powder  
25 mL of vegetable oil  
1 tsp of sodium chloride (table salt)  
Gravel and sand  
Styrofoam cup  
Funnel  
Latex rubber tube  
Ring stand  
Ring  
2 - 250 mL beakers  
Filter paper  
Charcoal  
Conductivity meter  
Glass tube with stopper

**Materials Continued** If the school does not have laboratory equipment, an inexpensive funnel device can be made from a plastic drinking bottle. Half of the bottle can be made into a funnel and the other half as a cup for catching the water filtrate. The device can be made as follows:



A 500 mL water bottle cut in half using a hacksaw or sharp knife, (teacher assist students or prepare bottles ahead of time).



Placing gravel in filter



Loading Sand

## Here Is Our Water Filter

→ **Big  
Gravel**

→ **Small  
Gravel**



← **Sand**

### Making a cap

Drill a 7/16 " hole in the cap and screw in a 1/4 " fitting with a barbed hose end. Place 5/8" O.D. O-ring on it and attach 3" of 1/4" latex tubing. All materials found at the hardware store for a total cost of \$3.00







Flushing the filter to remove dirt from the sand. (Do this before using the filter to clean your foul water sample).

### **Recipe For The Foul Water**

An easy recipe for the foul water is to place 400 mL of tap water in a 500 mL flask (or another empty water bottle or 5 gallon bucket) along with 1 tsp. of sifted coffee grounds, 1 tsp. of sifted garlic powder and 25 mL of vegetable oil and 1tsp of sodium chloride (table salt). Stopper and shake. The mixture tends to separate out; it is therefore important to shake the foul water sample just before giving it to students. To ensure a more or less consistent mixture sample for each student group, continue to keep the foul water shaken up. If you have one, another way to keep the mixture well stirred is to place it in a large beaker on a stir plate, and draw out samples while it is stirring using a plastic pipet.

**California Science Content Standards (4<sup>th</sup> Grade) Investigation and Experimentation**



6. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

- a . Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
- b . Measure and estimate the weight, length, or volume of objects.
- c . Formulate and justify predictions based on cause-and-effect relationships.
- d . Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
- e . Construct and interpret graphs from measurements.
- f . Follow a set of written instructions for a scientific investigation.

### **California Science Content Standards (5<sup>th</sup> Grade) Earth Sciences**

3. Water on Earth moves between the oceans and land through the processes of evaporation and condensation. As a basis for understanding this concept:

d. Students know that the amount of fresh water located in rivers, lakes, under-ground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water.

e. Students know the origin of the water used by their local communities.

### **National Science Education Content Standards (Middle School)**

Content Standard A

- Abilities necessary to do scientific inquiry
- Understanding scientific inquiry

#### Content Standard B

- Structure and properties of matter

#### Content Standard C

- Interdependence of organisms

#### Content Standard E

- Abilities of technological design
- Understandings about science and technology

#### Content Standard G

- Science as a human endeavor
- Nature of scientific knowledge

#### Content Standard F

- Personal and community health
- Natural resources
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

### **Background Information**

Nanotechnology could lead to advanced water-filtering membranes that may purify even the worst wastewater. Progress is being made in the research of anti-bacterial and anti-viral filters. For example, raw sewage could be poured in one of these advanced filters and come out with clear water on the other end.

**Data Table**

	<b>Color</b>	<b>Clarity</b> Can you see through it? Yes/ No	<b>Odor</b> Does it smell? Yes / No	<b>Presence of Oil</b> Is oil still floating on top? Yes/ No	<b>Presence of Solids</b> Chunky stuff in the water? Yes/no	<b>Volume</b> How much water do you have?
Before Treatment						
After Oil-Water Separation						
After Sand Filtration						
After Charcoal Adsorption/Filtration						

**Procedures: (Before you begin treating the foul water, record your observations before you do anything to it.)**

## **Procedures:**

1. Obtain approximately 100 ml of foul water in a beaker or the bottom half of the water bottle that you cut to make the bottle filter. Measure its volume precisely with a graduated cylinder; record the value with units (mL or  $\text{Cm}^3$  in your data table.
2. Examine the properties of your sample such as color, odor, clarity (how easily you can see through it), presence of solids, or oily regions. Record your observations in the "Before treatment" section of your data table.

## **Removal of Oil.**

The separation is similar to some large-scale water purification methods. Because oil and water do not mix... (This is because of the different densities of the oil and water). The first step involves just allowing the water to sit. As it does, large solid particles sink to the bottom and oil droplets along with some low density solids float to the top and form a scum layer on top. The top layer of oil and scum can be separated out by using the funnel device you made or an actual funnel and a piece of rubber hose. The top oily layer is discarded down the drain. The water obtained from this technique is considerably "cleaner" than it was to begin with, but it is still somewhat cloudy and smelly!

The following can be done as a teacher demo.

1. Place a funnel in a clay triangle supported by a ring clamp and a ring stand. Attach a rubber hose to the funnel tip.



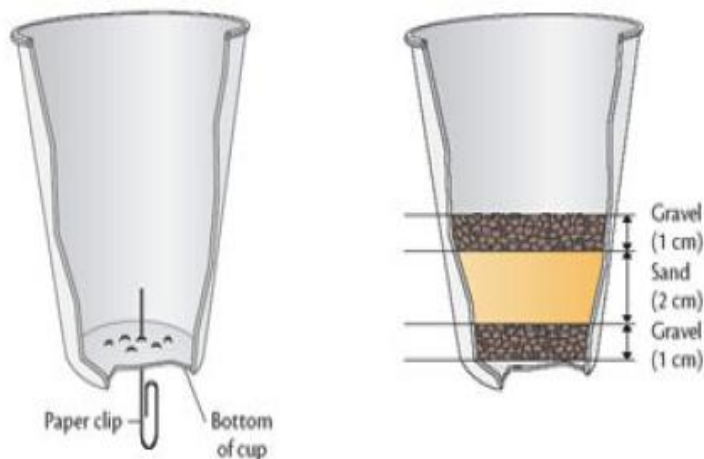
2. Close the rubber tube by pinching it with your fingers. Shake or stir the foul-water sample. Then pour about half the sample into the funnel and let it stand for a few seconds until the liquid layers separate.
3. Carefully open the tube to release the lower layer into a 150-mL beaker. When the lower layer has drained out, quickly close the rubber tube.
4. Drain the remaining layer into a second 150-mL beaker.
5. Repeat Steps 2-4 using the remainder of your sample, adding each liquid to the correct beaker.
6. Dispose of the top, oily layer into a central waste bucket. Observe the properties of the remaining layer and measure its volume. Record your observations and data. Save the water for the next procedure.
7. Wash the funnel with soap and water.
8. Record your observations in your data table.

## **Sand Filtration**

Next, pour the foul water sample through the paper cup sand filter, which traps solid impurities that are too large to fit between sand grains.

## **Procedures**

1. Using a straightened paper clip, poke small holes in the bottom of a paper cup.



2. Add pre-moistened gravel and sand layers to the cup as shown above. The bottom gravel prevents the sand from washing through the holes. The top gravel keeps the sand from churning up when the sample is poured in.
3. Gently pour the sample to be filtered into the cup. Catch the filtrate (filtered water) in a beaker as it drains through.
4. Dispose of the sand and gravel into a waste bucket.
5. Observe the properties and measure the volume of the water. Record your results. Save the water sample for the next procedure.

After the sand filtration, the sample is much clearer, although it might be slightly colored, and it still has the stench of garlic.

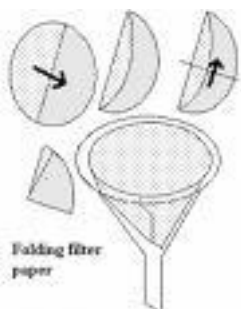
### **Charcoal Adsorption/Filtration**

Charcoal adsorbs (attracts and holds on its surface) many substances that could give water a bad taste, odor, or cloudy appearance. After the charcoal filtration, the sample is generally a clear, colorless, and more or less odorless liquid.

### **Procedure**

1. Fold a piece of filter paper as shown below.





2. Place the folded filter paper in a funnel. Wet the paper slightly so it adheres to the funnel cone.
3. Place the funnel in a clay triangle supported by a ring clamp. Lower the ring clamp so the funnel stem extends 2-3 cm inside a 150-mL beaker.
4. Place one teaspoon of charcoal in a 125- or 250-mL Erlenmeyer flask.
5. Pour the water sample into the flask, put a rubber stopper on top and shake vigorously. Then gently pour the liquid through the filter paper. Keep the liquid level below the top of the filter paper---no liquid should flow between the filter paper and the funnel.
6. If the filtrate is darkened by small charcoal particles, re-filter the liquid. Use a clean piece of moistened filter paper.
7. When you are satisfied with the appearance and odor of your purified water sample, pour it into a graduated cylinder. Observe and record the properties and the final volume of the sample.

Each step involves some loss of water, and the final purified sample might only have about one-fourth the volume that the original sample has.

### Detection of Invisible Material (Salt)



This purification does not remove soluble ionic salts. The salts do not adsorb on the surface of the charcoal particles. The presence of the invisible material (table salt) can be detected with a simple conductivity meter.



## Pocket Conductivity Meters

Point out to the students that just because the water looks clean does not mean that the water really is clean! Stress that there is still something in the water that they cannot see. Then demonstrate using the conductivity meter. A beep or light coming on is a positive test for the presence of an unseen material.

## Distillation of water

Boil the filtrate in the Erlenmeyer flask using a stopper and glass tube and a piece of rubber tubing to collect the vapors. Retest the distillate to see if it still conducts electricity.

