

# Be A Water Treatment Officer

Dear Presenter,

This activity is 20 to 25 minute presentation and HANDS-ON lab activity with approximately 24 ten year olds. You must do this activity at home BEFORE you attempt to lead the activity during the water festival.

As each new group of students arrive, introduce yourself, and let the teacher know this is a hands-on lab activity and you will need assistance from him/her. If you do not ask for assistance, the teacher will assume that YOU are the expert and they are the observer. Plan when you will ask the teacher for assistance. Do not hesitate to call the teacher by name and get him/her involved.

As each session begins, introduce yourself to the students. “Good morning, my name is.....and I work for.., I am a ....., or simply I am happy to be here today.” Then introduce the topic of the presentation. Each step of this presentation is explained in this packet. These are recommended guidelines and do not have to be followed exactly word for word. However, you may present this material just as written. Feel free to personalize the presentation to suit you.

Thank you for volunteering to present “Be A Water Treatment Officer.” Have fun, enjoy yourself and we hope you will consider volunteering again next year.

Big Sioux Water Festival

# Be A Water Treatment Officer

## MATERIALS LIST (FOR 6 SESSION WITH 24 STUDENTS PER SESSION)

### CONSUMABLES

- Sand (approximately 10 pounds or 5 quarts)
- Aquarium gravel (10 pounds)
- Paper towels (2 rolls plus 75 - 2x2" squares)
- 75 styrofoam cups with holes punched in the bottom (75 cups)
- 1.3 oz. containers of alum (12 containers)
- 1 bottle of non-chlorine bleach (Clorox 2 works well)
- 180 water treatment badges
- 2 garbage can liners
- 3/4 cup of soil in a ziplock bag
- 3 gallons of water
- 2 pencils
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### NON-CONSUMABLES

- 2 buckets (3 - 5 gallons)
- Ladle (to fill sand containers)
- Wooden spoon (for stirring muddy water)
- 15 plastic spoons
- 8 dropper bottles (filled with non-chlorine bleach)
- 16 oz. plastic cups (15 - 6 marked "gravel", 6 marked "sand" and a few extras of each)
- 8 oz. clear plastic cups (45 - 13 marked "clean, 26 marked "dirty")
- Poster-tak
- Rags
- Text folder of instructions
- Visuals (set of : 1 banner of cross section of an aquifer/groundwater and laminated color posters of water treatment process)

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This activity is a hands-on activity. To best explain and supervise this activity you must do it at home BEFORE the actual presentation.

Background information is provided as a basic overview with both general and specific information. Share this information with the students throughout the lab activity.

## WHAT DO YOU KNOW ABOUT WATER AND WATER TREATMENT?

When water falls to earth and flows into reservoirs, aquifers and lakes, it collects dirt particles, bacteria or pollutants because it is a good solvent. In nature, water is not always clean enough for people to drink, These contaminants must be removed before our water is safe to drink. Water treatment is the process of cleaning water. Treatment makes the water safer for people to drink. Almost every city in the world treats their drinking water. The United States has one of the best and cleanest drinking water systems in the world.

The process of cleaning water involves several steps. Water is first collected from a source. The water is aerated, by spraying it into the air to release trapped gases and absorb oxygen. Next, powdered alum is added to the water. This binds to dirt particles suspended in the water (coagulation). The particles now called floc, become heavy and sink to the bottom (sedimentation). The water is then filtered through layers of sand, gravel and charcoal to remove the small particles. As a final step, chlorine and other chemicals are added to disinfect or kill any bacteria or microorganisms in the water. The water is sampled and tested throughout the treatment plant. Sampling is performed to make sure the processes are working and that the water is safe before it leaves the plant. Storage and distribution of the clean drinking water is the final step. In North America, governments have set standards for drinking water. When water leaves a treatment plant, it is as clean or cleaner than required by these standards.

## VOCABULARY WORDS

**(When introducing these words, do not assume the students will already know the meaning of them. You will probably need to explain the meaning)**

<i>Aerate</i>	to expose to or supply with air
<i>Aquifer</i>	an underground layer of unconsolidated rock or soil that contains usable amounts of water
<i>Bacteria</i>	a tiny one-celled organism that may be helpful or harmful
<i>Coagulation</i>	to change from a liquid to a thicker substance
<i>Chlorinate</i>	to add chlorine
<i>Filtration</i>	process of passing a liquid or gas through a filter to remove particles
<i>Reservoir</i>	a place where a large amount of water has been collected and stored for use
<i>Sedimentation</i>	the process of matter falling to the bottom of a liquid

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## ROOM REQUIREMENTS

- A unadorned wall to display the poster and aquifer banner
- Close to a water source
- Tables for work stations - 2 teams of 2 students

## PRE-PREPARATION

### **Pre-preparation can include any or all of the following**

- Check supplies against supply list
- Clean sand if necessary - very fine white sand that can be purchased at most building supply places works best and doesn't need to be cleaned. Otherwise, one method of cleaning sand is to place it in an old pillowcase and place under running water until water is clear
- Clean aquarium gravel - put several holes in a ziplock bag and run water through the bag until water is clear
- Put 8 small holes in the bottom of each styrofoam cup
- Cut 75 2x2" paper towel squares

## PREPARATION - Approximately 1 hour to set up

- Mix 3/4 cup of soil with 3 gallons of water in one bucket
- Place pieces of poster tac on the back of each poster
- Set up 6 work stations

### **Each station will need (set up for 2 teams of 2 students each)**

6 clear plastic cups (2 marked "clean" & 4 marked "dirty")  
2 styrofoam cups (with holes)  
12 2x2" paper towel squares  
1 dropper bottle with non-chlorine bleach  
1 16 oz. plastic cup filled with aquarium gravel  
1 16 oz. plastic cup filled with clean sand  
2 1.3 oz. containers of alum  
2 plastic teaspoons  
Stack of 12 paper towels

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## INTENDED STUDENT OUTCOMES

By completing this activity the students should be able to:

- Explain the steps and process involved in purifying water at a water treatment plant
- Understand why water must be cleansed and purified before it is safe to drink
- Know the source of drinking water in this area

## PROCEDURE

1. Introduce yourself with enthusiasm to your students
2. This activity works well with a discussion about aquifers and reservoirs. Ask students if they know the source of their local drinking water. Use aquifer visual to explain where some drinking water comes from. State that water is treated before it reaches our faucets. Tell them they will learn how to treat water before it is released for consumption
3. Divide the class into groups of 4 students. You may wish to ask the teacher to assist you with this step.

## THE LAB ACTIVITY BEGINS

4. Ask the students to look at the materials at their station. Tell them to try to remember where everything is located because at the end of the session they will have to set up the materials in the same manner in which they were found. Begin the lab activity. Place **WATER SOURCE** poster on the wall. Explain all drinking water is taken from a water source. Logs, fish, plants, large rocks, etc. are screened out at the intake and then the water is drawn into the treatment plant. If the source is groundwater (an aquifer), the “screening” is done by the soil as the water travels under the earth’s surface. Sometimes very little treatment is required for groundwater. Have one student from each team of 2 come to the water source (bucket of muddy water) with one of the cups marked “dirty.” Both you and teacher will fill students’ cups 3/4 full of muddy water. Use the extra 16 oz. cup to ladle to save time. **DO NOT PUT LARGE PIECES OF MUD INTO THE STUDENTS CUPS.**
5. Place the **AERATION** poster on the wall next to the **WATER SOURCE** poster (you will continue to “build” the water treatment process with each poster added to the wall). Explain aeration is the process of spraying the water into the air to release any trapped gases and to allow the water to absorb oxygen. Instruct the other student in the team to pour the water back and forth between the two “dirty” plastic cups to simulate the aeration process. You may wish to demonstrate this process with the extra supplies.
6. Place the **CHEMICAL ADDITION (ALUM) AND COAGULATION** posters on the wall. Instruct student to carefully measure ½ teaspoon of alum and add it to the cup of dirty water. You will need to tell the students the plastic spoon is much larger than the amount needed. Have the student mix the alum and water together. Explain chemicals are added to the water to help settle solids that are still in the water. The alum will bind

to the dirt to make it heavier. This process is called coagulation. The larger particles are called floc.

7. Place **SEDIMENTATION AND FILTRATION** posters on the wall. Explain the water and floc move to the sedimentation basin. In the sedimentation tank, the floc settles to the bottom and is removed from the water. Instruct the students to remove the spoon and leave the water cup alone while they construct their filter for the filtration process.

### **CONSTRUCTION OF THE FILTER**

- Instruct student to place 2x2" square of paper towel into the bottom of the styrofoam cup making sure to cover the holes in the bottom
- Ask other student to place 2 teaspoons of aquarium gravel on top of the paper towel
- Ask first student to place 2 teaspoons of sand on top of the aquarium gravel
- Instruct other student to hold the constructed filter above the "clean" plastic cup

Explain the water leaves the sedimentation basin to flow through filters. Instruct the student not holding the filter to slowly pour the water into the constructed filter, not disturbing the settled floc. While the water is filtering, explain filters are made of layers of sand, gravel and charcoal, much like the one just constructed. The filters remove any remaining particles left in the water. This step takes some time to complete. If running short of time, cut the filtration time down. Have the students place the filter into an empty "dirty" cup and continue with next step

8. Place **CHEMICAL ADDITION (CHLORINE) AND STORAGE** posters on the wall. Explain this process is used to kill any remaining germs which are too small to filter out. A small amount of chlorine and other disinfecting chemicals are added to kill germs. **CAUTION THE STUDENTS ABOUT THE DANGER OF BLEACH.** Instruct student to add 2 drops of non-chlorine bleach to the filtered cup of water. *Have the students put the dropper bottle down on the work surface, do not let them hand the bottle to each other.* Explain if this were a real water treatment plant, you would now have water clean enough to drink. **DO NOT ALLOW THE STUDENTS TO DRINK THE WATER!!** Tell the students that in some water systems, especially those with groundwater sources, this is the only treatment provided. Storage is usually in a closed tank or reservoir called a clear well. This allows the chlorine to mix throughout the water in order for disinfection to take place.
9. Place **DISTRIBUTION** poster on the wall. Explain that water leaves the storage units by flowing through the distribution system which brings water to each home and place of business.

10.

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## CLEAN UP AND SET UP FOR NEXT SESSION

11. Instruct one student from the team to discard filter into the garbage can and pick up a new styrofoam cup.
12. Instruct the other student to use the “clean” water to rinse off the spoon by pouring the water over the spoon into the dirty cup. Instruct this student to pour all water back into the water source bucket.
13. Have all students replace the materials as they were when the activity started. If the “clean” cup is dirty, have the student take one of the paper towels on the table (not the 2x2" squares) and wipe out the cup.
14. Remove all the posters from the wall and repair poster tac (if needed) in preparation for the next session. As the students are replacing the materials, thank them for participating, compliment them on their behavior, answer any questions they may still have.
15. With the assistance of the teacher, give each student an official “Water Treatment Officer” badge. After they’ve stuck them onto their shirts, have students discard paper backing in the trash can.

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## **FINAL CLEAN UP**

**Approximately 45 minutes**

- Replace all instructions and cue cards in folder
- Rinse and save plastic cups
- Empty all remaining non-chlorine bleach from dropper bottles and rinse thoroughly
- Return all unused work station supplies to storage container
- Rinse and save any undamaged plastic spoons
- Empty and rinse water source bucket and dry out
- Rinse ladle used for sand
- Wipe off all work surfaces
- Store together the posters, banner and storage container