



Water Treatment Lesson 9		Grade 8, Science and Technology
Critical Learning		Guiding Questions
<ul style="list-style-type: none">• Everything we do affects the quality of our water.• Even though aquifers act as natural filters to store water underground, we still have a responsibility to protect the quality of the water that enters the water table.		<ul style="list-style-type: none">• Why do we need to treat water that is going to be used for human use?• How can small changes in our own practices make an impact on water quality both locally and globally?
Curriculum Expectations		
Relating Science and Technology to Society and the Environment 1. assess the impact of human activities and technologies on the sustainability of water resources		Learning Goals Students will be able to:
Developing Investigation and Communication Skills 2. Investigate factors that affect local water quality		<ul style="list-style-type: none">• describe how water is processed, (e.g., filtration) and managed, (e.g., disposal of waste water)• identify the effect of personal actions on local water quality• explain how watersheds relate to water management and planning• explain how human and natural factors can change the water table
2.2 investigate how municipalities process water (e.g., obtain it, test it, and treat it) and manage water (e.g., distribute it, measure consumption, and dispose of waste water)		
2.4 use scientific inquiry/research skills to investigate local water issues		
Instructional Components and Context		
Readiness <ul style="list-style-type: none">• Collaborative skills• Model building• Reliable and accurate observation and recording• Scientific Habits of Mind• Watershed Investigation	Terminology <ul style="list-style-type: none">• Conservation of resources• Environmental impact• Potable• Sustainability	Materials <ul style="list-style-type: none">• Building a Water Filter For each group: <ul style="list-style-type: none">• dirty water in a container with a lid, to be used (1) for filtration device and (2) for aquifer and (3) with a commercial filter• 5 grams alum• stir sticks• clean and empty 600-millilitre (20-ounce) plastic pop bottle• nylon, (e.g., squares of pantyhose)• rubber bands• 50 millilitres each of medium-sized gravel, coarse sand, and fine sand• clean water• clear plastic cups to catch filtered water• microscope and slides (optional)

Minds On (Elicit and Engage)

Whole Class → Linking to Prior Learning

Cue students to practise active listening strategies. Facilitate discussion using question prompts such as:

- Locally, where do we get our water?
- Considering the sources available, where do you want to get your water? Why?
- From which sources of water do you not want to get your water? Why not?

Link back to the watershed investigation, making connections between watersheds and potential dangers to water quality. Pose the following:

- In what ways do people negatively affect local water quality?
- In what ways do you personally have an impact on local water quality?
- How can you as an individual, and we as a community, act as environmentally responsible citizens to support the sustainability of our water resources?

Show a collection of common filters, (e.g., coffee filter, tea ball, furnace filter, aquarium filter, lint filter from dryer). Ask:

- What do these have in common?
- What is their purpose?
- Why do we need them?

Note that filtration is increasingly necessary because of threats to water quality such as pollution. Introduce the terms “freshwater” and “potable.”

Small Groups → Investigating Filtration

Show students a glass of pond water or dirty water. Students suggest how they could filter it to make it suitable for consumption. Display possible materials that could be used, (e.g., cheesecloth, nylons, coffee filters, strainer mesh of varying sizes). Discuss (1) what each filter does and what each does not do, and which combinations might compensate for these limitations, (2) how you might design and construct a support for multiple layers.

Tell students that they will be building and testing water filter models. This time they will approach model building through problem solving, rather than by following directions. Cue students to practise collaborative norms and scientific habits of mind, (e.g., by referring to **anchor charts**).

Action! (Explore and Explain)

Small Groups → Investigating Filtration

Students design, **build**, and test a water filtration device. The purpose of the **investigation** is to determine which materials are most effective in removing pollutants from water.

Students construct hypotheses, track materials tested, record observations in a chart in their Water Portfolio. They save filtered water from each test for the next part of the lesson.

Provide a scale for self-assessing the effectiveness of their device, and informing revisions to the filtration design. Facilitate sharing and discussion of findings, noting patterns.

Small Group → Building an Aquifer Model

Students build and test a model of a natural water treatment process (aquifer) to learn how fine sand, coarse sand, and gravel can filter particulate matter from a water source.

Distribute or have students access online instructions. Students (1) flush the system with clean water in order to remove any dust before testing the aquifer and between tests and (2) save filtered water from each test separately.

Consolidation (Elaborate, Evaluate, Extend)

Small Groups/Whole Group → Comparing Investigation Results

Students use a commercial water filter, (e.g., for jugs of water from a supermarket, to filter the muddy water). Save water separately from filtration and aquifer investigations. Using the scale, they compare the results from all three investigations.

Briefly share results and reasons for them with the whole class. Students select a form, (e.g., journal or chart), with which to add the results of their investigation to their Water Portfolio.

Based on students’ knowledge, they select an extension activity:

- organize a visit to your local or regional water treatment facility, or
- **read/view articles/video or**
- review the water treatment process in your local context

Pause and Ponder

QuickTip

See **Listening Guide** for active listening strategies. Teach these explicitly. Review norms for collaborative work, (e.g., by referring to anchor charts). Provide feedback on collaborative learning skills throughout the lesson.

A for L Observe (1) students’ technological problem-solving process, providing guidance with respect to critical steps in the process, (e.g., listing multiple solutions and choosing the most viable), and (2) the investigation, providing oral feedback on the ideas for building, testing, and refining the filters. See the **Technological Problem Solving Skills Continuum**, pp. 16-18, for a technological problem solving skills continuum. The continuum describes the development of skills such as making a plan for a design solution, and testing the model.

A for L Provide feedback on ideas for building, testing, and refining the filters, and on the technological problem-solving process. See the **Technological Problem Solving Skills Continuum**, pp. 16-18. The continuum describes the development of skills such as making a plan for a design solution, and testing the model.

A for L Note individual student’s ability to provide local and logical reasons for the differences noted in the water samples. Use this information to inform instructional planning.



Minds On

Anchor Charts

An anchor chart is a strategy for capturing students' voices and thinking. Anchor charts are co-constructed. By making students' thinking visible and public, they "anchor," or stabilize and scaffold classroom learning. Anchor charts should be developmentally appropriate and clearly focused, accessible, and organized.

Filtration Investigation

This filtration investigation has been adapted from **TryEngineering**.

Purpose

To determine which materials are most effective in removing pollutants from water:

Guidelines

1. Describe the water prior to filtering.
2. Describe what happens to the contaminant after filtering the water.
3. Describe the water using qualitative observations, (e.g., sight and smell, after filtering with various materials).
4. Decide whether any of the water samples are suitable to drink. Explain the reasons for your decisions.

Sample Image Link. Meredith Cargill, **Water Across The Curriculum**. *Teaching Green: The Middle Years*. pp. 102-106.

Action!

Investigation

Filtration Systems

Filtration systems are important for providing safe drinking water. The simplest way to "filter" is to pass a mixture or solution (such as water and dirt or mud) through a porous material or system so that the solids are trapped and the fluid passes through. The size of the openings in the filtering materials -- even microscopic -- will determine how much of the particles will make it through.

Some filtration materials include paper, sand, cloth, charcoal, and rocks.

Often staged filters are employed where a liquid, for example, might pass through a series of different filters. In this case, sometimes the first filter will eliminate larger particles, while the second, third, or fourth filter will eliminate smaller and smaller particles or sediment.

Building a Water Filter.

Instructions

This investigation is adapted from pages 3-4 on this web site: Meredith Cargill, **Water Across The Curriculum**. *Teaching Green: The Middle Years*. pp. 102-106.

Consolidation

Articles/Video

- Clips from **Crapshoot: The Gamble with Our Wastes**.
- Preview and select portions from the following articles, **From Sea to Stinking Sea** (Oct. 17, 2005), **Why Victoria still doesn't treat sewage** (July 9, 2008)

Building a Water Filter

Materials

- Bowls or small basins
- Supply of “muddied water” which can be made by taking a quart of drinking water and adding two tablespoons of dirt.

For each group of students:

- two cups of “muddied water”
- plastic or paper cups
- straws
- cardboard
- cotton balls
- sand
- aluminum foil
- rubber bands
- tape,
- toothpicks
- paper towels
- plastic wrap
- aquarium or other small rocks,
- cornmeal
- flour
- tape
- grass or charcoal, if available

Students work as a team to design and build a filtration system to remove as much dirt or sediment from the provided water sample, as possible. Suggest to teams that commercial filters often use many filtration stages or different layers of filters to achieve the desired results.

Student teams draw their plan for the filtration system, including a list of all materials they require. When construction is complete, students test their device using the muddy water sample provided. They record their observations.

Filtered water can be collected in small bowls or basins, and assessed on a scale such as:

Completely clear	About 25% of the dirt remains	About 50% of the dirt remains	About 75% of the dirt remains	No change from the original water

Note: Stress that the “filtered” water, no matter how clear, is not suitable for drinking.