



# Lesson 3: Toilet Talk

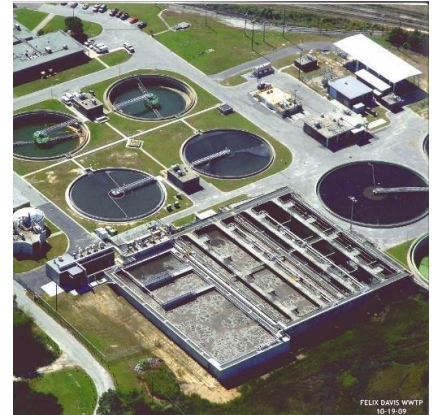
*In this lesson, students will be introduced to the various stages of the wastewater treatment cycle and the importance of water quality.*

## Focus

Wastewater Treatment  
Separation of Mixtures  
Water Quality

## Focus Questions

- What happens to water after it goes down my drain?



## Materials Needed

Our Water PowerPoint	Straw
Sieve/strainer	Spoon
Coffee Filter	UV Light/Flashlight
Crayons	Sand
Paper Towels	Small Beads
Video	Coffee Grounds
Vegetable Oil	Gloves
20 oz Clear Bottle	Food Coloring (optional)
Catch Bins/Containers (3 – for water and solids)	
Wastewater Cycle Diagram	

## Key Words

Wastewater, Sewer System, WWTF, Sludge, Clarifier, Aeration, Filter, Disinfect, Bacteria, Oxygen, Mixture, Separate

## Advanced Preparation:

Prepare a sample of "dirty water" for modeling the wastewater treatment cycle using a clear 20 oz water/soda bottle. In the bottle place the following: 1 tablespoon of sand, ½ tablespoon of vegetable oil, 1 tablespoon of small beads, 1 teaspoon of coffee grounds, and 2 drops of food coloring (optional). After the items have been added, fill the rest of the bottle with water and shake it up.

*Note: Do not create the sample above too far in advance. If it sits for 24 hours or more, it may become septic. Gloves would then be required for safe handling. To avoid this, it is*

## Grade Level: 2

## Learning Objectives

- Students will be able to explain what happens to water as it goes through the sewer system.
- Students will be able to develop and use models to exemplify how matter can be mixed and separated again based on the properties of the mixture.

## Prior Knowledge Required

- Students should be able to explain the basic processes of the water cycle.

## South Carolina Science Standards and Performance Indicators Addressed

2.P.3A.2



recommended that you create the sample right before the beginning of class. That being said, gloves are still recommended when using this model.

### Engage

Begin the lesson by posting a picture of a toilet (pictures are included in the PPT provided). Ask the students, "What is this a picture of? What do toilets normally hold?" You are likely to get the typical answers of poop, pee, toilet paper, and water. As discussed in Lesson 1, remind them that these are the only items that should ever go into the toilet.

Next, ask students, "Where do you think these items go after you flush? What happens to them after you flush?" Allow students to think about and respond to the questions. Explain that, just as water naturally circulates through Earth's water cycle, water in cities and towns goes through another type of water cycle.

### Explore

Then, hold up the bottle of dirty water you created. Explain to the students that it came from a local body of water. Ask the students the following questions:

- Would you drink it?
- Do you think it is safe to drink?
- What may be causing the water to become dirty?

When water becomes dirty after being used by schools, industries, businesses, and homes, it is called *wastewater* and is a lot like the dirty water in my bottle.

- How do you think we can clean the water?
- What do we need to remove?

Explain that wastewater treatment facilities (like North Charleston Sewer District) use processes to clean water and make it safe for people and the environment.

Now, it is time to discuss the stages of wastewater treatment. As you explain each stage, model it by using the methods and materials listed to the side.

#### *Step 1: Travel to the Wastewater Treatment Plant*

Before wastewater can be treated, it must first travel to the plant through a network of pipes. The North Charleston Sewer District maintains over 500 miles of piping underground

### Waste in Water:

- Human Waste
- Food
- Paper
- Dirt
- FOG (Fats, Oils, and Grease)
- Chemicals from cleaning, personal hygiene products, medicines, fertilizers, etc
- Microorganisms (bacteria, viruses, etc)

### Fun Fact:

On average, each person in America produces around 100 gallons of wastewater daily. That is roughly the equivalent of 2 full bathtubs (US Environmental Protection Agency).

### Separating Mixtures:

When discussing "dirty water," be sure students understand that it is a mixture of water and other substances. The other substances make it dirty. Therefore, in order to clean it, the goal of wastewater treatment is to separate the water from the other materials.

### Model Step 2:

Hold a strainer over an empty container. Pour your "dirty water" into the strainer and container. Allow students to observe the contents removed by the strainer and the water in the container. Have the students describe what they believe is still in the water.



to carry water from homes, businesses, schools, and industries to our wastewater treatment facility. This includes parts of Charleston, Summerville, North Charleston, Lincolnville, Berkeley and Dorchester.

### *Step 2: Preliminary Treatment*

When wastewater enters the treatment facility, it flows through a grid made of metal, sieve-like grates or screens. This removes larger solids.

### *Step 3: Primary Treatment*

Now, wastewater flows to a settling tank (aka Primary Clarifier). Here, the wastewater is held long enough for the solids to settle out and fall to the bottom. Also, FOG rises to the top of the tank. During this time, scrapers scour the bottom of the tank to remove solids, and skimmers run along the top of the water to remove any FOG and other floating solids.

### *Step 4: Secondary Treatment*

Next, wastewater moves to a container known as the aeration basin. Here, bacteria and other organisms remove carbon and other nutrients. Air is added to mix the wastewater and organisms. Also, it ensures that the organisms have oxygen to "breathe." The material removed by the organisms becomes solid and remains suspended due to the extensive dissolved air. Sometimes, an anoxic zone can be set up in the first section of the basin which creates a low oxygen environment where specific organisms known as "nitroifiers" break down ammonia. They use nitrogen instead of oxygen to survive. This step can take anywhere from a few hours to a whole day.

After the aeration basin, the wastewater travels to the Secondary Clarifier. Like the Primary Clarifier, the wastewater here is held to allow for solids to settle and floating FOG and solids to rise. A skimmer and scraper are used at this stage as well. However, here the settled solids can be either removed (WAS = wasted activated sludge) or returned to the aeration basin (RAS=returned activated sludge). The RAS step is used to add microorganisms back to the aeration basin.

### *Step 5: Advanced Treatment*

In this step of the process, wastewater is sent through one last filtering process. Not all wastewater treatment facilities implement this step.

### **Model Step 3:**

While discussing Step 2, allow the water in the container to sit so the solids settle out. Using a spoon, try to remove as much of the settled solids as possible.

### **Model Step 4:**

Use a straw to blow bubbles into the water. Be very careful not to swallow any water! As an alternative, you could use a small balloon hand pump with the straw to produce the bubbles

### **Model Step 5:**

Place a coffee filter over another empty container. Pour the water over the coffee filter. Anything filtered out of the water may be put to the side.

### **Model Step 6:**

Use a flashlight (or UV light if you have it) and shine it directly at the water as you explain the step.

### **A Note About Solids:**

In addition to treating the water, wastewater treatment facilities also "treat" the solids removed during the entire process. The solids (also called sludge) are dewatered and either sent to a landfill or are treated to be used for other purposes (fertilizer, compost, etc).



### Step 6: Disinfection

After traveling through the rest of the facility, the wastewater now flows through an area equipped with UV lights. These lights can disinfect and clean the water by killing off or changing the DNA of the remaining bacteria or pathogens, thus making them non-viable and no longer harmful.

### Step 7: Return to the Environment

The clean, treated water may now be sent back to the nearest body of water.

### Explain

Show the video of the wastewater treatment process and review the basic steps. Next, explain that just like the natural water cycle circulates water on earth all the time, wastewater goes through an entire cycle continually. As you explain, you can refer to the diagram in the *Our Water* PowerPoint. The Wastewater Cycle is as follows:

1. Water withdrawal from surface and ground water sources
2. Water is purified by water treatment plant
3. Water sent to community for use
4. Wastewater sent to wastewater treatment facility to be cleaned and treated
5. "Clean" water sent back to surface and ground water sources

### Elaborate

Further the lesson by asking, "*what might happen if you pour too much of something or if you pour the wrong thing down the drain?*" Answers will vary (pipes get clogged, water can't flow well, water becomes contaminated, the wastewater treatment facility has a harder time cleaning the water, water costs more). Next, refer to the *Our Water* PowerPoint for the game "*What has been found in my wastewater?*" Follow the directions given.

### Evaluate

As an assessment, have students complete the wastewater treatment process diagram (The Wastewater Cycle). Furthermore, show students each of the following items: sieve, straw, spoon, coffee filter, and flashlight. Have students explain the stage of the process for which each would work best. Students should be able to explain their reasoning.

### Resources

"Support Guide 3.0 for Second Grade." South Carolina Department of Education Office of Standards and Learning, June 2018.

Bennett, D., Hettenbach, S., & Welch, W. (2019, October 3). Creating Mini Wastewater Treatment Plants - Activity. Retrieved March 9, 2020, from <https://www.teachengineering.org/activities/view/uok-2216-wastewater-treatment-plant-model-water-quality>

### For More Information and Feedback:

We value your feedback on this lesson, including how you use it in your formal/ informal education settings. Please send your comments to:  
caitlin.graham@ncsd.sc.gov

### Acknowledgements:

Created by Caitlin Graham, FOG Program Manager, North Charleston Sewer District

Adapted from the work of Sarah Mason and Darnell Collins, North Charleston Sewer District using resources listed above.

*Note for Evaluate Section: Be sure students understand that the items (especially the flashlight) are simply models of the process and will not be able to actually clean water as well as a wastewater treatment facility.*