STEAM

Water Filter
Water Pollution Challenge

with

Supplemental Resources

Spivey Sparks

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Note to Teacher

STEAM Philosophy:

Learning through STEAM gives students the opportunity for hands-on, situation-based application. This challenge combines content areas, beginning first with the science standards, then layering with math and language arts content. With this real-world approach, students have opportunity for more rigorous cross-curricular learning, instead of learning each discipline separately.

By design, each Spivey Sparks STEM and STEAM challenge is open ended. I believe children are most creative and learn best when given opportunities to guide themselves. This model allows students flexibility to create and test their unique solutions. Specifications and parameters are included, but *specific* directions on how to design and create their models/solutions, are not. Each project is designed for students to think as engineers and discover various solutions while following the engineering design cycle, not copy and recreate. I design challenge units to be used as one component within a larger unit of study, with the assumption students have background information and/or access for additional research, as necessary. As the instructor, please adapt and model with your students to best fit their needs. The challenge can be done individually or collaboratively. Grouping students across ability level may increase success for students who need additional support.

Supply Suggestions:

As you prepare your classroom for this challenge, here are supplies you may want to have available for your students as they design structures for their Water Filter. *Having all of these supplies on hand is not necessary.* Certainly students will have other supply ideas as well. A nice variety of organic materials and mediums will allow students opportunity to develop their filter.

2-liter bottle	cotton balls	activated charcoal
milk carton	pebbles	mulch
orange juice bottle	grass	rice
sharp scissors	gravel	dirt
permanent markers	sand	coffee filter

Inquire, Discover, and STEAM ON!

Stephanie Spivey

Creating Greywater Solution
A Water Pollution **STEAM** Challenge

In order to have a consistent greywater solution for students to filter, it is important it be created, rather than gathered *organically*. During your pollution study or during student research time, students can identify various substances that are included in greywater. To incorporate mathematics, decide on specific measurements for each *ingredient*. Students can make the greywater solution in groups or individually. Some suggestions of ingredients include:
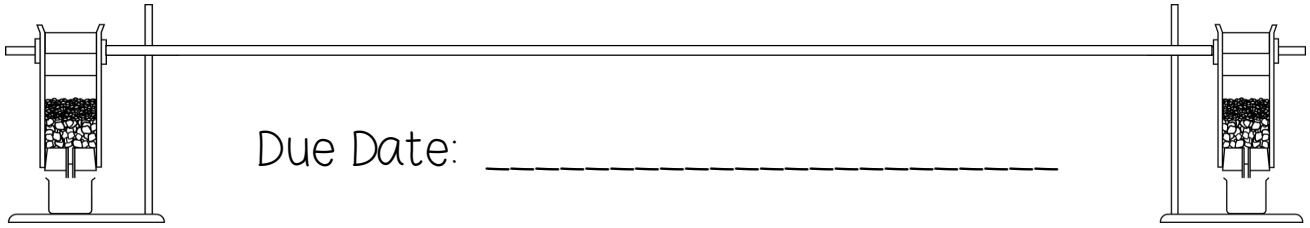
- Water
- Dirt (small amounts- remember it's supposed to replicate coming off skin in the bath, shower, or the sink.)
- Hand Soap
- Body Bar Soap
- Shampoo/Conditioner
- Shaving Cream
- Toothpaste
- Dryer lint (small amounts- remember it's supposed to replicate coming off in the washing machine.)

Inquire, Discover, and STEAM ON!

Stephanie Spivey

Creating a Water Filter
A Water Pollution STEAM Challenge

Due Date: _____

A humanitarian organization is helping a small rural village in a third-world country filter their polluted greywater supply. Your team of environmental engineers has been tasked to research ways to help cleanse their water. You will use the engineering design cycle to create a usable water filter, then present findings for using it in the village.

Your Task:

Create a Water Filter to help cleanse greywater!

<u>You Need</u>:
- Filter Base: Suggestion- A clear bottle
- No more than 5 organic materials of your choice.

<u>Investigate: Research Filters & Materials</u>:
- What materials naturally help filter water?

<u>Plan: Sketch Design</u>
- Develop your plan

<u>Create Model</u>:
- Create a usable model of a water filter.

<u>Improve: Collaborate with Classmates on Design & Modify</u>
- Make improvements based on testing observations.

<u>Evaluate: Submit Report on Observations & Findings</u>
- Record finding of how well your filter cleanses the greywater on data sheet.
- Create a visual recommending your model, explaining how it works, and why it is a good choice for the village.
- Explain how you used math.
- <u>Technology Connection</u>: You may also record a video showing how it works.
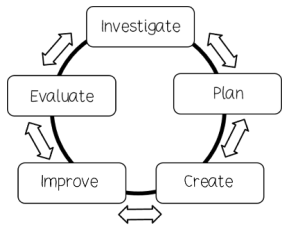
Investigate: Research & Materials

Learn about **water filters**. Conduct research to help you understand their characteristics, how they cleanse water, and brainstorm materials to use in your design.
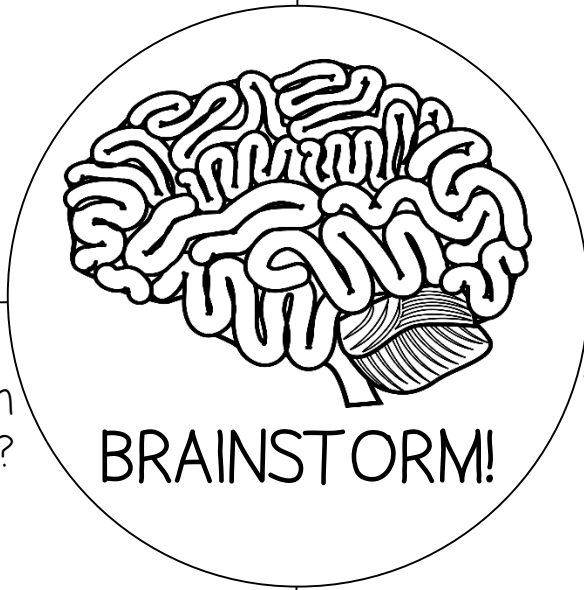
Investigate
Evaluate
Plan
Improve
Create

Research Water Filters:
Write about what you learned.
When/how are they used?

Materials for Water Filter:
Write about what you learned.
How do they work?

BRAINSTORM!

New Design:
What materials can you use in a design?

Applying Math:
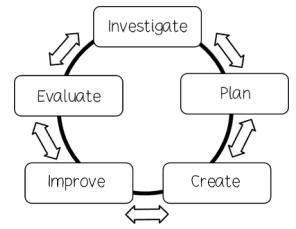What measurements should you consider?

Name _____ Date: _____

Plan: Water Filter Design Sketch

After investigating characteristics of water filters and materials used in other designs, **draw a plan for your filter**. <u>Label</u> the materials you plan to include.

Investigate
Evaluate
Plan
Improve
Create

Math Connection: Explain how you have used math to design your water filter. How will math be applied as you build the solution?

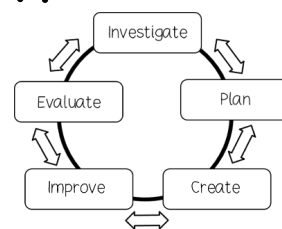*Consider: Size/Area of the space? Geometry? Measurements?*

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Name _____ Date: _____

Improve: Design Brainstorm

After you have <u>developed</u> your water filter model, share your design with a classmate. Brainstorm new ways to modify the design.

Investigate — Plan — Create — Improve — Evaluate

How can design be improved so it is **easier for the community to build**?

How can I improve the design's use of **materials**?

My Collaboration Colleague

How does this model help the **community use scientific ideas** to help the environment?
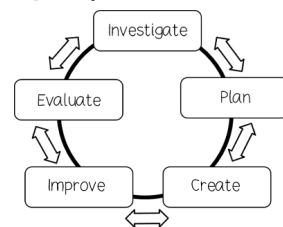
Applying Math:
What <u>other</u> measurements should I consider?

Improve: Testing Modifications

After you have <u>tested your water filter</u>, reflect on your results. Brainstorm new ways to modify the design so it can filter more particles from the greywater.

Investigate
Evaluate
Plan
Improve
Create

What **materials** need to be added or changed in order to help the filter work better?

How can I improve the **flow of water in the design**?

_____
My Collaboration Colleague

New Design:
Sketch/describe improvements to design.
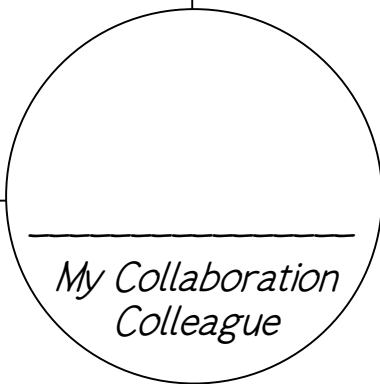
Applying Math:
Describe math updates.

Evaluate: Data Collection

Testing & Modifications

Today you'll test your water filter! You will make observations and record findings of your filtered greywater. Afterwards, you will make modifications and repeat test again.

Investigate
Evaluate
Plan
Improve
Create
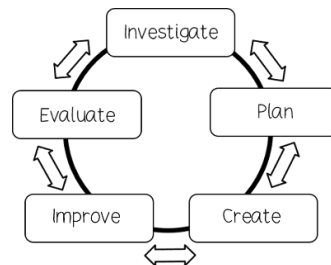
Greywater: Polluted Water	
Description of greywater solution:	Diagram of particles in greywater:

Greywater Observations: What do you see and smell?

Predict the type of filter needed to remove pollutants from greywater.

Trial 1:

| Description of Filter Design:	Diagram:
I poured _____ cup of greywater solution through filter. After _____ minute, I noticed…	Diagram of particles filtered:

What modifications could be made so filter better cleanses greywater?

Trial 2:

Description of Filter Design:	Diagram:
I poured _____ cup of greywater solution through filter. After _____ minute, I noticed…	Diagram of particles filtered:

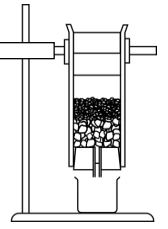What modifications could be made so filter better cleanses greywater?

Name _____ Date: _____
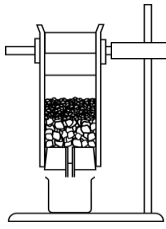
Evaluate: Submission Report

Materials:
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_____
_____
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What would communities use a full-size version?
_____
_____
_____
_____

Use scientific ideas to explain how it protects resources.
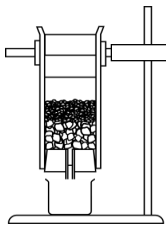_____
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How did you incorporate math into your design?
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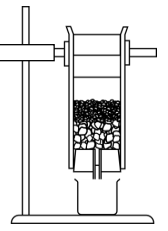_____

Name _____   Date: _____

Evaluate: Submission Report

Materials' Impact: Explain the materials you used and materials a community would use in a <u>full sized version</u>.

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How it Works: Use <u>scientific ideas</u> to explain how your design to protect natural resources.

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Mathematical Application: Explain how you used math to design your filter.

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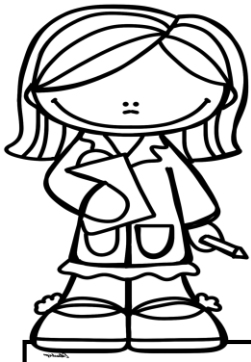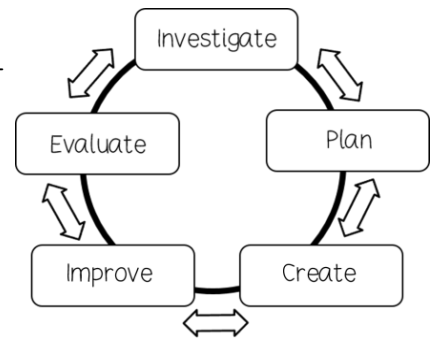
Name _____

Engineers use **critical thinking skills** when designing a solution. Write about what you did as you worked through the design cycle.

Investigate → Plan → Create → Improve → Evaluate

Investigate:

Plan:

Create:

Improve:

Evaluate:

Investigate

Evaluate   Plan

Improve   Create
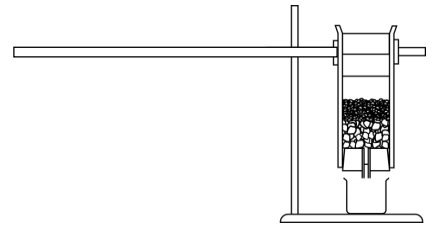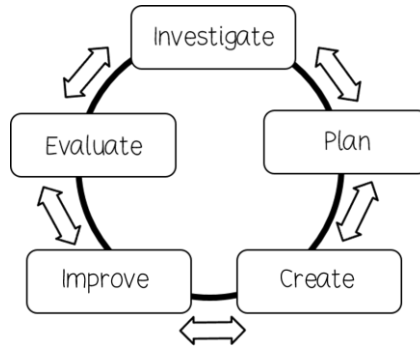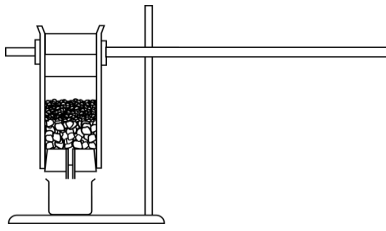
Hi Environmental Engineer! As you move through the **engineering cycle**, you will find yourself making changes. You may make modifications to your filter if something does not work correctly or you figure out how to improve the design. Keep going! Engineers are always having to use critical thinking when designing a solution. Write about what you did as you worked in each part of the cycle.

Investigate: _____
_____

Plan: _____
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Create: _____
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Improve: _____
_____

Evaluate: _____
_____

STEAM Challenge Rubric
Creating a Water Filter

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|	Water Filter & Effort	Engineering Design Cycle	Filter Report & Accuracy
Filter Specialist Excellent: 4 Points 😄	The student's water filter is uniquely and creatively hand made using at least four core materials. The filtered water is substantially cleaner than the original greywater. **The engineer goes above/beyond expectations.**	The student explained in **full detail** how the filter was created using the engineering design cycle. The student engineer **fully** showcased critical thinking to problem solve design improvements.	The student's _written_ explanation of how the water filter was made is explained in **full scientific detail.** Information includes specific materials with measured amounts, researched STEAM design, and testing/conclusion to include data. Their work is clearly legible. Visual aid is exceptional.
Master Gardner Satisfactory: 3 Points 🙂	The student's water filter is creatively hand made using at least three core materials. The filtered water is noticeably cleaner than the original greywater. **The engineer did not follow all the given directions.**	The student explained in **basic detail** how the filter was created using the engineering design cycle. The student engineer demonstrated **some** critical thinking to problem solve design improvements.	The student's _written_ explanation of how the water filter was made is explained in **basic scientific detail.** Information includes specific materials with measured amounts, researched STEAM design, and testing/conclusion to include data. Their work is clearly legible. Visual aid is well done.
Water Worker Needs Improvement: 2 Points 😐	The student's water filter is hand made with little creativity using at least two core materials. The filter is slightly cleaner than the original greywater. **The engineer did not follow all the given directions.**	The student explained in **few details** how the filter was created using the engineering design cycle. Some phases may be omitted. The student is **limited** in showcasing how critical thinking was used to problem solve the design.	The student **left out important scientific information** in their _written_ explanation of how the water filter was made. There are gaps in the information related to specific materials with measured amounts, researched design, and testing and conclusion to include data. Their work may or may not include a visual or clearly legible.
Sprinkler Unsatisfactory: 1 Point 🙁	The student's water filter is made without creativity using at least one core material. The filter is not visually cleaner than the original greywater. **The engineer did not follow all the given directions.**	The student explained in **limited detail** how the filter was created using the engineering design cycle. Some phases may be omitted. The student did not **adequately** showcase how critical thinking was used to problem solve the design.	The student **did not include relevant scientific details and information** in their _written_ explanation of how the water filter was made. There are significant gaps in the information related to specific materials with measured amounts, researched design, and testing conclusion to include data. Their work may or may not include a visual or clearly legible.

Name: _____

Date: _____

Compare your water filter created during **STEAM** with that of a classmate.
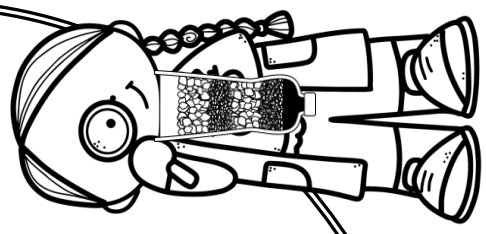
Venn-Diagram
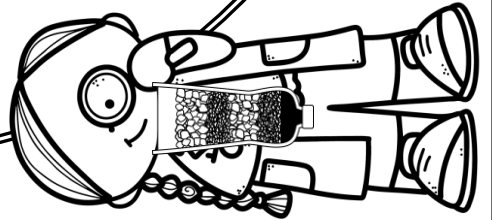
_____'s Filter

My Filter

Name: _____

Date: _____

Compare the greywater with the water after using your **STEAM** filter.

Venn-Diagram

Filtered Water

Greywater
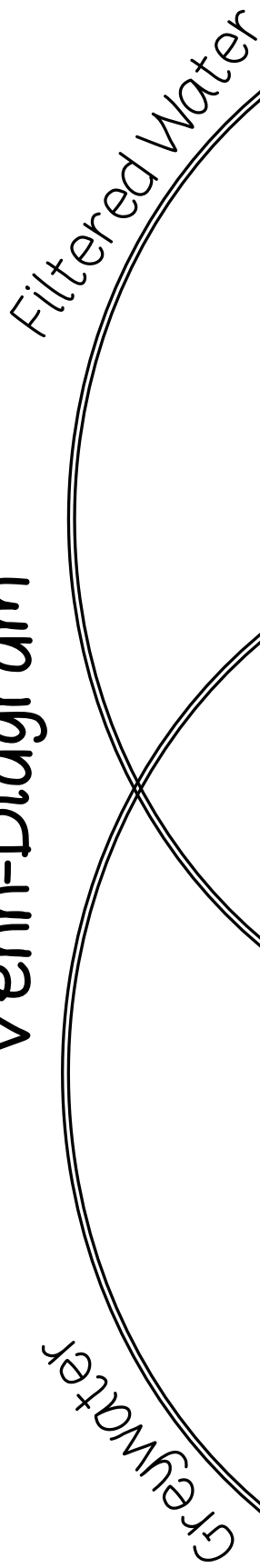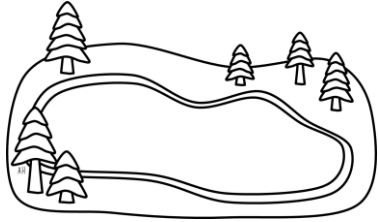
Name _____   Date: _____

Research a rural village in a third-world country. How do they access clean water? Explain some challenges.

Country: _____   Area: _____

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Name _____ Date: _____
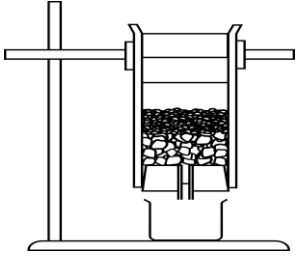
How does a water filter work? Cite facts gathered from research and your STEM project to support your answer.

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Name _____   Date: _____

Who would benefit from using a water filter?
Write a convincing letter sharing how it would be
helpful to them or their business.

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Name _____ Date: _____

Your town has excess greywater run-off after storms from mountains above. How could this be collected to be used to help the community? Write a letter convincing the mayor.

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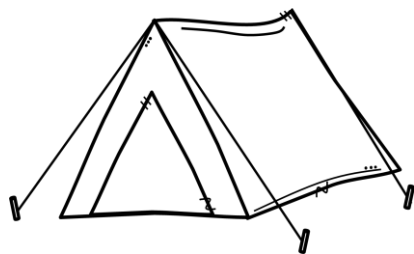_____

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Name _____   Date: _____

You and your family went on a camping trip to the mountains. Tell the tale of your adventure using a water filter to clean your drinking water.

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Name _____   Date: _____

You heard the pet shop needed volunteers to clean the fish tanks and water filters and decided to help. Write about your service project.

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Name: _____   Date: _____

Greywater: How can water conservation help the environment?
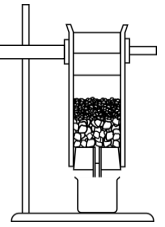
Read About It!

Reduce, reuse, and recycle! There are lots of ways to help Earth. You can reuse water! Sometimes people collect rain. Another way is to use **greywater**. **Greywater** is used water from bathroom sinks and tubs. Pipes keep the water from going to the **sewer**. The dirty water goes through these pipes to containers when it goes down the drain. Next, **filters** remove dirt from the water so it is ready to be reused.

Filtered it can be used in many ways. The water can be used to water plants, flush toilets, and wash clothes! It is helpful to plants because it has nutrients. Make sure you do not drink this filtered water or use it for cooking because it has not been **purified**. Using **greywater** helps Earth!

Write About It!

What is greywater? How can using it help conserve the environment? Use at least **3 bold words**.
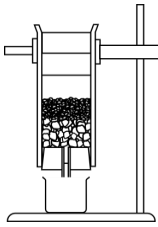
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Name: _____   Date: _____
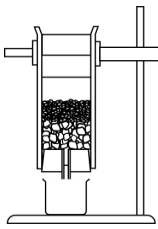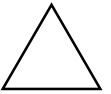
Greywater: How can water conservation help the environment?
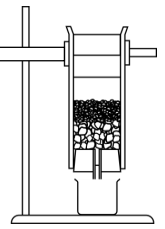
Read About It!

Reduce, reuse, and recycle! The three Rs help Earth. Did you know that reusing dirty water can help, too? **Greywater** comes from used water in bathroom sinks, tubs, and clothes washers. This dirty water can be used again. **Filters** help clean the water. Not all water is safe to reuse. Used water from kitchen sinks, dishwashers, and toilets are called **blackwater**. This water is mixed with waste and chemicals. **Blackwater** must be **filtered**, heated, and **purified**.

It is fairly easy to make a filter to clean greywater. When the water goes down the drain, pipes can be added to move water away from **sewer** lines and towards filters. After it is filtered, it can be used to water plants, flush toilets, and wash laundry. There are nutrients in greywater that are also helpful to plants! You cannot drink this filtered water or use it for cooking. It is great to help Earth!

Write About It!

What is greywater? How can using it help conserve the environment? Use at least **3 bold words**.

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Name: _____   Date: _____
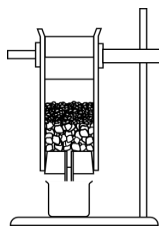
Greywater: How can water conservation help the environment?
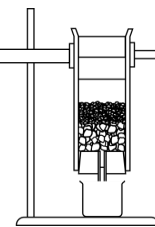
Read About It!

Reduce, reuse, and recycle. These three Rs remind us to help Earth. Did you know that you can collect water to use again? It may sound strange, but it helps **conserve** our water supply. Used water, called **greywater,** drains from bathroom sinks, tubs, showers, and clothes washers. When water passes through a **filter**, dirt is removed. After it is **filtered**, it can be used again. Not all used water is greywater. Used water from kitchen sinks, dishwashers, and toilets are called **blackwater**. It does contains human waste, fats, and chemicals. Blackwater must go through a process that heats and **purifies** to remove bacteria before being used again.

Many at home systems can be built to help collect and reuse household greywater. These systems have pipes and valves to move water towards filters rather than the **sewer**. Filtering greywater makes it safe to reuse. It is not safe to drink or use for cooking, but can be used to water plants, flush toilets, and wash laundry. There are **nutrients** in greywater that are also helpful to plants. It is great to help Earth!

Write About It!

What is greywater? How can using it help conserve the environment? Use at least **3 bold words**.

_____

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Name: _____   Date: _____ ◯

The Great Pacific Garbage Patch:
A Global Problem

Read About It!

The Pacific Ocean is home to a huge garbage patch! The area between Hawaii and California is full of trash. How does this happen? Wind and currents called a **gyre**, move water in a circular path. It is a great trash trap! It gets bigger each year.

Most plastics, fishing nets, and debris are from land. Some trash can take six years to reach the patch! Ships and boats also drop trash that gets trapped. This is a big problem for marine life. Sea mammals can get caught and drown in nets. Algae plants are a food source for many sea animals. Plastics can block sunlight to the algae. The food chain will be impacted if algae plants die.

No nation takes responsibility for this trash problem. In 2011, a 16 year old high schooler wrote a paper about The Great Pacific Garbage Patch. He saw lots of trash after scuba diving in Greece. This gave him an idea! n 2013, The Ocean Cleanup organization began. His team plans to use **gyre** to trap plastics and trash. They hope to get rid of 50% of the debris by 2023. It is possible to have cleaner oceans when we all help.

Thoughts and Wonders: What do you find interesting? What would you like to learn about The Great Garbage Patch?

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Extra, Extra: Research more about the Great Garbage Patch to answer your wonders. Write about the issue and conservation efforts.

Name: _____   Date: _____ △

The Great Pacific Garbage Patch:
A Global Problem

Read About It!

In 1997 Charles Moore found the largest ocean garbage patch. The area between Hawaii and California is full of trash! How does this happen? Wind and currents called a **gyre**, move water in a circular path, trapping trash. It collects more trash over time and gets bigger each year.

Most plastics, fishing nets, and debris are from land. Some trash can take six years to reach the patch! There are also small amounts from boats. This causes a big problem for marine life. Sea mammals can easily get caught and drown in nets. Algae plants are a food source for many sea animals. The food chain will be impacted if trash from the ocean blocks sunlight to algae!

No nation takes responsibility for this problem. In 2011, a 16 year old high schooler wrote a paper about The Great Pacific Garbage Patch after scuba diving in Greece. He had an idea. In 2013, The Ocean Cleanup organization began. His team plans to use **gyre** to trap plastics and trash. They hope to rid 50% of the debris five years after their clean-up begins. It is possible to have cleaner oceans when we all work together to help.

Thoughts and Wonders:
What do you find interesting? What would you like to learn about The Great Garbage Patch?

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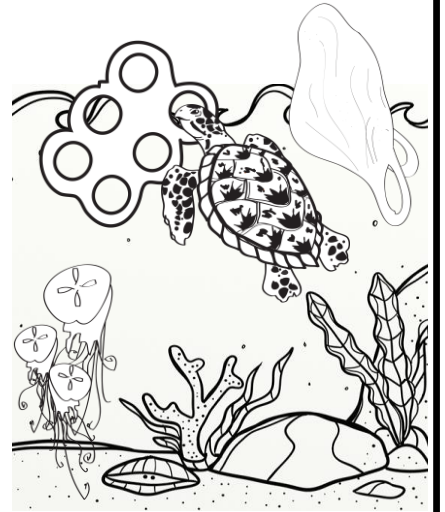## Extra, Extra:
Research more about the Great Garbage Patch to answer your wonders. Write about the issue and conservation efforts.

Name: _____ Date: _____

The Great Pacific Garbage Patch:
A Global Problem

Read About It!

Imagine a world where plastics and other trash floated for miles. In 1997 Charles Moore discovered this in Earth's largest ocean. How does this happen? Wind and a system of ocean currents called a **gyre**, move water in a circular path trapping trash. Between Hawaii and California, floats the world's largest garbage patch. Some scientists estimate this area is the size of Texas!

Most of the plastics and debris are from land, with a small portion coming from boats. Some trash can take six years to reach the patch! Fishing nets make up most of the pollution. Sea mammals can easily get caught in these nets and drown. Algae is a food source for many animals. It depends on sunlight to grow. The food chain can be critically impacted if trash from the ocean blocks sunlight to algae!

No nation takes responsibility for this global problem. In 2011 a 16 year old wrote a high school paper about The Great Pacific Garbage Patch after scuba diving in Greece. He came up with an idea. In 2013 The Ocean Cleanup organization began. His team plans to use **gyre** ocean currents to trap plastics and other trash. They believe they can rid Earth of 50% of the trash within five years of their mid-2018 launch. With the global effort of citizens, it is possible to have cleaner oceans.

Thoughts and Wonders: What do you find interesting? What would you like to learn about The Great Garbage Patch?

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Extra, Extra: Research more about the Great Garbage Patch to answer your wonders. Write about the issue and conservation efforts.

The Great Pacific Garbage Patch:
Researching My Wonders

My Sources:

Write About It:

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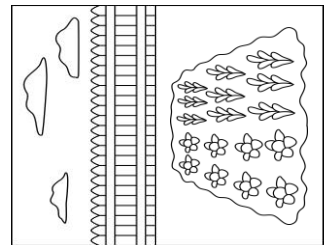
Protecting Earth's Resources & Environment
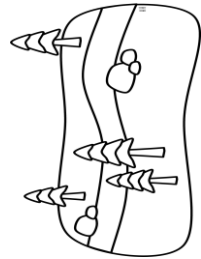
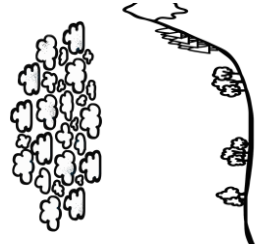Glue
Down
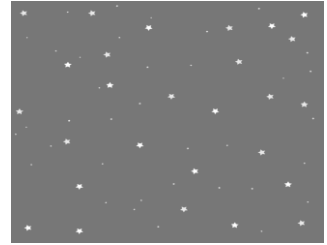On
This
Side.

Outer Space

Air

Ocean

Streams

Vegetation

Land

Flippable Organizer: Protecting Earth's Resources & Environment

Cut around the dotted lines then fold on the solid lines to create a foldable organizer for your science notebook.
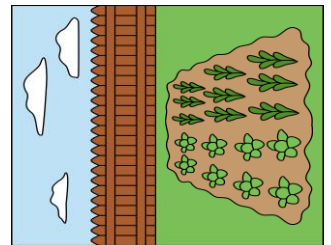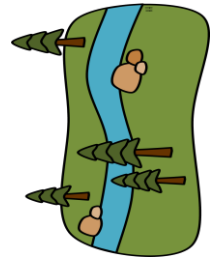
Description of negative impact:	Communities can protect resources & environment:
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Humans have major effect on the earth.

Communities are doing things to protect Earth's resources and environment

Protecting Earth's Resources & Environment

Glue
Down
On
This
Side.

Outer Space

Air

Ocean

Streams

Vegetation

Land

Flippable Organizer: Protecting Earth's Resources & Environment

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~Stephanie Spivey~

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