

DEMONSTRATION 1

WATER SOURCES & TREATMENT

LEARNING OBJECTIVES

☒ ***At the conclusion of Demonstration 1, participants will be able to:***

1. State the primary purpose of the Drinking Water Treatment Plant.
2. List sources of water for cities, rural areas, industries and recreation areas.
3. Explain how water is cleaned and treated in preparation for human use and consumption.
4. Explain how water travels from the Treatment Plant to users.
5. Explain how treated water is stored in cities and in rural areas.
6. List ways to conserve water.

☒ ***Terms to be familiar with:***

- | | | |
|----------------|----------------|------------------|
| • Contaminant | • Sediment | • Groundwater |
| • Aeration | • Filtration | • Aquifer |
| • Coagulation | • Disinfection | • Water table |
| • Flocculation | • Reservoir | • Desalinization |

☒ ***Before you begin:***

1. Review the list of organizations in the back of the Guide for more in-depth information on how to keep our source waters clean and for tips on using water wisely. For information by watershed try <http://www.epa.gov/surf/>.
2. Find out what the average use of water (per person/per day) is in other parts of the world.
3. Consult EnviroScape®'s Groundwater Kit and Guide for more in-depth demonstrations and discussions on groundwater.

INTRODUCE PARTICIPANTS TO DEMONSTRATION 1

Thank the participants for participating in this demonstration. Tell them that there will be (one/two/three) presentations (depending on how many you're doing). Tell them that they will be learning about water treatment and wastewater.

Draw their attention to Demonstration 1 by asking opening questions such as the following:

- What did you do before you came here today?
- Did you use water?
- How did you use water? (Allow time for brief responses.)

We use water every day and don't stop to think about it unless we lose our water for some reason.

Pose the following as rhetorical questions, not to elicit answers at this point, but to spur the participants' thinking.

- Do you know how we get the water we use in our homes, schools, offices and factories?
- Do people in the city get water the same way as people in the country?
- Do businesses and factories get water the same way we do in our homes?
- Do you know how water is treated so that it's clean and safe for our use?
- Do you know how water is stored?

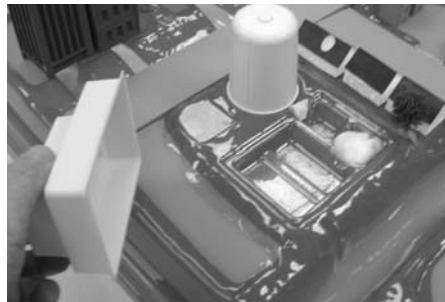
These are some of the things we're going to talk about today and I'm going to let you help me tell the story.

So, let's get started.

DEMONSTRATION 1: WATER SOURCES & TREATMENT

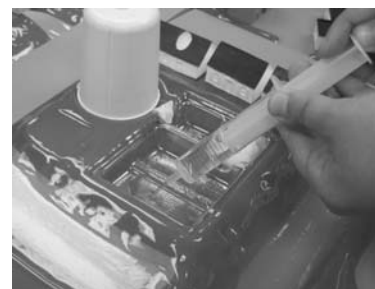
- ✓1. **LIFT OFF THE DRINKING WATER TREATMENT PLANT (DWTP) COVER and set aside.**

ASK *Does anyone know where we get our drinking water?*



- ✓2. **USE SYRINGE TO DRAW WATER from the river and pump enough water into Section 1 of the DWTP so that it flows over into Section 2.**

DISCUSS For cities and suburban areas, water is drawn from a natural source, such as a lake, river or bay (surface water) or even from groundwater.

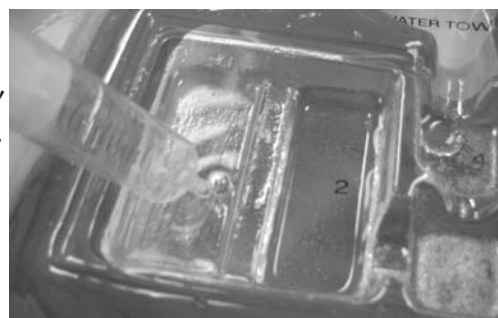


These sources often contain dirt and pieces of leaves and other organic matter, as well as trace amounts of certain contaminants. It's important to keep our sources of water as clean as possible and free from contaminants you can see and contaminants you can't see.

ASK *What happens to this water when it reaches a Drinking Water Treatment Plant?*

- ✓3. **USE SYRINGE to squeeze air into the liquid in Section 1, creating bubbles.**

DISCUSS In some water treatment plants, the first step is to pump air into the water, creating bubbles throughout the water to remove gases that make it smell and taste bad. This process of adding air to the water is called aeration.



Here's an interesting fact. In some water treatment plants, the first step is to use screens to keep out stray fish and water plants.

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- ✓4. **SPRINKLE OR POUR COAGULANTS** into Section 1 of the **DRINKING WATER TREATMENT PLANT** (enough to cover the bottom of the section).

DISCUSS When it arrives at the treatment plant, a chemical is mixed into the water. This chemical can be alum, iron salts or synthetic organic polymers. These chemicals are called "coagulants." The coagulants cause tiny particles of dirt and contaminants to form larger particles that are easier to remove. These larger particles and dirt collect in little bunches call floc. This is called flocculation.



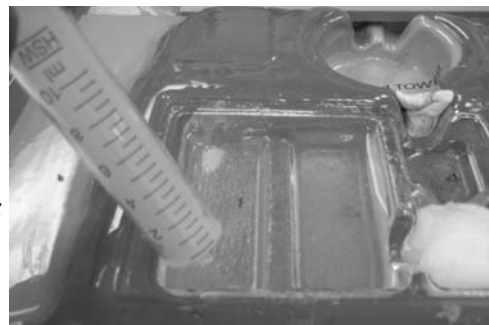
DIP A COTTON SWAB INTO SECTION 1 AND GENTLY STIR, helping some of the mixture to move on to Section 2. Then lift the swab out to see how the particles have begun to gel together. (You can go back and visit later to show it "gelling" even more.)



ASK *What do you think happens next?*

- ✓5. **USE SYRINGE TO PUMP MORE WATER** from the river into Section 1 almost filling both sections. Watch the water flow onto Section 2.

DISCUSS These flocculated particles that are created from the coagulants become heavy enough to naturally settle out of the water. They sink to the bottom. This is called sedimentation. You can see some of the heavy particles settle to the bottom in Section 2.



Coagulation, Flocculation and Sedimentation are three processes commonly used together to remove impurities from raw water supplies.

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ASK *Why do we do this?*

Because removal of impurities improves the appearance and taste of drinking water and helps remove some of the chemical and microbiological contaminants that might be harmful to humans.

ASK *Now the clear water (not the settled particles) moves on to filtration. What happens there?*

- ✓ 6. **LIFT OUT THE FILTER** to show how it changes color and catches contaminants. **Replace Filter.**

DISCUSS When the clear water moves to filtration, the water is cleaned even more. Filters usually consist of layers of coal, sand and gravel that trap and help remove solids and the smallest particles as the water passes through.



ASK *What other steps are taken to clean our drinking water?*

- ✓ 7. **SQUIRT A LITTLE CHLORINE** in Section 4 of the **DRINKING WATER TREATMENT PLANT.**

DISCUSS In our demonstration, blue water is clean. A chemical (chlorine) is mixed with the water to kill any germs in it. This is called disinfection. Ozone and ultraviolet radiation are other disinfectants used instead of chlorine.



In some instances, fluoride is added to the water to help prevent tooth decay.

DEMONSTRATION 1: WATER SOURCES & TREATMENT

⊗ **DISCUSS WATER QUALITY TESTS REQUIRED BY LAW**

Treatment plants are required by law to monitor and test their water many times throughout all these processes. These tests tell how clean the water is and assure us that it is safe to drink. If something goes wrong (like a storm turns the river all muddy or something at the plant breaks down) and the water fails a test, people may be instructed to boil their water before they drink it to be sure it is safe. Boiling removes dangerous pathogens (pathogens are things that can cause disease, such as bacteria or a virus) but not all chemical contaminants.

ASK *Do you think all water treatment plants use exactly the same steps to clean water?*

No. Not all water treatment plants provide the same steps.

Each water supplier's annual water quality report should include a summary of all of the water quality test results that occurred during the previous year. The water company usually includes this information with its customers' water bills or publishes it in local newspapers. Find out where the information is in your community.

For the United States, you can log onto <http://www.epa.gov/safewater/>. This site provides local drinking water information for each state.

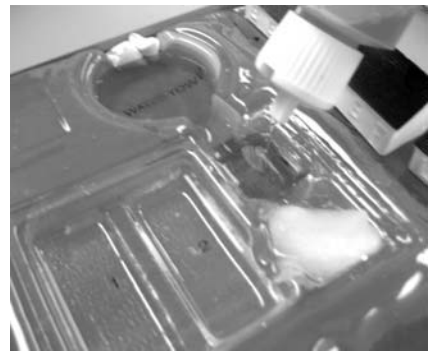
Water quality reports for systems in Ontario that serve more than 10,000 people are available from the owner of the system on the local municipality's website.

ASK *After water goes through these cleaning processes, what happens next? Have you seen a water tower in your community? What about a reservoir?*

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✓8. At the **DRINKING WATER TREATMENT PLANT**, **LIFT off the Water Tower and set aside.** (*Ignore this step if you are not using the water tower building and demonstrating the area as a reservoir instead.*)

- Lift the adhesive tack/putty (or clay) between Section 4 (Chlorination Basin) and the Water Tower (or Reservoir if it applies to your demo).
- Watch the water move to the Water Tower (reservoir) from the Drinking Water Treatment Plant.
- Add more chlorine to completely fill the Water Tower (or Reservoir if it applies).



DISCUSS The treated water is then stored for future use in either a reservoir or closed tank/water tower. Water towers store clean water and also help keep water pressure constant. If water is stored up high, it can flow to homes and fire hydrants by gravity even when the electricity is out.

✓9. **REMOVE the adhesive tack/putty (or clay) plug between the Water Tower (or reservoir if it applies) and main water pipes.**

LIFT house w/whole and also look at the city area. What is happening?



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DISCUSS Point to the City and the homes. (These two areas are provided for demonstration purposes.) In a community, the water flows from the Water Treatment Plant through pipelines in several different directions to serve the city, factories, schools and hospitals. When people turn on the faucet, flush the toilet or start the washing machine, the water is there. Each consumer and business is responsible for paying for the amount of water they use. It's important to not waste water.

ASK *What are some ways you can conserve water?*

Examples:

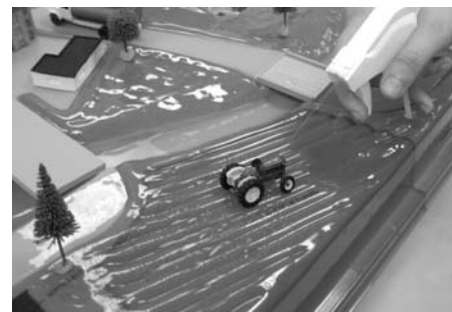
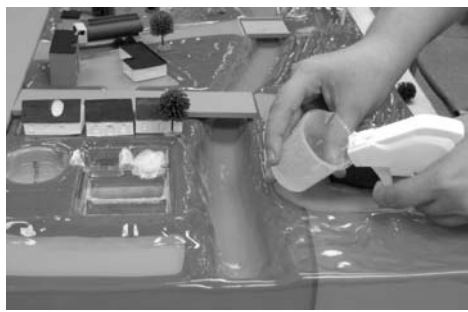
- ✓ Turn off the faucet while you brush your teeth.
- ✓ Fill the dishwasher full before you start it.
- ✓ Turn off the hose between washing and rinsing your car.
- ✓ Water lawns early in the morning or at night.

ASK *What about the rural customers, such as farmers or those living in the country?*

✓10. **INSERT WELL PUMP(spray pump) into each of the well holes – one by the rural home; the other by the farm.**

- PUMP water from the rural home into a cup.
- PUMP water from the well on the Farm and spray onto the field.

NOTE: Well spray pumps are inserted through the hole to access the groundwater; you may need to prime the pump by holding your finger over the spray opening and pumping a few times.



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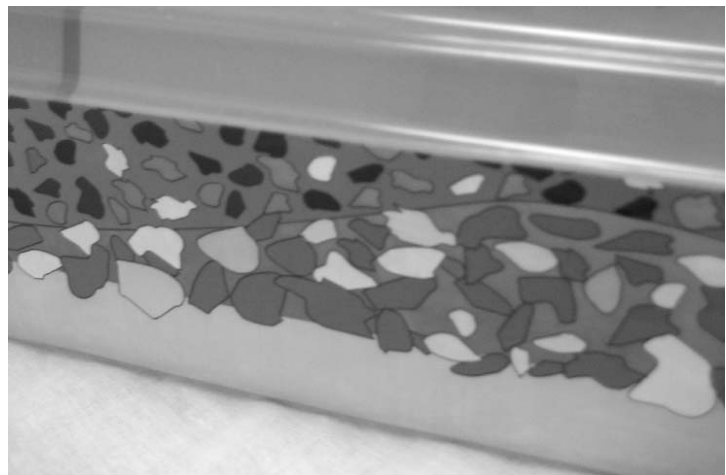
DISCUSS A well is a pipe installed in the ground that fills with groundwater and is brought to the surface by pumping the well. Many farmers and others living in rural areas depend on their own private wells for their water. They use the water for drinking and personal use, as well as for watering crops.

Some towns in rural areas keep water stored in closed tanks/water towers for use in town. This water is usually drawn from the groundwater through wells. As noted earlier, some cities rely on groundwater, also.

ASK *Who knows what an aquifer is?*

- ✓11. **POINT to side of the model by the wells to show the location of the aquifer. Locate water behind the transparent blue in the sticker.**

DISCUSS Groundwater is stored in aquifers. Wells tap into aquifers, which are geological formations of sand, gravel and porous rock that hold large amounts of water. They range from a few miles to thousands of miles wide and some span many states or provinces. Precipitation



(water) slowly moves through layers of soil, sand and rock to fill aquifers with groundwater. Recharging or filling aquifers can take many, many years.

Groundwater in the aquifer can become polluted from contaminants seeping through the land above and around them.

Water from wells is not always treated before use, so it's important to keep our groundwater safe. If water from wells is treated, the treatment usually addresses only a few contaminants.

NOTE TO FACILITATOR: Expand on this with EnviroScape's Groundwater Kit.

WRAP-UP

DISCUSS We've seen where our drinking water comes from, such as from lakes, rivers, bays or groundwater. Cities and suburban areas may draw water from a different source and/or send it through a different treatment process than rural areas.

- Ask your audience to look at their water bills when they return home and see how much water they use each month and what the cost is.
- Ask them to find out how their water provider measures the use of water. (Ask younger audience to get this information from a parent.)

ASK *How many gallons of water does each person in the U.S. use each day?* **Answer:** Approximately 100 gallons, which is very high compared to the rest of the world.

NOTE: If you have uncovered other data, tell the average use in other parts of the world. Have participants guess before you give the answer(s).

ASK *We know that many people in the world don't have much water to use and we use quite a lot. Do you have any other ideas for how we can use our water wisely?*

ASK *Can you think of any other sources of water? What about salt water?*

DISCUSS Salt water is plentiful in our vast oceans and it can be made into fresh water. This process is called desalinization. Desalinization is being used more and more around the world to provide people with fresh water, particularly where it is in short supply. For example, Tampa Bay, Florida is currently desalinizing water. It's not used a lot, because it's expensive, but as the demand for fresh water increases and technology keeps advancing, desalinization will likely increase, especially in areas such as California and the Middle East.

☒ **CONCLUDE:** *We have talked about how we get our water, how water treatment plants clean the water, how the water gets to us and how we use it. Now the question is, "What happens to the water after we use it?"*

That brings us to Demonstration 2.