Make Your Own Water Filter Activity Guide

Activity Provided Courtesy of Techbridge
(http://www.techbridgegirls.org)

Grade Level: 5-12

Activity Time: 60-90 minutes

Preparation Time: 15 minutes

Grouping: 2-3 youth per group

Objectives:

- To practice the design process that scientists and engineers do
- To increase ability to predict, observe, question, design and redesign
- To better articulate how engineers can help make the world a better place

Materials:

For the discussion:

1. Handout – Water Filter Design Notes

To make the water filters:

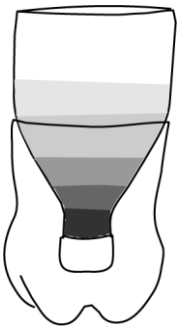
1. 2 liter plastic soda bottles
2. Gravel
3. Sand
4. Sponges
5. Paper coffee filters

6. Paper clips
7. Straws
8. Cotton balls
9. Rubber bands
10. Tape (electrical or duct)
11. Panty hose
12. Clay or putty
13. Cotton batting
14. Cheesecloth, mesh, or some other fabric with large porous holes
15. Scissors

To make the dirty water:

1. A large clear bucket filled with water
2. Food coloring or soy sauce (to represent chemicals)
3. Raisins or dried beans (to represent animal/human waste)
4. Potting soil (to represent the earth)
5. Baking soda (to represent road salt)
6. Cooking oil (to represent motor oil)
7. Torn pieces of paper & Styrofoam (to represent litter)

Before the session:



Depending on the age of the youth or the time allowed for the activity, you may need to prepare the soda bottles in advance, having them cut for each group as shown at right.

For Step 1, label three areas of the room each A, B or C using the pages later in this document.

Hang a poster of the engineering design process on the wall or reproduce the cycle on the whiteboard. Use the example in the Facilitator Resource Guide.

Directions:

Step	Activity	Tips for Implementation
1	Point out the station labels A, B and C to the youth. Explain that they will be making decisions and going to those stations. Read each of the questions in the Water Facts Facilitator Resource and ask the youth to indicate their answer by going to the station.	These questions help introduce the context for the activity and make filtering water a real world issue the youth can understand. Determine how many of the questions you might ask based on the interest level of the youth. When asking them to choose which station the youth go to, A, B or C, emphasize that it is okay if their choice is just a guess and they make a choice no one else has made. Encourage them to take risks, listen and think for themselves.
2	Explain that today the youth will be engineers, designing a water filter to make clean water. Point out the bucket of dirty water the youth will be cleaning with their filters. Walk through the engineering design process using the poster on the wall or drawing on the whiteboard. Ask the youth to explain each step. What is brainstorming? Design, what does that mean?	Encourage the youth to ask one another if they do not know an answer. As they are answering, ask the respondents to share examples of when they have used each skill. The facilitator might want to create a story about how the water became polluted along the way as it rained, hit the ground, ran along the street, gathered the oil and dirt and add one ingredient at a time. Prepare the polluted water in front of the youth, explaining what each material represents or asking them what they think it could represent as you pollute the water they will

Step	Activity	Tips for Implementation
		use. The clear bucket enables them to see what is happening to the water as each pollutant is added.
3	Divide the youth into groups of two or three. Explain that they have a variety of different materials to choose from in building their filters. Pass some of the materials around the room. Have the youth examine each item and identify its properties. Handout the Water Filter Design Notes sheet to each team. Ask the team to begin by identifying the problem they are addressing today and record it on their worksheet.	Encouraging the youth to look at the materials, touch them and talk as a group about what they might use gives them a chance to observe and begin to predict.
4	Distribute the bottle tops and bottoms. Demonstrate inverting the top so the bottom can collect the filtered water.	If they haven't been cut already, provide instructions for cutting the bottle into two pieces.
5	Instruct the youth to begin brainstorming. Encourage them to sketch their ideas and clearly label their sketches. Remind the youth that their focus should be on generating ideas. They will not be able to use the materials during this stage.	Encourage youth to use their handout to record their design ideas and select one solution to build. Walk around as the youth are drawing their designs and ask them questions that helps them further think about the materials, the design, the order of materials and predicting what will happen. As appropriate sit with a

Step	Activity	Tips for Implementation
		team and asks a few questions as it fits in their flow of work. ▪ How will you work with your team to decide how to make your filter? ▪ How are you going to make your filter? ▪ How will you choose the materials? ▪ What do you think will happen?
	Give the youth a short period of time to select the design they want to test.	Remind youth that engineers have to try many designs before finding one that is successful.
6	Give each group about 30 minutes to build their filters. Encourage them to keep track of any changes or improvements they make to their original design.	During construction, float around the room and ask questions that encourage youth to share what is happening as they work ▪ Do certain materials work better than others? ▪ Does a certain order of layers work better than others? ▪ Tell me more about why you chose to use this material. ▪ What made you choose one material over the other choices? ▪ What materials are NOT getting filtered out of the water? ▪ What made you decide design your filter this way? How do you think it is going to work?

Step	Activity	Tips for Implementation
7	If time permits, have each group test their filter one at a time in front of the whole group. If you are short on time, have each group share their prediction, then let all test their design at the same time.	Ask each group for a prediction before testing. ▪ What do you think will happen when the water is poured through? ▪ How are you going to adjust your design for the next test? ▪ What happened? ▪ Why do you think it happened? Support mistakes: ▪ That didn't work, why do you think that happened? ▪ How might you adjust your design?
8	If time permits, allow the youth time to redesign their filters based on the results of testing.	Encourage students to build off of each other's ideas and use the knowledge they gained from the first trial. Their brainstormed ideas that were not tested may also be important as they redesign. Explain how in engineering it takes many different ideas to create one great product. Remind them to record their redesign ideas on their handout.
9	Reflection can be led effectively in a variety of ways. It is important each youth gets an opportunity to process and apply. The culture of your group should be an important factor in deciding your strategy. You may:	**What?** Youth describe what happened from their own perspective. ▪ How did you adjust your design? ▪ Was your water filter successful? Why or why not?

Step	Activity	Tips for Implementation
	▪ Ask youth to write responses on a piece of paper or in a journal. ▪ Ask youth to discuss questions in a small group (3-4 youth). ▪ Lead a discussion with the whole group. **Always take time for questions that help youth reflect on what they have learned.**	**So What?** Youth make sense of their experience and connect it to other experiences. ▪ What steps did you use that were similar to what anyone designing a solution might do? ▪ Where else do you think design can be done? What about an iPad, and iPhone, a toy, etc.? ▪ What is one thing you would share with a friend or with your family about what you did here today with your water filter? **Now What?** Youth think about what this learning has to do with them and their everyday experiences. ▪ How can you use the Engineering Design Process to solve problems at home? At school? ▪ What parts of the Engineering Design Process do you do best? What makes you good at that? ▪ How could engineers use what we learned here today to make the world better?

Resource Guide

Water Facts

1. Ask the youth what they think the "developing" world means. As they come up with their suggestions make sure they are clear that people tend to use this term for countries that are less developed, that have a lower economic base, etc. The average person in the developing world uses 2.6 gallons of water each day for drinking, washing and cooking. *(Be sure to make the connection w/ youth as to how much this is in terms they can visualize easily ~ 2 and a half jugs of milk.)* North Americans *(like us)* use an average of ____ gallons every day.

    a. 26 *(10X amount used daily by those living in the developing world)*

    b. 53 *(Amount average European uses)*

    c. 106! *(answer - Amount average North American uses)*

    Have youth share out ways we use water in our daily lives, why is our # so high? You could then tie in a Q about how we could reduce our water consumption either here or at the end of the lesson, with ideas for how they can help to solve the clean water shortage problem overall.

2. 884 million people in the world do not have access to safe water. This is roughly ___in ___ of the world's population.

    a. 1 in 2

    b. 1 in 8 (answer)

    c. 1 in 10

    You may want to describe what this means, if there are 16 people in the room, if they were from all over the world 2 of them would have access to clean drinking water, you could even pull 2 names at random from a hat and say something like- "I'm sorry but you

two are from a place where clean drinking water is inaccessible…" or have some sort of larger discussion around this point and just how many people that really is.

3. Households in rural Africa spend an average of ___% of their time fetching water, and it is generally women and girls who are burdened with this task.

    a. 10%

    b. 15%

    c. 26% (answer)

    You may want to discuss how many hours this translates to... ~ 6 hrs. a day- that would be working/ walking and fetching from 10-4pm straight... no school, etc... How do the girls think they may feel if this task fell to them?

4. The weight of water that women in Africa and Asia carry on their heads is commonly ___ lbs.

    a. 45 lbs. (answer)

    b. 30 lbs.

    c. 10 lbs.

    You may want to discuss how this may be 1/2 of one of the student's body weight...

5. The simple act of washing hands with soap and water can reduce diarrheal disease by over ___%.

    a. 30%

    b. 40% (answer)

    c. 50%

    You may want to point out that clean water access can reduce the # of deaths caused by diarrheal diseases by an average of 65%.

Station

A

ONLINE, ON TARGET PROFESSIONAL
DEVELOPMENT RESOURCES FOR
OUT OF SCHOOL TIME PROVIDERS

CLICK 2 SCIENCE pd

Station

B

ONLINE, ON TARGET PROFESSIONAL
DEVELOPMENT RESOURCES FOR
OUT OF SCHOOL TIME PROVIDERS

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Station C

ONLINE, ON TARGET PROFESSIONAL DEVELOPMENT RESOURCES FOR OUT OF SCHOOL TIME PROVIDERS

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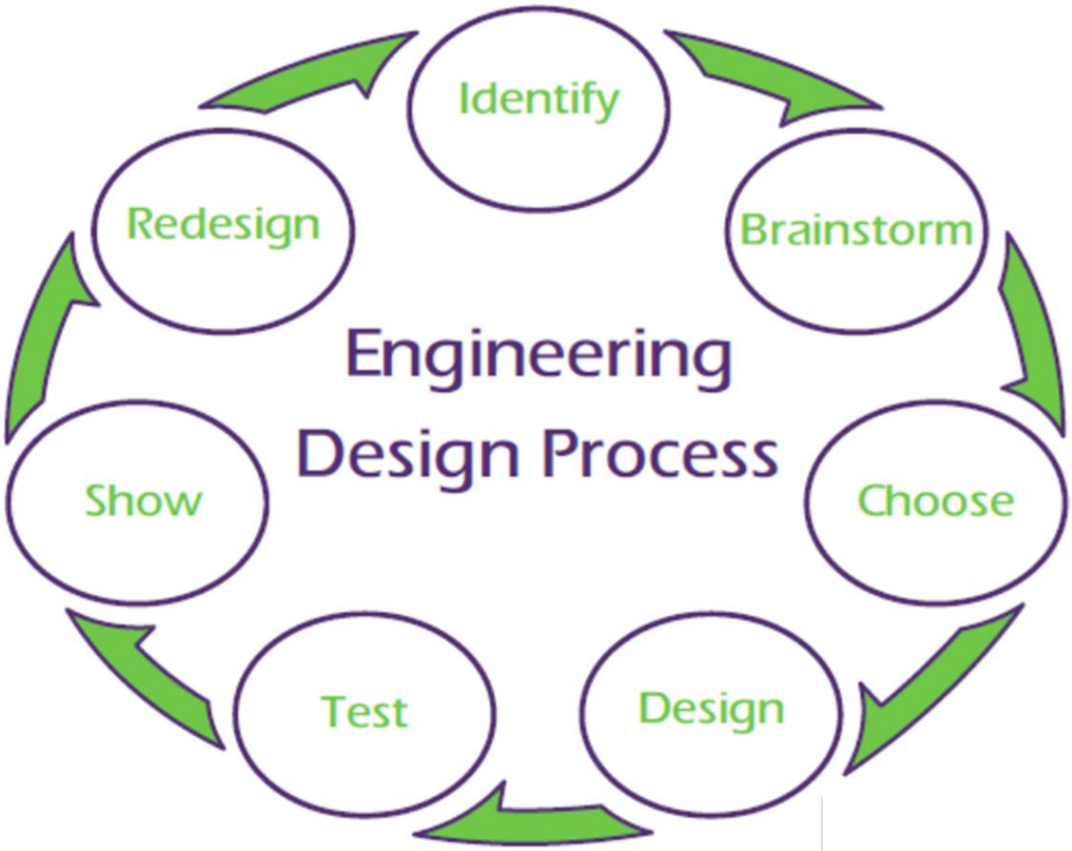
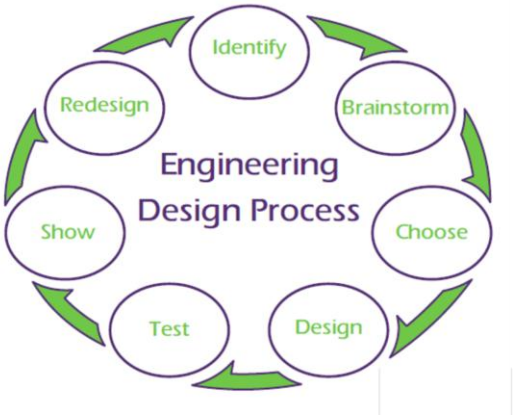
Engineering Design Process



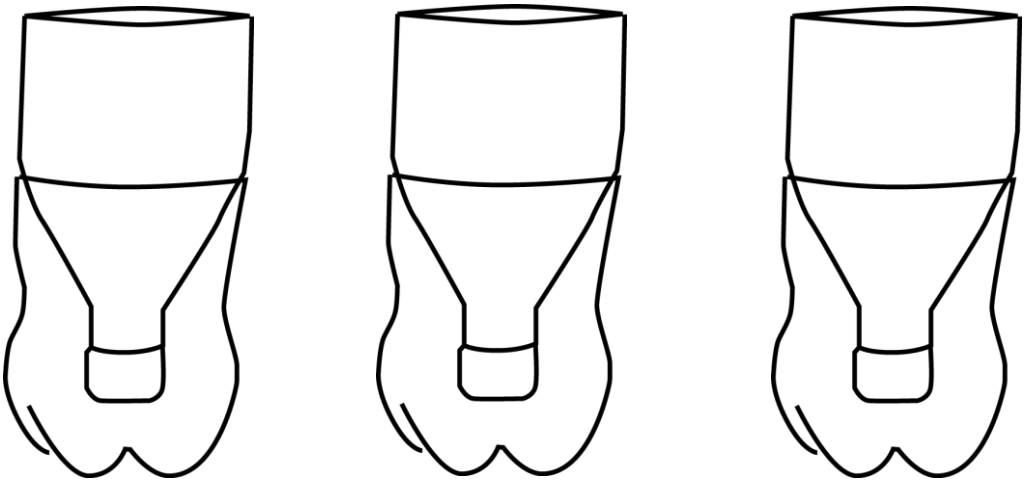
Water Filter Design Notes Names: _____



Use the engineering design process to help you engineer the water filter. Use this worksheet to record notes, make sketches and evaluate success

1. Identify the problem you are solving.

2. Brainstorm solutions. Label well.



3. Which solution did you choose? Why?

4. What happened when you tested your design? Is the water clear? What was successful about your design? What needs improvement?

5. Sketch your final design.

6. What improvements did you make in the redesign? What did you keep the same?

7. What is one thing you would share with a friend or with your family about what you did here today with your water filter?