EDUCATIONAL OUTREACH
FLORIDA POLYTECHNIC UNIVERSITY

SUSTAINABLE WATER FILTER

Reduce the turbidity of a polluted water sample

Overview: What is sustainability?
There is no universally agreed definition on what sustainability means. There are many different views on what it is and how it can be achieved. The idea of sustainability stems from the concept of sustainable development which became common language at the World's first Earth Summit in Rio in 1992. Sustainability draws on politics, economics and, philosophy and other social sciences as well as the hard sciences. The quality of not being harmful to the environment or depleting natural resources, and thereby supporting long-term ecological balance.

Environmental engineering is the branch of engineering concerned with the application of scientific and engineering principles for protection of human populations from the effects of adverse environmental factors; protection of environments, both local and global, from potentially deleterious effects of natural and human activities; and improvement of environmental quality. Environmental engineering can also be described as a branch of applied science and technology that addresses the issues of energy preservation, protection of assets and control of waste from human and animal activities. Furthermore, it is concerned with finding plausible solutions in the field of public health, such as waterborne diseases, implementing laws which promote adequate sanitation in urban, rural and recreational areas. It involves wastewater management, air pollution control, recycling, waste disposal, radiation protection, industrial hygiene, animal agriculture, environmental sustainability, public health and environmental engineering law. It also includes studies on the environmental impact of proposed construction projects.

Water Filtration Activity

Pollution is a problem all people deal with on a daily basis. Environmental engineers design water filters. In addition to designing systems that clean water, they also design systems to clean land and air to protect the environment around us.

Water quality is an assessment of how dirty or clean water is by the characteristics such as dissolved oxygen content or pH among several other criteria. This activity will evaluate water quality based on **turbidity**; the cloudiness or haziness of a fluid caused by small particles that are generally, though not always, invisible to the naked eye.

Objectives

Understand what an environmental engineer does

Explain the process involved in water filtration

Successfully build a sturdy water filter

Reduce the turbidity of a given water sample

Materials

For Building:

coffee filters	cotton balls	netting	bug screen
PVC pipes	rocks	beans	aquarium rocks
panty hose	paper towels	cheesecloth	charcoal filter (fish tank)
cotton material	PVC pipe	assorted cups with bottom cut out	
masking tape	rubber band	String	various adhesive

***any household items you can find that can be reused

For Testing:

Contaminated water sample

Clear cup with a mouth wide enough for filter to sit on

Turbidity testing kit

Vernier Turbidity sensor (optional)

Gallon distilled water

Procedure

1. First, observe the materials that are available to build your water filter

2. Make sure you don't have any building constraints (ex- can only used 4 items, minimum/maximum selection of each item, etc.)

3. Plan
Make a list of materials you would like to build your filter with:

_____

_____

_____

_____

_____

_____

4. Make a sketch of your structure and label:

5. Construct- Using the engineering process, create a water filter with materials provided on the table. Your structure should be a device able to hold water so that it can be filtered.

Remember, the goal is to reduce the turbidity of the water sample.

Test

1. Check water filter for sturdiness. All parts should be attached. Water filter should be able to fit on the clear cup without assistance.

2. Pour approximately 1 cup of the pollute sample through your water filter as seen in figure 1.

3. Allow water sample to filter through to the clear cup
*Note- there is not a time limit, but keep in mind, efficiency should be an overall factor in the real-world

4. Make observations. Can you determine if you've reduced the turbidity with the naked eye (figure 2)?

5. Record your findings.

Group Number:	Reduce Turbidity (Y/N)
Visible change to the naked eye	
Other method of testing (NTU)	

6. Compare your results to your classmates.

7. Compare the materials and design of your classmates' filter.

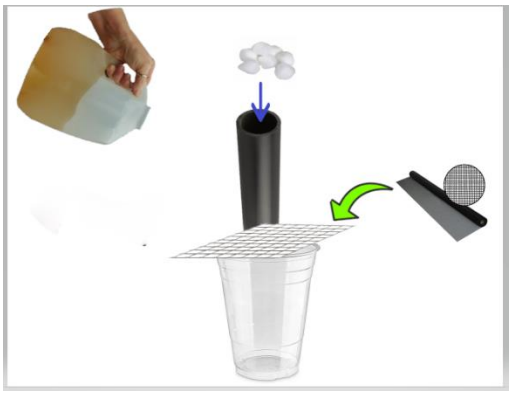

Figure 1: Example-In the diagram the student has attached a piece of plastic screen to the bottom of a PVC pipe. Cotton balls were placed inside the PVC pipe. The water filter is placed or held over the clear cup. The polluted water sample is then poured into the water filter, with the filtered sample running into the clear cup.

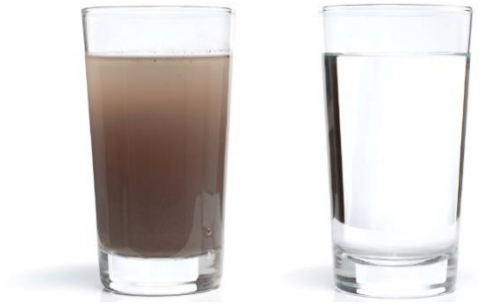

Figure 2: Example- A sample of the polluted water (left) can be compared to the filtered water sample (right) to determine with the naked eye if the turbidity of the sample has been reduced.

Analyze

1. How could you re-arrange the materials you used to make a new functioning object?
2. Compare the design of multiple classmates. What are the strengths and weaknesses?
3. How can your design be improved?
4. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
5. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
6. Evaluate a solution to a related complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability and aesthetics as well as possible social, cultural and environmental impacts.

Additional Information

1. The materials list is a suggestion. The idea is to find readily available materials that are sustainable and can be reused. Not only are the students improving water quality, they are finding a new use for items that would most likely end of as landfill waste.

2. Depending on the materials you have on hand or the age of the students, you can impose constraints. These constraints can be limiting the number of materials allowed to use overall, limit the amount of a single material (limited resource), allow them a "free" item like tape or rubber band. Be as creative as you would like to apply more class concepts.

3. The water sample can be collected from a local waterway. If not accessible, a cup of local soil mixed with tap water in a gallon jug can be used as a substitute.

4. To test turbidity… Have students test with the naked eye. Have them visually compare their sample to the original water sample by holding their cup up against a white sheet of paper and compare it to a cup of the original sample against a white sheet of paper.

Chemical tests can be purchased from a lab supply company

The Education Outreach Department uses a turbidity sensor from Vernier. This sensor measures the turbidity of fresh-water or seawater samples in NTU (Nephelometric Turbidity Units, the standard unit used by most water collection agencies and organizations). The distilled water will be needed to rinse the sample bottle between each test.

Extensions

1. Filter the sample a second time. Pour your already filtered sample through the water filter for a second time to see if your filter is able to reduce the turbidity even more.

2. Continue with the engineering design process. Have the students modify their design, allowing the use of one to two additional materials. Retest with the polluted water sample and compare results.

3. Test additional water quality factors, especially if you purchased a water quality testing kit that tests multiple variables. Have students research methods in which to remove pollutants that cannot be physically removed. This is also a good time to discuss point and non-point pollution, eutrophication and more.

Thank you for downloading this lesson, please take a moment to complete our survey