

CHAPTER 1

Lesson 1: The Water Treatment Process

Purpose

To create an understanding of the process for providing clean water throughout the Beaver Water District.

Objective

Students will research and model the processes that the Beaver Water District water treatment plant uses to purify water for drinking.

Students will write a story describing and illustrating the water treatment process by making a Zine.

Arkansas Framework Correlation

Language Arts

7th Grade

OV.1.7.1 Use vocabulary from content area texts and personal reading

OV.1.7.2 Use standard English in classroom discussion and *presentations*

OV.1.7.4 Demonstrate appropriate eye contact, posture, and volume

OV.1.7.5 Use correct pronunciation and inflection/modulation to communicate ideas and information

OV.1.7.6 Contribute appropriately to class discussion

OV.2.7.1 Demonstrate effective listening skills by exhibiting appropriate body language

OV.2.7.3 Listen attentively for main ideas, details, and organization

OV.2.7.4 Demonstrate attentive listening skills to respond to and interpret speaker's message

OV.3.7.1 View a variety of visually presented materials for understanding of a specific topic

OV.3.7.2 Use appropriate criteria to evaluate media for bias and propaganda

W.5.7.1 Write to develop narrative, expository, descriptive, and persuasive pieces

W.5.7.2 Select the form of writing that addresses the intended audience

W.5.7.3 Create expository, narrative, descriptive, and persuasive writings

W.5.7.10 Write across the curriculum

R.9.7.15 Organize information, including simple outlining

R.9.7.16 Use skimming, scanning, note-taking, outlining, and questioning as study strategies

R.9.7.19 Evaluate personal, social, and political issues as presented in text

R.10.7.5 Use skimming, scanning, note taking, outlining, and questioning as study strategies

R.10.7.6 Organize and synthesize information for use in written and oral presentation

R.10.7.11 Read and utilize functional/practical texts, including forms, reports, cover letters, letterheads, and business letters

R.11.7.3 Add content words to sight vocabulary

R.11.7.6 Use resources to determine meaning of technical and specialized vocabulary

IR.12.7.3 Use print and electronic sources, such as card catalogs and computer databases, to locate information

IR.12.7.7 Develop notes that include main topics, details, summaries, and paraphrasing from multiple types of sources

IR.12.7.9 Use research to create one or more oral, written, or visual presentations /products

Mathematics

7th Grade

M.12.7.1 Understand, select and use the appropriate units and tools (metric and customary) to measure length, weight, mass and volume to the required degree of accuracy for real world problems

Science

7th Grade

NS.1.7.1 Interpret evidence based on observations

PS 5.7.5 Demonstrate techniques for forming and separating mixtures: mixing, magnetic attraction, evaporation, filtration, chromatography, settling.

PS 5.7.6 Classify substances as elements, compounds, mixtures.

Problem Question

How is water from Beaver Lake made safe for drinking?

BACKGROUND INFORMATION

- Water is such a good solvent that it is known as the universal solvent. It picks up all kinds of contaminants causing water in nature to often not be clean and safe enough for people to drink.
- Our drinking water comes from both surface and groundwater. Water in lakes, rivers, and swamps contains impurities that may make it look and smell bad.
- Water may contain harmful chemicals, bacteria and other organisms that can cause disease even though it looks clean. In the United States today, waterborne diseases are no longer a health threat because of our water treatment systems. In many other countries, this is not the case.
- At the water treatment laboratories, technicians test water to insure that our drinking water supply is free of disease-causing bacteria. These test results are reported to state and local governments.
- Our drinking water supply is made safe and in good supply by cooperation among state, local, and federal governments and the Beaver Water District. It takes the efforts of both federal and state governments, as well as local water supply systems to keep our drinking water safe and in good supply.
- The Safe Drinking Water Act and its amendments set the standards for public drinking water. The Environmental Protection Agency administers these standards.
- **Use the Power Point “Making It Safe the Water Way” written by Beaver Water District. Download from the Beaver Water District website at www.bwdh2o.org.**
- The process of water treatment cleans water and makes it safe for people to drink.

The Beaver Water District treatment plants clean and maintain the quality of drinking water by taking it through the following processes: (1) rapid mix, (2) coagulation/flocculation, (3) sedimentation, (4) filtration, and (5) disinfection.

Keywords

Coagulation: Adding chemicals that cause the dirt and other particles to clump together.

Flocculation: Process using gentle stirring to bring suspended particles together to form larger particles (floc) that will settle out.

Sedimentation: The heavier clumps settle to the bottom (based on density).

Filtration: The substance (water) is poured through a filtering system (made of layers of materials) designed to trap the contaminants that did not settle out during sedimentation.

Disinfection: Chlorine is added to the water to kill germs that may cause disease.

Timeline

Days 1 and 2: Elicit student background and teacher introduces the history of water treatment, careers in water treatment, and the water treatment process.

Day 3: Field trip to Beaver Water District to research their topic(s) (water treatment and its local history and careers)

4 additional days to finish the water treatment portion of the project including explore, explain, elaborate, and evaluate

Materials

4 L water
 600 mL soil or mud
 overhead transparency
 2 plastic pitchers
 3 2-Liter plastic bottles (or 2 bottles and a beaker)
 funnel
 scissors
 30 mL alum
 30 mL of bleach
 500 mL fine sand
 500 mL coarse sand
 250 mL fine gravel
 250 mL coarse gravel
 250 mL activated charcoal
 2 cotton balls for plug
 coffee filter
 rubber band
 tap water
 tablespoon
 splash goggles
 stopwatch

Teacher Preparation

Set up the field trip visit so that (rotating) student groups may have BWD personnel tell about their careers and the water treatment process. Also, arrange for (rotating) student groups to observe and take notes about the treatment process using the model at BWD. If a field trip is not possible, try to set up guest speakers.

Gather materials that will be needed.

Prepare “dirty water”; add approximately 2 1/2 cups (600 mL) of soil or mud to 1 gallon (4 L) of water.

Prepare instruction sheets and other handouts as needed.

Decide procedure for selecting student teams. (Each team of 4-5 students will be responsible to divide the work evenly by possibly having smaller subgroups as they collaborate to build a water treatment model.)

Additional Resources

Resources for materials not included:

UA Center for Math & Science Education

<http://www.uark.edu/~k12info/>

479.575.3875

Northwest Arkansas Education Co-Op

<http://starfish.k12.ar.us/web/>

479.267.7450

Beaver Water District

www.bwdh2o.org

479.717.3807

Know of other resources? Please let us know!

education@bwdh2o.org or 479.756.3651

7E's The Water Treatment Process

Elicit

Brainstorm: Ask the students the following questions and have them record their answers on the board or a poster, etc.

- How did you use water today? Students list charted on board.
- Where does the water for Fayetteville/Springdale/Rogers/Bentonville come from?
- Is your water clean and safe? How do you know?

Engage

Students participate in the interactive tour of a water facility at the EPA website:

<http://www.epa.gov/safewater/watertreatmentplant/flash/index.html>

This may be done as a whole class, as student teams at one computer, or as individuals in the computer lab.

And/or <http://streaming.discoveryeducation.com/> (free to Arkansas teachers). Have students view the 5-minute video “A Natural Focus with Laurie Sanders: Water Quality” and as a class answer the quiz questions (available for teacher to download and/or print at the same website).

Explore

The activity procedure may be done in any of the following groupings:

- whole class project (4 teams)
- demonstration set up at each end of classroom (2 groups of 4 teams each)
- each group of 4-5 students does the entire activity (if time and materials allow)

Safety

All participants should wear **splash goggles** during their part of the demonstration.

1. **Coagulation Team demonstrates to class:**

- a. Pour the water into a 2-liter bottle with the top cut off or a large beaker.
- b. Add 30 mL of alum to the water.
- c. Stir the mixture slowly for 5 minutes.
- d. During this time, students predict outcome and record observations.

2. **Flocculation/Sedimentation Team demonstrates to class:**

- a. Let the water stand undisturbed for about 20 minutes.
- b. Set the stopwatch to sound at 5 minute intervals.
- c. All students observe and record changes at each 5-minute interval.

3. **Filtration Team demonstrates to class:**

- a. Construct a filter from the bottle with its bottom cut off as follows
 - Place the 2 cotton balls in the original bottle opening.
 - Attach the coffee filter to the outside neck of the bottle using a rubber band.
 - Turn the bottle upside down placing it in a beaker or cut-off bottom of a two liter bottle.

- Pour a layer of pebbles into the bottle - the filter will prevent the pebbles from falling out of the neck.
 - Pour the coarse sand on top of the pebbles.
 - Pour the fine sand on top of the coarse sand.
 - Clean the filter by slowly and carefully pouring through 3 L (or more) of clean tap water. Try not to disturb the top layer of sand as you pour the water.
- b. Pour the top two-thirds of the settled water through the filter, collect the filtered water in the beaker.
 - c. Pour the remaining (one-third bottle) of settled water back into the collection container.
4. **Teacher Disinfection (Chlorination) Technician demonstrates to class:**
- a. Add 30 mL of chlorine (bleach) to the filtered water.
5. **All students** compare the treated and untreated water. Observe (appearance and smell) and record.

This project is a Water Treatment **Simulation**: Therefore, the end product is **not** safe to drink.

Explain

In groups of 3-4 students, list the steps in the water treatment process using and explaining the terms coagulation, flocculation, sedimentation, filtration, and disinfection. Place one term on each of 6 index cards. Write the vocabulary term on one side with the explanation of the term on the back. Take turns placing the cards in order, first using just the fronts of the cards. Then shuffle the cards and place them in order using just the backs of the cards while naming the step as you read the description

Elaborate

You, your family and a few others are shipwrecked on a deserted tropical island. There is a stream of fresh water on the island, but it does not appear to be clean. There are supplies on the boat which has grounded on the island as well. The supplies include food, clothing, and cleaning supplies, as well as, many other items. Write a story explaining how you will provide safe, clean water for your family.

Evaluate

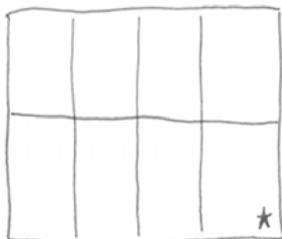
1. Each student constructs a Zine of the steps in the water treatment process. A Zine is an 8 page mini-magaZine. It is constructed from a single 8 _ x 11 sheet of paper and fits in the palm of your hand. (Instructions for folding and cutting follow this lesson.)
2. Students should **illustrate and explain** the process, including each of the following terms; coagulation, flocculation, sedimentation, filtration, and disinfection.
3. True or False and Explain
 - Our community has a safe water supply. *True: Clean, safe, good tasting water is what the Beaver Water District supplies.*
 - There is enough clean water in nearby areas to support all the people living here now and in the future. *True as long as we protect our watershed.*
 - What gets dumped into or taken out of local streams, rivers, and lakes is more important than what happens to the land surrounding the rivers. *False: both are important. What happens on surrounding land (in the watershed) ends up in the local streams, rivers, and lakes.*

Extensions

- **Play Beaver Water District's Watershed Jeopardy Challenge for 7th Grade. Download from the Beaver Water District website at www.bwdh2o.org.**
- Students research methods for converting salt water to fresh water suitable for drinking.

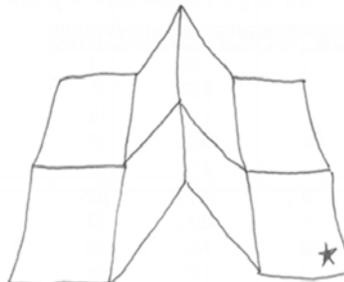
a short guide to folding an eight-page mini zine

- 1** Fold a standard piece of white copy paper (8.5 x 11 inches) into eight even parts like so:



(the little star helps tell you where you are!)

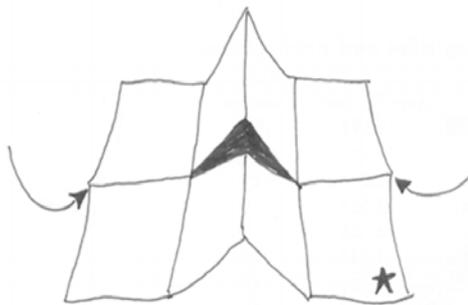
- 2** Now crease those folds so the paper rests like this naturally:



- 3** Now fold the paper in half as below and cut it halfway through so it looks like "4"...



- 4** Place the paper down like so. Now put your index fingers where the arrows are, lifting up while folding the sheet lengthwise over your index fingers...



- 5** During lengthwise folding in step "4" the middle of the sheet should buckle so that it can fold into this form naturally:



- 6** And now you have your eight-page zine! Notice the "starred" page is the front page of the zine. Voila!

