

Subject: Elementary Science (Earth & Space)

Grade: 3rd-5th

Date:

Lesson Title: Water Resources Recovery Facilities

Overview: This is the second lesson plan in the water resources recovery curriculum. Once students become familiar with the water cycle and pollution, this lesson further analyzes water treatment and water resources recovery. It educates students on different processes of wastewater treatment, why water treatment is important, and the benefits of water resources recovery.

Targeted Common Core Standards		Objectives
<ul style="list-style-type: none">✓ ELA 4: Determine or clarify the meaning of unknown and multiple-meaning word and phrases based on grade specific reading and content, choosing flexibly from a range of strategies.✓ RI3: Describe the relationship between a series of scientific ideas or concept in an experimental design. Using language that pertains to time, sequence, cause/effect.✓ RI 7: Use information gained from illustration (e.g., maps, photographs) and the words in a reading to demonstrate understanding (e.g., where, when, why, and how key events occur).✓ SL1: Engage effectively in collaborative group discussions with diverse partners on grade specific topics and building on ide	<ul style="list-style-type: none">✓ W2: Write informative/explanatory pieces to examine a topic and convey ideas and information clearly.✓ W8: Conduct short research projects that build knowledge about a topic.✓ W9: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (4th – 5th grade learners)✓ W10: Draw evidence from literary or informational materials to support analysis, reflection, and research.	<ul style="list-style-type: none">• To understand what happens to water after it is used.• To learn the process of the wastewater treatment.• To identify the different types of wastewater.• To learn what happens after water is treated.

Materials for Lesson

Water Resources Recovery PowerPoint

Student Guide Worksheet

https://www.teachengineering.org/activities/view/csm_amazon_lesson5_activity1_tg

Definitions

Types of Wastewater

Industrial Wastewater: Wastewater from factories, agriculture, mining, and other businesses.

Domestic Wastewater: Wastewater from homes, schools, and other facilities.

Stormwater Runoff: Snow and rain collected from street drains.

Primary Treatment: The first process in wastewater treatment

Bar Screen: First step in treatment. Bar screens catch rags, sticks, and other floatable objects.

Grit Chamber: Sand, silt, small rocks, and other heavy items settle to the bottom and are removed.

Primary Clarifier: In the primary clarifier, the smaller solids that are left over are given time to settle.

Sludge: The solids that settle at the bottom of the primary clarifier.

Sludge Digester: The sludge digester further treats the sludge. Any oil or scum that is removed from the top of the top may be incinerated, sent to an approved landfill, or burned.

Secondary Treatment: The second process in wastewater treatment

Aeration Tank: In the aeration tank, air is added to the wastewater and bacteria. Air helps the bacteria grow, and decompose the waste.

Secondary Clarifier: At the secondary clarifier waste and bacteria settle to the bottom.

Activated Sludge: Some of the material that has sunk to the bottom in the secondary clarifier is now called activated sludge that is reused in the aeration tank.

Disinfection: Chlorine or ultraviolet light is used to kill any harmful microorganisms that may be left.

Tertiary Treatment: Advanced treatment process that may be used at certain facilities

Nutrients: Phosphorus and nitrogen that can harm aquatic life are removed or changed using special treatment.

Suspended Solids: Small solid particles that remain in suspension in water.

Effluent: The discharged water that has finished undergoing treatment.

Turbidity: The cloudiness of water.

Salinity: The saltiness of water.

Background

One of the biggest problems that we face is the availability of clean drinking water. Engineers and scientists work together to identify the problem and create and test solutions using the engineering design process. To provide communities with safe drinking water, engineers design water resources recovery facilities and distribution systems. Not only does water treatment prevent diseases that effect public health, it provides organic material that can be used as fertilizer for plants or turned into energy.

Essential Questions

Before going through the PowerPoint ask students:

- How do they use water daily?
- What do they think happens to it after we use it?
- What would they do if they did not have clean water?

PowerPoint & Activities

Use *Water Resources Recovery Facilities* PowerPoint to introduce and explain the different categories of wastewater, the water treatment process, and why water resource recovery is important. After going through the lesson, play the short clip so that students can visualize that treatment process, and understand the key terms being used. Once the lesson is done, set students up into groups of 3 to work on the “Is it safe to drink?” activity.

This hands-on activity by Adventure Engineering, Colorado School of Mines, allows students to work together to create a water filter system. It allows students to follow the steps of engineering design by teaching them to understand the need to clean water, brainstorm different ideas, select the best design to fit the circumstance and constraints, plan, create and improve.

Materials

For the teacher:
1-gallon bottle
1 bag potting soil

Each group needs:

2-liter bottle with base cut off and no cap
2" x 2"-piece nylon stocking or cheesecloth
rubber band
4 oz cup coarse sand
4 oz cup aquarium gravel
small coffee filter
large bowl, approximately 2"– 3" deep
empty 12 oz cup, to be later filled with dirty water

Procedure

Before the activity:

- Gather materials and make copies of the [Student Guide Worksheet](#).
- *Prepare the plastic bottles.* Use scissors to cut the bottom off the 2-liter bottle. Use masking tape to cover the resulting sharp plastic edge, to protect students. Remove any labels from the 2-liter bottle. Repeat this procedure on the rest of the 2-liter bottles for the teams.
- *Make a class supply of "dirty water."* Fill the gallon bottle three-quarters full with water. Use potting soil to fill the remaining one-quarter. Shake the bottle. Then shake it again a few minutes before the activity since the soil will settle after time. A gallon of water is more than sufficient for the entire class.

With Student

1. Review with students the scenario provided in the Introduction/Motivation section.
2. Pass out the worksheets and materials to groups composed of three students each.
3. Show students the bottle of "dirty water." Ask them: Who would want to drink this water? Explain to students that their team challenge is to find a fast and effective way to filter the water, so it is clean enough to drink.
4. Fill each group's empty 12 oz cups with "dirty water." Remind students to never drink this water, even after filtering.
5. With the worksheet as a guide, have students complete the engineering challenge. Remind them of the basic steps of the engineering design process: understand the need, brainstorm different ideas, select the best design to fit the circumstances and constraints, plan, create and improve.
6. After answering the worksheet questions, have students turn them in for grading. Lead a class discussion to compare results and conclusions. Students may find that a more "scientific filter" (that is, one using sand and gravel) is slower and does not work as well as one using a coffee filter, or gravel and a coffee filter. Discuss with students their different designs and compare the good and bad points about their filter designs. Example successful points: the filter worked very quickly, and the water looked much better than before. Example negative points: the filter took a very long time to filter and did not do a good job of removing particles.

***** For lower grades, do the activity by building a filter as a class. If students suggest several ways, they think the materials should be layered, then build two or three different filter designs and test them as a class. For more information/ ideas on how to facilitate experiment visit:**

https://www.teachengineering.org/activities/view/csm_amazon_lesson5_activity1_tg

Teacher Notes

