

Activity 5 Improve a Process

Overview:

Youth will *improve* their water reuse processes to better meet the criteria for their extreme environment.

Note to Educator:

Lead this activity in a room with a sink for easy cleanup. Have paper towels on hand in case of spills. The pH strips may stain the tabletop, so place used strips on a paper towel. Encourage groups to focus on *improving* their processes. Make sure to provide encouragement and reinforce their identities as successful engineers. **Be sure to save any materials that can be reused, the water samples, and groups' designs for the next activity.**

Activity Timing

| | |
|---------------|--------|
| Introduction: | 5 min |
| Plan: | 5 min |
| Improve: | 35 min |
| Reflect: | 10 min |

55 min

21st Century Skill Highlight

Critical Thinking
Collaboration

Activity 5 Materials

For the whole group

- Engineering Design Process* poster
- Extreme Environments* chart from Activity 4
- Remaining materials from Activity 4
- 1 measuring cup, 1/4 cup
- 1 roll of masking tape
- 1 roll of paper towels
- 1 strainer
- 2 tablespoons
- 8 craft sticks
- 8 jars, 1/2 gallon, with water samples
- 35 sheets of copy paper
- optional: 1 roll of plastic wrap

For each group of 3

- 1 foil tray, 12" x 12"
- 1 packet of pH strips
- 1 pair of scissors
- 1 permanent marker
- 1 Secchi disk
- 1 set of *Water Reuse Plan* cards

For each youth

- Engineering Notebook

Activity 5 Materials Preparation (20 min)

1. Post the *Engineering Design Process* poster.
2. Post the *Extreme Environments* chart from Activity 4 for youth to reference in this activity.
3. Create a Materials Store with the materials remaining from Activity 4.



Activity 5 Materials Preparation (continued)

4. Make copies of the Engineering Showcase invitations, p. 59 in this guide, for youth to share with family and friends.
5. Optional: Prepare more water samples in the jars using the recipes on *Water Samples for Final Challenge*, p. 52 in this guide.
6. Optional: Make a new copy of the *Water Reuse Plan* cards, p. 53 in this guide, if the first copies were damaged by water.

Notebook Pages for Activity 5

Cost Sheet, p. 17

Cost Sheet
Activity **5**

Use this page to determine which filter materials you can use without going over budget.

| Extreme Environment | Budget |
|--------------------------------|--------|
| 1. Eco-Friendly Home | \$125 |
| 2. Mars Habitat | \$250 |
| 3. Floating Research Lab | \$250 |
| 4. International Space Station | \$325 |

| Materials List | | | |
|--------------------------|------|---------------|------------|
| Material | Cost | Number Needed | Total Cost |
| Rubber bands | \$15 | _____ | _____ |
| Paper towel (half sheet) | \$20 | _____ | _____ |
| Cheesecloth (1' x 1') | \$25 | _____ | _____ |
| Cotton ball (1) | \$25 | _____ | _____ |
| Sand (1/4 cup) | \$30 | _____ | _____ |
| Charcoal (2 Tbsp) | \$50 | _____ | _____ |
| Limestone (2 Tbsp) | \$75 | _____ | _____ |
| Grand Total | | | _____ |

Did You Know?
Water filters that help kill germs were invented by NASA in the 1970s. Your dentist now uses that same technology so they don't spray bacteria-filled water into your mouth!

Testing the Waters:
Engineering a Water Reuse Process
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Improving a Process, p. 18

Activity **5**
Improving a Process

Draw a detailed plan for the improvements your group would like to make to your water reuse process. Make sure to label your drawing and keep track of any new materials you use.

| Test | Water Quality (After Filter 1) | | | | Final Water Quality (After Filter 2) | | | | Final Amount of Water |
|------|--------------------------------|-------|----|----------|--------------------------------------|-------|----|----------|-----------------------|
| | Clarity | Color | pH | Optional | Clarity | Color | pH | Optional | |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |

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Youth will learn:

- The *improve* step allows engineers to reflect upon and alter their original designs.

Tip

Remind youth that they can *improve* by lowering the cost of the process, decreasing the amount of materials they use, or by increasing the quality and/or amount of the water they produce for their final product.

Tip

For some youth, the introduction of the budget may be distracting and too challenging. Encourage these youth to improve their designs in other ways. See suggestions above.

Tip

If youth are having trouble *improving* their designs, encourage them to ask another group for advice.

Introduction (5 min)

1. Congratulate youth on their engineering work so far.
2. Have groups volunteer to share their results, discuss problems, or give advice from the last activity. Ask:
 - **Which scenario did you choose and were you able to meet your goal(s)?**
 - **What is working well in your water reuse process?**
 - **Did your design work the way you *imagined* it would?**
 - **What challenges did you encounter?**
 - **How can you rearrange the process to get more water or to *improve* the quality of the water?**
3. Let youth know that today they will *improve* their water reuse process to make it work better and be more cost efficient. Some groups may have thought of ways to *improve* during the last activity. Today, all groups should continue to work on those improvements.
4. Remind youth that the *improve* step is an important part of the Engineering Design Process. Let youth know that they should *test* all the changes they want to make today before they share their final design with visitors in the next activity.

Planning Improvements (5 min)

1. Tell youth that one way to *improve* their process is to make sure it is not too expensive. Explain that each extreme environment now includes a budget as an additional constraint.
2. Youth can find their budget and the costs of materials on *Cost Sheet*, p. 17 in their Engineering Notebooks.
3. Tell groups that they will now *plan* how they will *improve* their process for reusing water. They should use the data they gathered from their tests last time to choose at least one part of their process to *improve*, and account for the budget.
4. Have youth split into the same groups as the last activity.
5. Give groups 5 minutes to record their *improved* designs on *Improving a Process*, p. 18 in their Engineering Notebooks.

Improve (35 min)

1. When groups have completed their *plans*, have them collect

Tip

Groups can refer to p. 6 and p. 8 in their Engineering Notebooks to review the procedures for testing water quality and using a Filter Base.

Tip

Some groups may want to use the charcoal in their processes and let the filter work overnight. Be sure to label their designs, cover them with plastic wrap to prevent evaporation, and store them in an area where the water will not spill.

Sustainability Tip

Consider saving materials for when you teach this activity in the future. Rinse and set aside the limestone, charcoal, filter bases, and aluminum trays. Once dry, store any loose materials in airtight containers.

the materials they need from the Materials Store and begin *improving* their designs.

2. Encourage groups to *test* their designs as they *improve*. Let groups know that they can record new testing data on *Improving a Process*, p. 18 in their Engineering Notebooks.
3. As groups work, rotate among them and ask questions like:
 - **How are you *improving* your design?**
 - **Are your improvements working out the way you thought they would?**
 - **What else can you do to *improve* your design?**
4. As youth finish *testing* and *improving*, congratulate them on their engineering work.
5. Let groups that are still working know when there are 10 and 5 minutes remaining.

Reflect (10 min)

1. Call groups back together and have them gather around the *Engineering Design Process* poster. Ask:
 - **Which steps of the Engineering Design Process did you use as you were engineering your water reuse processes?** *We planned how we wanted to change our design, we created and tested our designs to improve them.*
2. Tell youth that in the next activity, they will prepare a presentation to share their designs and the different ways they used greywater. Ask:
 - **Which steps of the Engineering Design Process do you think you will use to prepare a presentation?** Communicate.
3. Have youth discard used filter materials (except charcoal) and their final water samples, then rinse their Filter Bases and place them in their tray with their *Water Reuse Plan* cards. Have groups relabel their tray if needed.
4. At the end of the session, hand out *Engineering Showcase* invitations for youth to share with family and friends.
5. Save the jars with the water samples and groups' design components in a safe location so youth can share them in the next activity.



You're Invited...

ENGINEERING SHOWCASE



WHERE:

WHEN:

WHAT:

Come support your local water resource engineers as they present a process for reusing water!



