**Water Pollution**

**Title:** Create your own Water Filter

**Grade Level:** 9-12

**Subject/Content:** Earth and Space Science

**Summary of Lesson:** Students will learn how different types of substances must be filtered out of water using different techniques. Students will build a water filter that can filter out multiple types of pollutants and result in clean water that the students can drink.

**Focus Question:** How can pollutants be filtered out of water?

**Resource:** *Science in Context*

**Procedures:**

**Steps/Activities by the Teacher:**

- Before class starts, create a bucket of ‘dirty water’ using non-toxic substances like clean water, sterile soil, vegetable oil, and fine sand/silt. The ingredients and relative amounts are up to teacher discretion and can be modified based on availability.
- Direct students to research magazine articles in *Science in Context* that pertain to the water quality in different countries around the world. Have students write a summary about each article that they read (a minimum of three).
- Lead a discussion about where the local drinking water comes from and compare that to sources of bottled water. Both sources usually begin in aquifers that are deep underground where the water has been naturally filtered through the soil.
- Explain to students that they will be making a water filter from materials mostly found in nature.
- Direct students to make the following data table on their paper:

<table>
<thead>
<tr>
<th></th>
<th>No Filter</th>
<th>Holes Only</th>
<th>Gravel</th>
<th>Sand</th>
<th>Activated Charcoal</th>
<th>Coffee Filter</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Observations</strong>&lt;br&gt;<em>(Color, turbidity, etc)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Direct students to follow the procedure below:
  - Poke small holes in the bottom of a paper cup. This is now your filter.
  - Obtain a cup of the ‘dirty water’ that your teacher has provided you and record your observations of this water in the ‘No Filter’ column of your data table.
• Make sure that you have a container below your filter to catch the filtered water.
• Pour the dirty water into your filter.
• After waiting for at least half of the dirty water to filter through the holes, record your observations under the ‘Holes Only’ column in your data table. Make sure to also compare this newly filtered water to the water before filtering and note any differences.
• Add 2cm in height of gravel into your filter.
• Run the same dirty water through the filter again and record the results on your data table.
• Add sand to your filter up until 6cm from the top of the filter cup.
• Run the same dirty water through the filter again and record the results on your data table.
• Add the activated charcoal up to 2cm of the brim of the filter cup. Fill in any gaps with more sand.
• Run the same dirty water through the filter again and record the results on your data table.
• Use a rubber band to add a coffee filter to the bottom of the filter cup.
• Run the same dirty water through the filter again and record the results on your data table.

• If you feel confident that your ‘dirty water’ has been filtered enough then you may choose to have students sip a very small sample of their water.
• Direct students to write a conclusion paragraph about their experiment. Students should focus on writing about the following topics:
  o Which filters filtered the soil the best?
  o What types of substances were filtered out by each filter?
  o Did you trust your filter enough to drink your water? Why or why not?
  o How does your filter compare to the filtering methods in your local area?
  o How does your filter compare to the filtering methods used in other countries of the world? (use your research)

**Steps/Activities by Student(s):**

• Access *Science in Context* and locate at least three magazine articles that discuss water quality in other countries.
• Write a summary paragraph about each article which gives an overview of all key points that the article addresses.
• Make the following data table on your paper:

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<thead>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
When directed by your teacher, follow the procedure below:

- Poke small holes in the bottom of a paper cup. This is now your filter.
- Obtain a cup of the ‘dirty water’ that your teacher has provided you and record your observations of this water in the ‘No Filter’ column of your data table.
- Make sure that you have a container below your filter to catch the filtered water.
- Pour the dirty water into your filter.
- After waiting for at least half of the dirty water to filter through the holes, record your observations under the ‘Holes Only’ column in your data table. Make sure to also compare this newly filtered water to the water before filtering and note any differences.
- Add 2cm in height of gravel into your filter.
- Run the same dirty water through the filter again and record the results on your data table.
- Add sand to your filter up until 6cm from the top of the filter cup.
- Run the same dirty water through the filter again and record the results on your data table.
- Add the activated charcoal up to 2cm of the brim of the filter cup. Fill in any gaps with more sand.
- Run the same dirty water through the filter again and record the results on your data table.
- Use a rubber band to add a coffee filter to the bottom of the filter cup.
- Run the same dirty water through the filter again and record the results on your data table.
- Wait for instructions from your teacher.

Write a conclusion paragraph about this project. Make sure to answer the following questions in your paragraph:

- Which filters filtered the soil the best?
- What types of substances were filtered out by each filter?
- Did you trust your filter enough to drink your water? Why or why not?
- How does your filter compare to the filtering methods in your local area?
- How does your filter compare to the filtering methods used in other countries of the world? (use your research)

Outcome: Students will have an understanding of how water is purified and contaminants are removed. Students will understand how different substances have different properties that allow them to remove different contaminants. Students will learn about the status of water purification in different parts of the world.

Related Activities:

Global Studies

- Direct students to research one area of the world and analyze how that area deals with the unique challenges presented around water purification. Students should also research how water issues have impacted the history of
Biology

- Have students take a sample of pond water and look at some of the protists that it contains. Direct students to pick a pathogenic protist to research and have them make a presentation to educate the class about their protist.

Learning Expectation: Students will use their research skills to find relevant information about water purification. Students will use skills in conducting a detailed procedure in order to complete the project.

Standards Alignment

Next Generation Science Standards

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

LS2.C.2. Moreover, anthropogenic changes (induced by human activity) in the environment, including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change, can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7)

ETS1.A.2. Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)


Common Core State Standards

Grades 9-10

CCSS.ELA-Literacy.RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

CCSS.ELA-Literacy.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks attending to special cases or exceptions defined in the text.

CCSS.ELA-Literacy.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
CCSS.ELA-Literacy.RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

CCSS.ELA-Literacy.RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

CCSS.ELA-Literacy.WHST.9-10.1 Write arguments focused on discipline-specific content.

CCSS.ELA-Literacy.WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

**Grades 11-12**

CCSS.ELA-Literacy.RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

CCSS.ELA-Literacy.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

CCSS.ELA-Literacy.RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

CCSS.ELA-Literacy.RST.11-12.10 By the end of grade 12, read and comprehend science/technical texts in the grades 11-12 text complexity band independently and proficiently.

CCSS.ELA-Literacy.WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

**Standard Source:** Common Core State Standards Initiative (2010)