

Engineering Activity 7: The Final Test: Improve a Process

Educator Preview

Activity Snapshot

Learners improve their water reuse processes to better meet the criteria for their environment.



Timing | 45 minutes

Get Ready & Team Up 10 min.
 Improve 25 min.
 Reflect 10 min.
Total 45 min.
Level Up Activities 5–20 min. each



Prep Snapshot*

Prep Time 20 min.

- Space Need: Sink
- Set up Materials Store.

**See Materials & Preparation for full info.*



21st Century Skills

Connection

- Critical Thinking
- Collaboration

Habits of Mind

- Persist and learn from failure.
- Innovate processes, methods, and designs.



Guiding Question

How can we improve our water reuse processes?

Learners Will Do

Attempt to make their water reuse processes more effective.

Learners Will Know

Engineers reflect upon, change, and improve their designs.



Connecting Across Activities

Activity 6: Create a Process	Activity 7: Improve a Process	Activity 8: Preparing for the Engineering Share-Out
Last time , learners worked in groups to plan, create, and test a water reuse process.	Today , learners improve their water reuse processes to better meet the criteria for their group's environment.	Next time , learners will prepare to communicate their ideas about designing a water reuse process in the Engineering Share-Out.

Activity Resources

Access videos and digital resources using the link or QR code below. More information for teaching this curriculum is available in the [Educator Guide Introduction, pgs. iii-xxvi](#). Access more PLANETS units, research, and pathways at <https://planets-stem.org/>.



weblink: <https://hov.to/f8463f44>

Materials and Preparation

Materials

For the whole group

- *Our Ideas* poster (on paper or a shared digital document) in Prep & Setup Guide (PDF) [Examples](#) & [Template](#)
- Remaining materials from Activity 6
- 1 measuring cup, 1/4 cup
- 1 roll of masking tape
- 1 roll of paper towels
- 1 strainer
- 2 tablespoons
- 8 craft sticks
- 8 containers, 1/2 gallon, with water samples
- 35 sheets of copy paper
- 1 roll of plastic wrap (optional)
- towels or disposable tablecloths (optional)

For each group of 4

- 1 flashlight
- 1 foil tray, 12" × 12"
- 1 packet of pH strips
- 1 pair of scissors
- 1 permanent marker
- 1 piece of construction paper (the same color for all groups)
- 1 set of [Engineering Activity 6 Water Reuse Plan Location and Filter Base Cards, pgs. 93-94](#)
- 2 Filter Bases

For each learner

- [Engineering Notebook \(PDF\)](#)

Activity 7 Materials Preparation (20 min.)

Ahead of Time

1. Review the “In-Use Example” in the *Our Ideas* [Prep & Setup Guide \(PDF\)](#) to help you think about what to add to the *Our Ideas* poster during the discussions in this activity.
2. Optional: Make a new copy of the [Engineering Activity 6 Water Reuse Plan Location and Filter Base Cards, pgs. 93-94](#), if the first copies were damaged by water.

In Your Space

3. Place the *Our Ideas* poster in a visible place in your learning setting or prepare to share it digitally.
4. Create a Materials Store with the materials remaining from Activity 6.
5. Optional: Prepare more water samples in the containers using the recipes on *Water Samples for Final Challenge Recipes*, pgs. 87-88, and other recipes from Activity 6.



Teaching Tip

Lead this activity in a room with a sink for easy setup.

Activity Guide

Get Ready & Team Up (10 min.)

1. Ask: **If you did the last activity, what did you do and why?** (*We planned, created, and tested a water reuse process for an environment.*)
2. Say: **Today you will improve your water reuse process to make it more affordable and effective. You can improve by lowering the cost of the process, decreasing the amount of materials you use, or increasing the quality or amount of water your process produces.** Share the Guiding Question with learners aloud and in writing on the *Our Ideas* poster (using multiple languages as needed): **How can we improve our water reuse processes?**
3. Organize learners into their groups of four from the previous activity.

Improve (25 min.)

4. Remind learners that improving is an important part of the Engineering Design Process. It will help them understand what design principles work best for water reuse systems. Later, they will share their design recommendations with visitors in an Engineering Share-Out.
5. Have groups pair up and share their results, discuss problems, or give advice from the last activity. Ask: **Which environment did you choose? Did your design work the way you imagined it would? What worked well? What challenges did you encounter? How can you rearrange the process to get more water out of the process, or improve water quality?**
6. Say: **One way to improve your process is to make sure it is not too expensive. Each environment now includes a budget as an additional constraint.** Ask: **Which materials do you think will cost more? Why?** Say: **You can find your budget and the costs of materials on *Cost Sheet*, pg. 17 in your Engineering Notebook.**
7. Have learners calculate the cost of their previous filter using the materials listed on *Planning a Process*, pgs. 11-12 in their Engineering Notebook.
8. Say: **You will now plan improvements to your process for reusing water. You should use the data you gathered last time to choose at least one part of your process to improve. You also need to stay within your budget.**
9. Give groups five minutes to record their improved designs on *Improving a Process*, pg. 18 in their Engineering Notebook.
10. When groups complete their plans, have them collect materials from the Materials Store and begin improving.



Support Learner Differences

If new learners are joining you, lead an [inclusion activity](#) (pgs. xx-xxi) and use other [engagement strategies as necessary](#) (pgs. viii-xviii).



Support Learner Differences

For some learners, the introduction of the budget may be distracting and too challenging. Encourage these learners to improve their designs in other ways, such as by improving the effectiveness of the filters or increasing the number of times water is reused.



11. Encourage groups to test their designs as they improve. Let groups know that they can record new testing data on *Improving a Process*, pg. 18 in their Engineering Notebook.



Support Thinking

If needed, distribute copies of [Engineering Activity 3 How to Test Water Quality Handout](#), pgs. 47–51 and [Engineering Activity 4 Testing Materials for Cleaning Handout](#), pgs. 63–64, to review the procedures for testing water quality and using a Filter Base.



Teaching Tips

The pH strips may stain the tabletop, so place used strips on a paper towel.

If learners have trouble improving their designs, encourage them to ask other groups for advice.

12. Let groups that are still working know when there are 10 and 5 minutes remaining. As learners finish testing and improving, congratulate them on their engineering work.



Teaching 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.

Reflect (10 min.)

13. Have each group come up with an answer to the Guiding Question: **How can we improve our water reuse processes?** (*We can improve the filters and adjust the order to make the water reuse process better.*) Additionally, have them discuss the following questions: **Are your improvements working out the way you thought they would? What else can you do to improve your design?** As needed, remind learners of terms on the *Our Ideas* poster.
14. Say: **Next time, you will think about the design recommendations you would give to someone else designing a water reuse system.**
15. Have learners discard used filter materials (except charcoal, limestone and other reusable materials) and their final water samples, then rinse their Filter Bases and place them in their tray with their *Engineering Activity 6 Water Reuse Plan Location and Filter Base Cards*. Have groups re-label their trays if needed.



Level Up!

- ✦ Ask this story prompt question: **Can you tell a story about how you made changes to make something better?** (*Possible responses include stories about improving skills, technologies, ideas, or relationships.*) Have learners share with a partner (note that the sharing can take forms other than speaking aloud). Consider returning to learners' ideas at the start of the next activity. (20 min.)
- ✦ Tell learners, if anyone asks them what they did today, they can tell them "We improved a process to filter and reuse water." (5 min.)
- ✦ Astronauts on the International Space Station have improved their systems enough that they are able to recover and reuse 98% of the water they use! Read more about the filters they use here [NASA Achieves Water Recovery Milestone on International Space Station - NASA](#). (5 min.)
- ✦ Refer to the *Engineering Design Process* poster. Ask: **What phases of the Engineering Design Process did you use today?** (*We planned how we wanted to change our design; we created and tested improved designs.*) (5 min.)

After the Activity

1. Clean up:
 - Save the containers with the water samples and groups' design components in a safe location so learners can share them later.
 - Save the *Our Ideas* poster for Activity 8.
2. Plan for Engineering Activity 8. See [Engineering Activity 8 Preparation on pg. 102](#).
3. Take time to reflect on the following educator prompt. **How did you support learners to persist through and learn from failure?**

Water in Extreme Environments Additional Resources

Resources include All Downloads, All Videos, Family Connections, and more.



weblink: <https://hov.to/7cb5c428>