Your PLANETS Engineering Notebook

for:

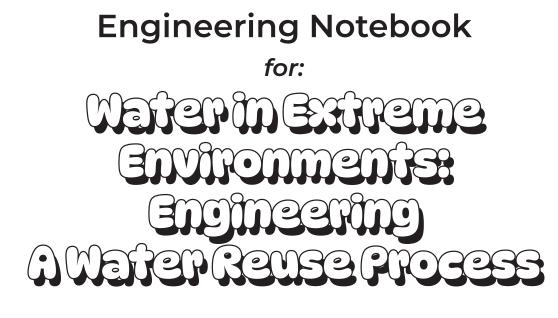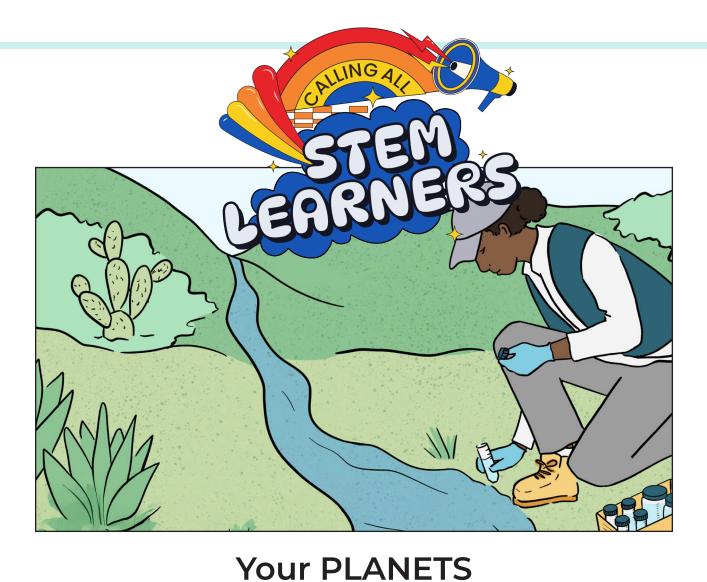# Water in Extreme Environments: Engineering A Water Reuse Process

Name: _____

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Ready, S.E.T., Go!

How can we identify where there is water? How can we get it?

Find the Water

1. As a group, go to each of the stations.

2. Try to figure out what is in each container without opening it.

3. Record your ideas below.

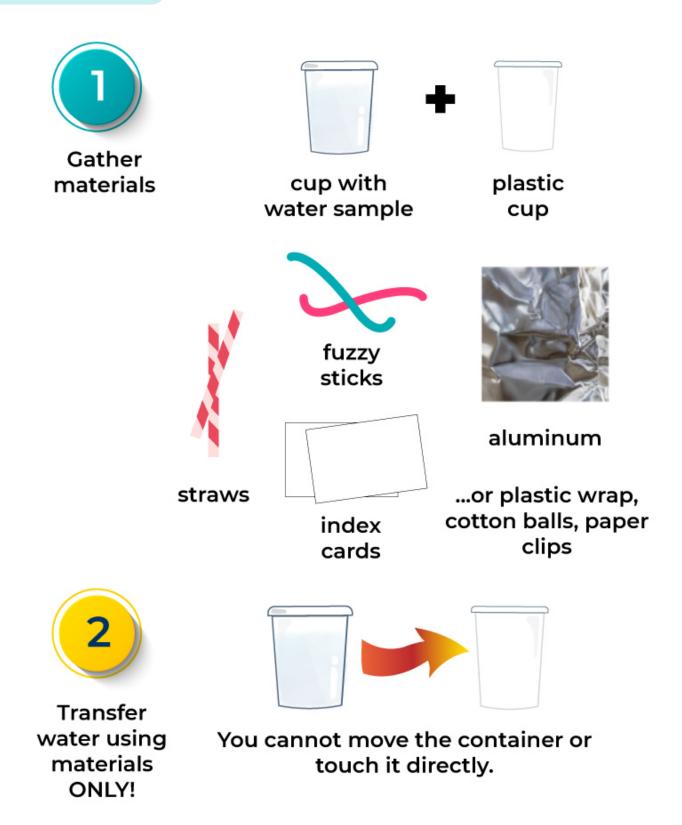| Container	Is There Water Inside?	Is There Something Else Inside?
1		
2		
3		
4		
5		
6		

Collect the Water

Goal

- Collect water from the container and put it in the cup.

Requirements

- You cannot move the container or touch it directly.

- You can use only the materials provided.

1 Gather materials

cup with water sample **+** plastic cup

straws

fuzzy sticks

index cards

aluminum

...or plastic wrap, cotton balls, paper clips

2 Transfer water using materials ONLY!

You cannot move the container or touch it directly.
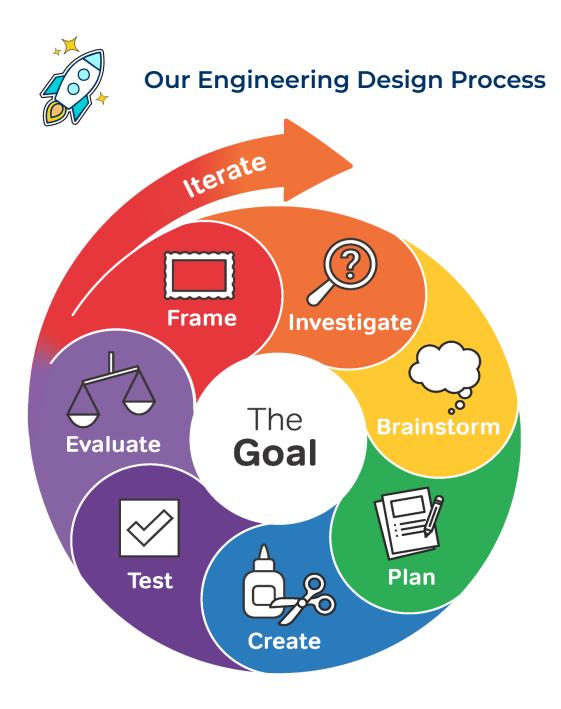
Plan

You can write or draw your ideas to collect water below.

Record

You can write or draw how your design worked below.

Improve

Write or draw ways to improve your technology below.

Our Engineering Design Process

The Goal

Iterate

Frame

Investigate

Brainstorm

Evaluate

Test

Create

Plan

YES
Middle School

Engineering Activity 1:
Water Stories: Sharing Experiences

Why is water important?

My Water Story

Think of a story about why water is important.

- It can be a story you heard, watched, read, or experienced.

Then

- write or draw your story on this page, or

- build something to demonstrate it.

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Water in Extreme Environments: Engineering a Water Reuse Process
Engineering Activity 1: Water Stories: Sharing Experiences

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Engineering Activity 3:
Measure Up: Investigating Water Quality

How can we tell if water is safe to reuse?

Our First Water Sample

Record the location your first water sample comes from.

Location _____

Record the measurements for your sample.

Water Quality Feature	Measurement
How clear is it?	
What is the color?	
How acidic is it?	
What does it smell like?	
What is the texture?	

Record the quality for your sample.

- Clean

- Somewhat contaminated

- Very contaminated

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Engineering Activity 3: Measure Up: Investigating Water Quality

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Engineering Activity 4:
Block It Out: Investigating Filters

How can we improve water quality?

Cleaning Results

We are filtering water from

Location: _____

Water Quality Feature	Before filtering	5 cotton balls	1 square of cheese-cloth	1 paper towel, half-sheet	1/4 cup sand (with cheesecloth lining)	2 Tbsp limestone (with cheese-cloth lining)
Clarity Not clear Cloudy Clear						
Color Has color Colorless						
pH Acidic (0–5) Neutral (6–8) Basic (9–14)						
Smell Strong smell Weak smell No smell						
Texture Gritty Smooth						

Were you able to improve the water quality of your sample using the materials?

Cotton Balls: Yes ☐   No ☐

Cheesecloth: Yes ☐   No ☐

Paper Towel: Yes ☐   No ☐

Sand: Yes ☐   No ☐

Limestone: Yes ☐   No ☐

Draw, write, or tell a partner about materials you could combine to improve the water quality even more.

Engineering Activity 6:
Reuse in Action: Create a Process

Does our final water reuse process meet our water quality goals?

Planning a Process

Environment: _____

Water Sources: _____

The goal is to produce

_____ cups of somewhat contaminated water

_____ cups of clean water

How will you order your water samples and Filter Bases?

Consider these questions when planning your water reuse process:

- Which water sample(s) should go into the first filter?

- Which water sample(s) should go into the second filter?

- Which materials should be used in the first filter?

- Which materials should be used in the second filter?

PLANETS Water in Extreme Environments: Engineering a Water Reuse Process
Engineering Activity 6: Reuse in Action: Create a Process

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Draw a detailed plan of your group's water reuse process.

- Label the locations in your drawing.

- List the materials you would like to use in your filter(s).

Materials List

Material	Number Needed
Rubber bands	
Paper towel (half sheet)	
Cheesecloth (1' × 1')	
Cotton ball (1)	
Sand (1/4 cup)	
Charcoal (2 Tbsp)	
Limestone (2 Tbsp)	

Humans have never been to a planetary body beyond the Moon, so it's important to make sure astronauts are able to reuse water when they travel to Mars, asteroids, and beyond.

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Water in Extreme Environments: Engineering a Water Reuse Process
Engineering Activity 6: Reuse in Action: Create a Process

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Testing a Process

Record the final results of your water reuse process here.

Test	Trial 1	Trial 2
Clarity		
Color		
pH		
Smell		
Texture		

Does the final water sample meet the water quality goal?

Did You Know?

Remember that failure is natural in engineering!
Engineers gain information from failed designs and
use it to make future designs better.

NASA Career Spotlight

Phyllis Friello

My job at NASA is to work with my space medicine team to develop and provide what we need to keep our astronaut crews on moon and Mars missions healthy and safe.

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Engineering Activity 6: Reuse in Action: Create a Process

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NASA Career Spotlight

Daniel Sturber

My job at NASA is to work with astronauts and other engineers to make sure spaceships work the way astronauts need them to work.

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Engineering Activity 6: Reuse in Action: Create a Process

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Engineering Activity 7:
The Final Test: Improve a Process

How can we improve our water reuse processes?

Cost Sheet

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

Environment	Budget
Farmhouse	$125
Mars Habitat	$250
Floating Research Lab	$250
International Space Station	$325

Materials List

Material	Cost	Number Needed	Total Cost
Rubber bands	$15		
Paper towel (half sheet)	$20		
Cheesecloth (1' × 1')	$25		
Cotton ball (1)	$25		
Sand (1/4 cup)	$30		
Charcoal (2 Tbsp)	$50		
Limestone (2 Tbsp)	$75		
Grand Total Cost:			

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Water in Extreme Environments: Engineering a Water Reuse Process
Engineering Activity 7: The Final Test: Improve a Process

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Improving a Process

Record a detailed plan for the improvements your group would like to make to your water reuse process.

- Make sure to keep track of any new materials you use.

Test	1	2
Clarity after Filter 1		
Color after Filter 1		
pH after Filter 1		
Smell after Filter 1		
Texture after Filter 1		
Final Clarity		
Final Color		
Final pH		
Final Smell		
Final Texture		

Engineering Activity 8:
Spread the Word: Preparing for the Engineering Share-Out

What design recommendations do we have for water reuse processes?

Communicate

During the Share-Out, you will get to share information about your engineering challenge.

Who is your audience? What do they already know about water conservation?

What are some things you might want to tell them about engineering a water reuse process?

How can we share our water reuse process recommendations with others?