Activity 3 Order Up!

Educator Preview

Overview

Youth apply what they learned about water quality to reconfigure a model house to reuse as much water as possible.

Note to Educator:

In this activity, youth reference the *Water in the Home* diagram from Activity 1 and reconfigure the way the pipes are placed so that they can reuse the water. They will use straws to represent the model pipes and tape them in place to *create* a map of the new layout.

Activity Timing

Introduction:	5 min
A Greywater Process:	35 min
Reflect:	10 min
	50 min

21st Century Skill Highlight

Critical Thinking
Collaboration

Tip

Place the *Mapping Greywater* pages in plastic sheet protectors before aligning and attaching them together to use again in the future.

Activity 3 Materials

For the whole group

- ☐ *Engineering Design Process* poster
- ☐ *Investigating Filter Materials* chart from Activity 2
- ☐ plastic container with lid, 8 oz., with yellow water and charcoal filter from Activity 2
- ☐ 4 rolls of painter's tape
- ☐ 16 sheets of copy paper
- ☐ 40 straws, color 1
- ☐ 40 straws, color 2
- ☐ 40 straws, color 3

For each group of 3

- ☐ *Mapping Greywater*, pp. 43–45 in this guide
- ☐ 1/2 stick of modeling clay
- ☐ 1 pair of scissors
- ☐ optional: 2 sheet protectors

For each youth

- ☐ Engineering Notebook

Activity 3 Materials Preparation (30 min)

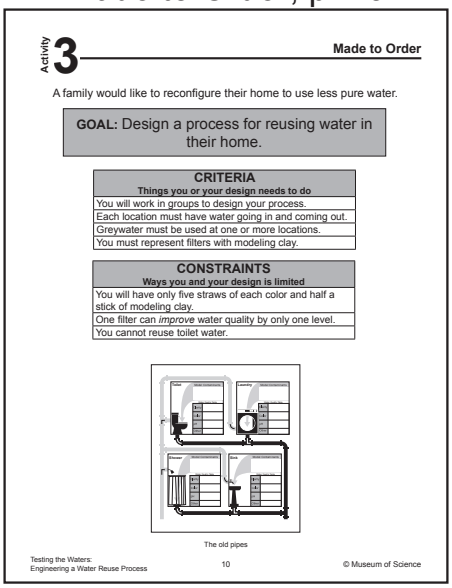
1. Post the *Engineering Design Process* poster.
2. Fill in the "After Use" water quality sections on the *Mapping Greywater* pages, pp. 43–45 in this guide, by using the data on *Water in the Home,* p. 4 in youth's Engineering Notebooks.
3. Make copies of both pages of *Mapping Greywater* and tape the two pages together to make one larger sheet for each group (see p. 40 in this guide).

Activity 4 Pre-Preparation (15 min)

Youth will need a total of 16 Filter Bases over the course of this unit (only 8 are needed for Activity 3, but 16 are needed for Activities 4–6). Making Filter Bases can be time consuming, so consider preparing them ahead of time. Follow the instructions on *Preparing Filter Bases*, p. 37 in this guide.

Notebook Page for Activity 2

Made to Order, p. 10



Activity 3 — Made to Order

A family would like to reconfigure their home to use less pure water.

GOAL: Design a process for reusing water in their home.

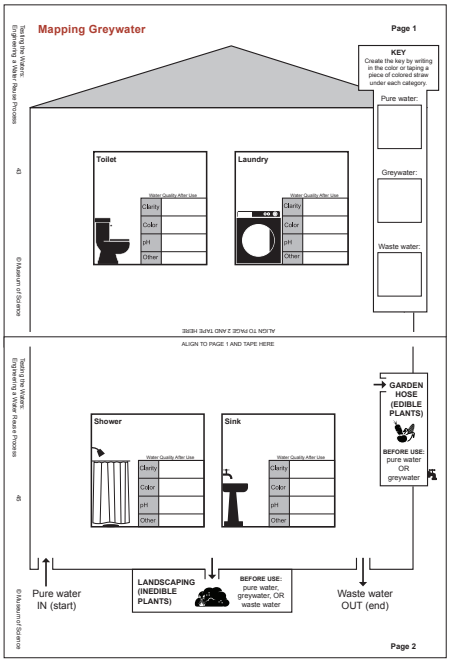
CRITERIA Things you or your design needs to do
You will work in groups to design your process.
Each location must have water going in and coming out.
Greywater must be used at one or more locations.
You must represent filters with modeling clay.

CONSTRAINTS Ways you and your design is limited
You will have only five straws of each color and half a stick of modeling clay.
One filter can *improve* water quality by only one level.
You cannot reuse toilet water.

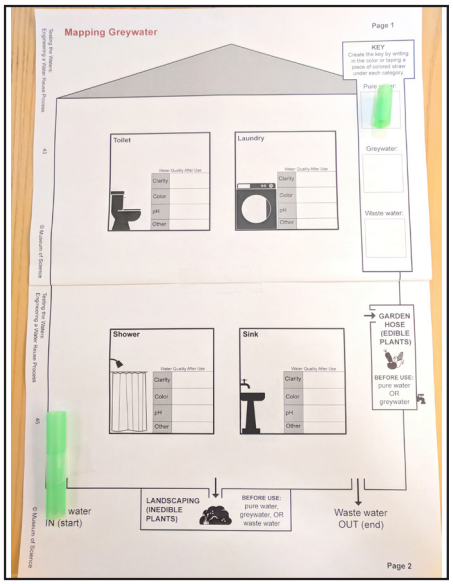
The old pipes

Testing the Waters: Engineering a Water Reuse Process 10 © Museum of Science

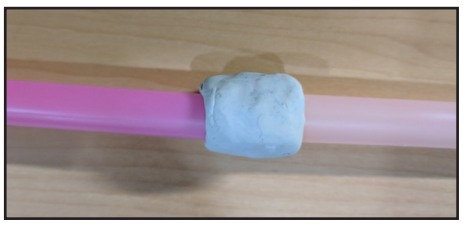
Mapping Greywater Examples



Pages taped together with water quality values filled in



Example: straws modeling pure water pipes are taped on pages



Modeling clay represents a filter.

Activity 3 Order Up!

Activity Guide

Youth will learn:
- Water quality determines the order water can be reused for specific locations.
- There can be multiple solutions to the same problem.

Tip

Replay the *Special Report* video from 3:25 to 4:05 to remind youth of how pipes deliver water to and from different areas. Consider bringing youth to an area where you can see pipes connected to a sink or toilet.

Tip

If youth are unfamiliar with the terms *edible* and *inedible*, provide some examples, e.g., carrots, lettuce, apple trees (edible); flowers, grass, trees (inedible). Edible plants become inedible when they are watered with waste water, so it is important to know which plants will be used for food and which will be used for decoration.

Introduction (5 min)

1. Congratulate youth on the excellent engineering work they have done so far. Ask:
   - **What did we *investigate* in the last activity?** *How different filter materials can improve water quality in different ways.*
2. Have youth turn to *Water in the Home*, p. 4 in their Engineering Notebooks. Ask:
   - **Why were we not able to reuse any of this water?** *Because all of the water was waste water after it had been used.*
3. Tell youth that today they will use what they learned about water quality to change the flow of water in the home on p. 4 so that the water can be reused.

A Greywater Process (35 min)

1. Have youth turn to *Made to Order*, p. 10 in their Engineering Notebooks, to review their challenge. Have a volunteer read the criteria and constraints aloud.
2. Show youth one of the taped *Mapping Greywater* pages, straws, and modeling clay. Explain they will use straws as model pipes and modeling clay as model filters.
3. Assign one straw color to indicate each water quality (pure, grey, and waste).
4. Remind youth that the water may not immediately qualify as greywater. Ask:
   - **How can we improve the water quality?** *We can use filters to improve the pH, color, and clarity.*
5. Remind youth they can use *How Clean Does It Need to Be?*, p. 6 in their Engineering Notebooks, to review the criteria for pure water, greywater, and waste water.
6. Split youth into groups of 3. Pass out a taped set of *Mapping Greywater* pages to each group.
7. Remind groups record the colors of the straw in the key on their *Mapping Greywater* pages.
8. Let youth gather their materials (i.e., straws, modeling clay, tape, and scissors) and begin designing their water reuse

processes. Encourage them to discuss a *plan* with their group before they start cutting straws and securing them in place with painter's tape.

9. As groups are working, move around the room and ask:
   - **Why is it important to know the water quality of the samples?** *So you know if the water is safe to reuse.*
   - **How are you ordering your process for reusing water?**
   - **In how many locations have you been able to reuse water?**
   - **Can you think of other ways you could order the water flow?**

Reflect (10 min)

1. When youth have finished, gather them together to share and compare their processes for reusing water. Ask:
   - **What similarities do you notice between your processes? What differences do you notice?** *We both started with shower, but we only reused the sink water and they reused sink and shower water.*
   - **How can you *improve* your water reuse process?** *We can increase the number of times water is reused.*
   - **Why do you think it is important to reuse water in a particular order?** *Order is important because some locations require cleaner water than others.*
   - **Is the process of reusing water a technology?** *Yes. It is solving the problem of not having enough water by ordering the flow of water so it can be reused.*
   - **Which steps of the Engineering Design Process did we use today?** *We* investigated *why order is important, we* planned *how to order the flow of water, we* created *a process for reusing water in the home.*
2. Remind youth how they talked about how some filters take time to treat the water.
3. Bring out the plastic container of yellow water with the charcoal filter. Ask:
   - **What do you notice about the quality of the water now?** *The water sample should be less yellow than it was before. If you took a picture in Activity 2, compare the color in the picture and in the sample.*
   - **How can you use this filter material in your water reuse process?** *Accept all answers.*
4. Let youth know that next time they will begin designing a process for reusing water in a water-scarce environment like a home in the American Southwest or a research lab in space.

Tip

Encourage groups to be creative with the way they design their greywater process. The process can be arranged in a straight line, branches, or even in a loop.

Tip

If youth have questions about when greywater is used, let them know its usage can vary depending on region, local regulations, plant species, and/or personal preference. Encourage them to look up the local legislation regarding greywater.

Tip

Take a picture of the "before" stage of the yellow water to compare it to the "after" results.

Tip

The charcoal filter may take anywhere from 24-48 hours to remove color from the water sample.

Mapping Greywater

KEY
Create the key by writing in the color or taping a piece of colored straw under each category.

Pure water:

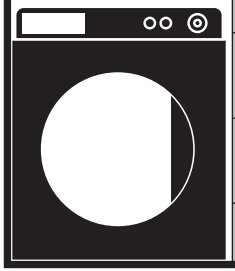
Greywater:

Waste water:

Toilet

Water Quality After Use	
Clarity	
Color	
pH	
Other	

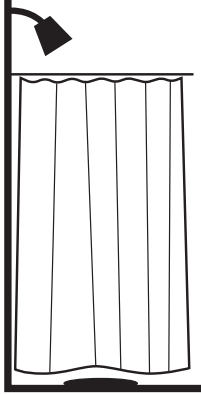
Laundry



Water Quality After Use	
Clarity	
Color	
pH	
Other	

ALIGN TO PAGE 2 AND TAPE HERE

Shower



Water Quality After Use	
Clarity	
Color	
pH	
Other	

Sink

Water Quality After Use	
Clarity	
Color	
pH	
Other	

GARDEN HOSE (EDIBLE PLANTS)

BEFORE USE:
pure water
OR
greywater

Pure water IN (start)

LANDSCAPING (INEDIBLE PLANTS)

BEFORE USE:
pure water,
greywater, OR
waste water

Waste water OUT (end)