

W A T E R F I R S T

A STUDENT RESOURCE

POLLUTION SOLUTION CHALLENGE

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WATER: THE UNIVERSAL SOLVENT

Activity 1

A solvent is a **substance**, usually a liquid, that is able to dissolve other substances. Scientists often call water the **universal solvent** because it dissolves and mixes with more substances than any other liquid. Of course, you can have a **mixture** of any two substances; water is just very common and very important when talking about mixtures in the environment. When a substance dissolves completely into a solvent, we call the mixture a **solution**. A solution usually has two parts:

1. the **solute**, the substance that dissolves; and
2. the **solvent**, the substance the solute dissolves into.

A popular example of a solution is juice! Water mixed with a package of sugar crystals. It is incredibly difficult to turn this juice back into water and sugar crystals. Solutions like juice are also known as a homogeneous mixtures. A **homogeneous mixture** is when the different parts cannot be distinguished from one another, so it looks like one thing. The opposite of a homogeneous mixture is a heterogeneous mixture. A **heterogeneous mixture** is when we are able to clearly see the different parts of a mixture. These are also called mechanical mixtures. An example of a **mechanical mixture** is a slice of pizza. In this example, it would be pretty easy to separate one substance from the others. You can pick off toppings from a pizza like picking up garbage from the ground. When the mechanical mixture involves water, it often becomes slightly more difficult to separate the substances because as the universal solvent, water wants to mix with everything!



Rilsonav, Pollution.2020 pixabay.com

Lets think beyond our table with juice and pizza and think for a minute about the earth. In nature, water isn't sitting in a cup, it is constantly moving, and when it does, it carries substances with it in both solution and mechanical mixture form. Now, Imagine an oil company has an accidental oil spill that impacts a lake near your home. From that lake, a small river leads to a pond where the local sewage treatment plant pumps your sewage. Imagine a husband and wife left their garbage on the beach,

and the wind blew it into the water next to some emptying chemical barrels that rolled down the hill from a local factory up-shore. This pollution, the oil, sewage, garbage and chemical barrels are all substances that are creating a mixture with the water. **Pollution** is anything that is in the water or on the land that shouldn't be there. Pollution like these make the environment a dangerous place for many plants, animals and humans to live.

Unfortunately, these are scenarios that are familiar to many environmental scientists and First Nations communities. Humans contribute to a variety of pollution on land and in the water, but because water is the universal solvent and is always moving and transporting, these pollutants can be very difficult to control or remove. There are special tools and complex procedures that polluted water has to go through before it is safe for humans and other life to use. Fortunately, there are people who dedicate their life to this processes of removing pollution out of water.

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Water Science Glossary

Optional
Activity

Science Words- Create the definitions for the words below using the reading and your own understanding.

If you need help, the definitions are on the next page, but these ones must be in your own words!

Substance:

Universal Solvent:

Mixture:

Solution:

Solute:

Solvent:

Homogeneous:

Heterogeneous:

Mechanical Mixture:

Pollution:

Water Science

Glossary

Science Words-Definitions

Optional
Activity

Substance: a specific thing (type of matter).

Universal Solvent: water is given this title because it dissolves and mixes with more substances than any other liquid.

Mixture: two or more substances put together.

Solution: A mixture of two or more substances. It is impossible to tell them apart because they are spread out equally to look like one.

Solute: the substance that dissolves into another substance

Solvent: the substance the solute dissolves into.

Homogeneous: a mixture of two substances in which it is impossible to tell them apart because they are spread out equally to look like one (e.g. coffee, salt water).

Heterogeneous: a mixture of two or more substances that are easy to tell from one other because they are not equally distributed and you can see all the parts (e.g. tossed salad, ice cream sandwich).

Mechanical Mixture: a heterogeneous mixture where you can see the different parts.

Pollution: The presence of a substance that is harmful to the environment or living things it interacts with.

Create A Pollution Disaster!

Activity 1

Materials:

- 1 medium/large empty clear cup of that holds approximately 400 ml
- 3 small clear empty cups of at least 50ml
- 2 measuring tools (measuring cups or 1/4 cups)
- A sheet of paper towel
- 3 staples (alternatives: paperclips/safety pins/bobby pins)
- corn syrup (fructose)
- water (tap or bottle)
- vegetable oil
- Parsley flakes (or alternative large flake herb)
- (optional) a bottle of food colouring (blue works best to see it most clearly)
- (optional) a spoon

Follow these steps to create your pollution disaster.

Before you begin make sure all of your cups are clean and empty.

1.

Add some metal pieces: Place 3 staples, paperclips or safety pins in the bottom of your clear cup.

2.

Add 1/4 cup or 50 ml of corn syrup on top of the staples. This will be a slow process. Speed it up with a spoon or spatula if you have one.

3.

Optional: Add a drop of blue food colouring to the water to see it better! Using a clean measuring tool. Slowly add 1/4 cup or 50 ml of water on top of the corn syrup.

4.

Slowly add 1/8 (half a 1/4 cup) or 25 ml of vegetable oil on top of your water. **Important:** The experiment will not work properly if you do not do this step slowly

5.

Sprinkle a small amount of parsley flakes on top of the oil.

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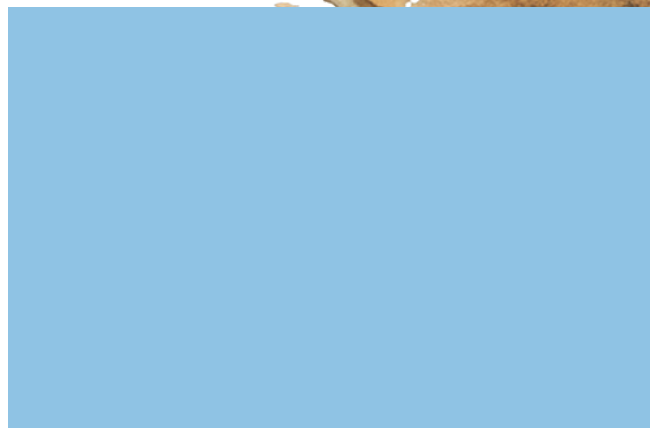
Thinking About Pollution

Activity 1

The solution you just made should look something like this



Ria Sopala, Polluted Water.2020 pixabay.com



1.) What type of mixture did you create with the pollution disaster instructions? Explain how you know. Look to your glossary of science words for help if needed!

3.) Draw a line connecting the materials you used to which pollution you think it represents in our environment.

● Staples:

● Corn Syrup:

● Vegetable Oil:

● Parsley Flakes:

Garbage like candy wrappers

Metal trash like old bikes

Transmission oil:

Sewage sludge:

Water First Challenge!

Your scenario:

A water source has been polluted from multiple sources of industry. Downstream is your First Nations community where people depend on that water in many ways. The **Pollution Disaster** you created represents this scenario.

Examine your pollution disaster. Water First challenges you to rescue the water by separating the contents of the mechanical mixture so that the First Nation community can have safe water to use.

Your Success Criteria

(Take a picture of your results for proof of success)

1. All 3 liquids must be in one of the smaller cups (oil, water & corn syrup "sludge")
2. All solids (parsley & staples) must be on a paper towel
3. There should be the same amount of water in the cup at the end as when you started (1/4 cup or 50 ml of water.)
4. Cleanliness: Treat your table, desk and floors like your land. Do not get the water pollution on the land!
5. Follow the rules found on the next page!

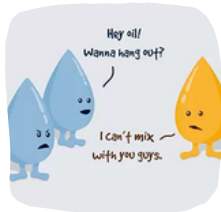
The Tools

- magnets
- coffee filters
- cotton balls
- sponges
- scrubs
- a small spoon
- turkey baster
- disposable washcloths
- a paper cup with holes
- Other non chemical tool you think would be useful



Water Rescue: The Plan !

Before you get your hands dirty saving the water, write down you plan! Follow these rules...



- a) Each tool can only be used to separate one ingredient from the mix
- b) You can use 2 of the same tool, but not 3
- c) Pouring liquids into the small cups is not allowed unless it's through a tool
- d.) 20 minutes to complete the task

That's not very kind, oil...Thumbpress. 2013 ;thumbpress.com

Step	Pollution Being Separated	Tool to Be Used
1.		
2.		
3.		
4.		
5.		
6.		

NOW LETS GET STARTED!

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Water Rescue

Separating and Filtering Materials:

1.) Highlight or underline every tool that you tried during this process. If you used a tool not listed write it down on the line provided.

- magnets
 - coffee filters
 - cotton balls
 - sponges
 - scrubs
 - a small spoon
 - turkey baster
 - disposable washcloths
 - a paper cup with holes...
 - Other non chemical tool you think would be useful
(write down any tool you used that was not listed)
-
-

2.) Describe your filtering and separating process step by step including any trial and error that may have occurred. Write what worked and what didn't work from your original plan and why.



**Remember your Success Criteria
Take a picture of your results for
proof of success!**

Thinking About the Big Picture

1.) Think about the process you went through to clean your water and separate the pollutants. Circle the answers below that you relate to.

- 20 Minutes was too much time for this challenge
- The plan I made for this challenge was perfect.
- I took more than 20 minutes to complete the challenge
- I changed a lot of my plan to complete the challenge
- I did not get any pollution on the table, desk or ground. My environment is safe!
- The tools I had were easy to use and effective at separating the pollution.
- I got some pollutants on the table, desk, or ground, but not too much!
- I wish I had some different tools, or not as many rules to follow

Your pollution disaster represents real rivers that are polluted with dangerous pollution like mercury and oil. Some rivers are hundreds of kilometres long, and have been polluted for over 40 years.

2.) After your experience with this challenge, can you think of why some bodies of water have been polluted for this long? Write your thinking.

Self Assessment



Rate your success 1-5

5 = Celebration worthy

4 = Successful

3 = Close but not clear

2 = It is what it is

1 = Not even close

- ☐ Water in one cup
- ☐ Oil in one cup
- ☐ Sludge in one cup
- ☐ Metal on paper towel
- ☐ Herb flakes on paper towel
- ☐ No pollution on the table or floor
- ☐ Followed the rules
- ☐ Made a plan
- ☐ Completed the Challenge in 20 minutes
- ☐ Completed all the experiment questions

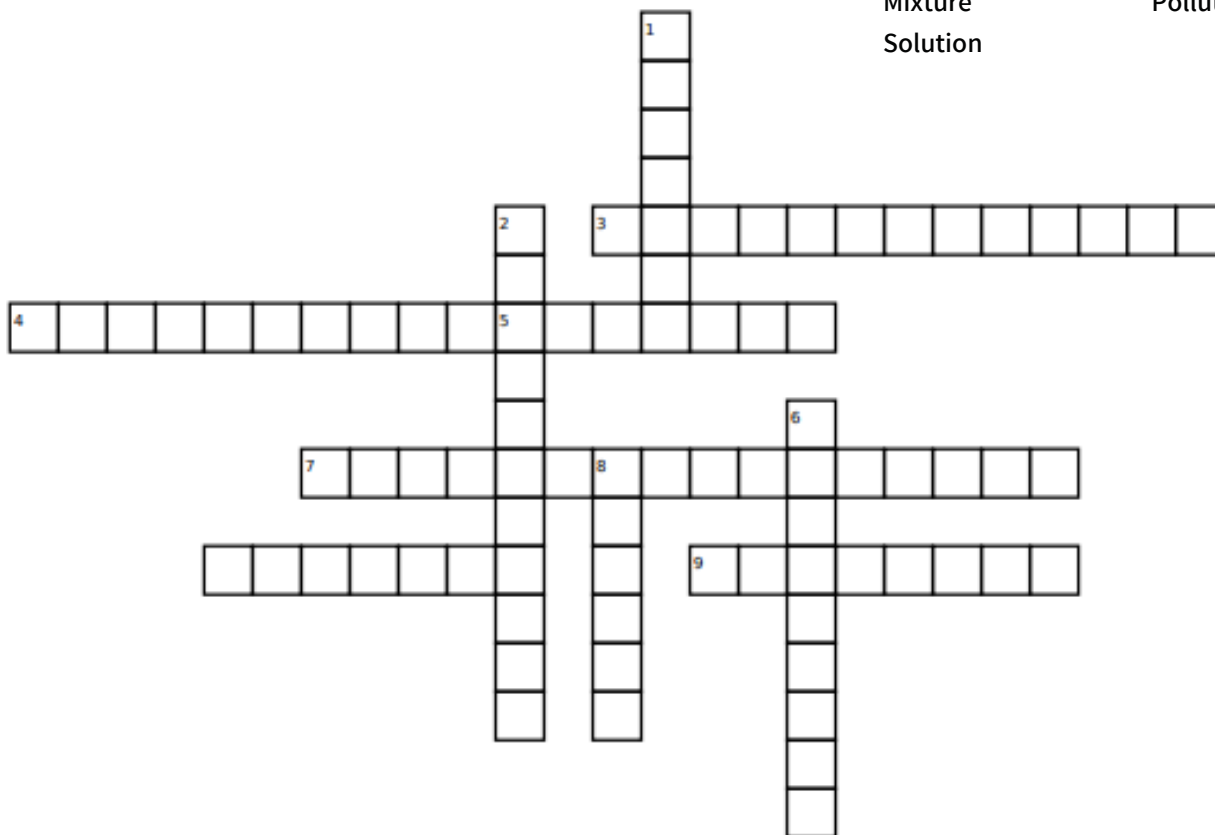
What would you do differently if you has the chance to do this experiment from the start?

Water Science Crossword

Answer the questions below by filling in the blanks in the puzzle.

WORD LIST

Solvent	Mechanical Mixture
Solute	Homogeneous
Universal Solvent	Heterogeneous
Mixture	Pollution
Solution	



DOWN

1. the substance the solute dissolves into
2. a mixture of two substances in which it is impossible to tell them apart
6. the presence of a substance that is harmful to the environment or living things it interacts with
8. a substance that dissolves into another substance

ACROSS

3. a mixture of two or more substances that are easy to tell from one other
4. a heterogeneous mixture where you can see the different parts
5. two or more substances put together
7. dissolves and mixes with more substances than any other liquid
9. a homogeneous mixture; looks like one

Water Pollution Solution Challenge

	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding	<ul style="list-style-type: none"> -Demonstrates limited connections between the Water First Challenge and real life water pollution. -Shows limited understanding of water pollution, and the filtration process 	<ul style="list-style-type: none"> -Demonstrates some connections between the Water First Challenge and real life water pollution. -Shows some understanding of various water pollution, and the filtration process 	<ul style="list-style-type: none"> -Demonstrates considerable connections between the Water First Challenge and real life water pollution. -Shows considerable understanding of various water pollution, and the filtration process 	<ul style="list-style-type: none"> -Demonstrates many clear connections between the Water First Challenge and real life water pollution. -Shows complete understanding of various water pollution, and the filtration process
Thinking and Investigation	<ul style="list-style-type: none"> -Gives a limited explanation of steps taken to complete the filtration challenge. -Provides minimal or no detail in their challenge plan 	<ul style="list-style-type: none"> --Gives some explanation of steps taken to complete the filtration challenge. -Provides some thought in their challenge plan 	<ul style="list-style-type: none"> -Gives considerable explanation of steps taken to complete the filtration challenge. -Provides considerable information in their challenge plan 	<ul style="list-style-type: none"> -Gives a thorough and thoughtful explanation of steps taken to complete the filtration challenge. -Provides a thoughtful and detailed plan for the challenge
Communication	<ul style="list-style-type: none"> -Expresses and organizes ideas and information with limited effectiveness. -Limited or no pictures provided for proof of completion. -Reflections were brief and did not connect to the big picture in most written responses.as 	<ul style="list-style-type: none"> -Expresses and organizes ideas and information with some effectiveness. -Some pictures provided for proof of completion. -Reflections were brief and needed more detail in most written responses. 	<ul style="list-style-type: none"> -Expresses and organizes ideas and information with considerable effectiveness. -Thoughtful pictures provided for proof of completion. -Reflections were relevant to the challenge and big picture in all written responses. 	<ul style="list-style-type: none"> -Expresses and organizes ideas and information with a high degree of effectiveness. -Thoughtful pictures provided for proof of completion, with descriptions. - Reflections were relevant and meaningful to the challenge and big picture in all written responses
Application	<ul style="list-style-type: none"> -Displays limited understanding of the connections between the scientific concepts and the environment. -Has limited success completing "Water Rescue Challenge" and following the necessary steps. 	<ul style="list-style-type: none"> -Displays some understanding of the connections between the scientific concepts and the environment. -Follows the steps in the "Water Rescue Challenge" activity and included the necessary components 	<ul style="list-style-type: none"> Displays considerable understanding of the connections between the scientific concepts and the environment. -Follows the steps in the "Water Rescue Challenge" activity and included the necessary components with care and detail. 	<ul style="list-style-type: none"> -Clearly follows the steps in the "Water Rescue Challenge" activity and included the necessary components with exceptional care and detail.



Ria Sopala, Polluted Water.2020 pixabay.com

Water Pollution: Substances and Mixtures

There are still many First Nations communities in Ontario and across Canada that do not have access to safe drinking water. Water Pollution is a major factor in this reality. This hands on experiment can help students to understand the difficulty of regaining a state of purity in a polluted water body.

KEY QUESTIONS TO GUIDE LEARNING EXPECTATIONS

- Would the challenge have been easier if there was more water?
- How does water pollution effect the environment?
- How does water pollution effect society?
- Why is clean water important?
- How can we keep it clean?

TEACHER DOCUMENT

HANDS ON LEARNING

Hands on experiential learning is for more than kinesthetic learners. All students benefit from a challenging lived experience. The activity included in this learning pack aims to bring a large world problem of water pollution into the classroom or home for a more thorough understanding of our actions as humans on the environment. Some of the suggested tools can be altered for the challenge to be successful, however the pollutants should remain the same for the genuine difficulty level of removing certain pollutants from water.

CURRICULUM CONNECTIONS

Grade 5: Understanding Earth and Space systems-
Conservation of energy and resources

Grade 6: Understanding Life Systems-
Biodiversity

Grade 7: Understanding Matter and Energy- **Pure Substances and Mixtures**

Grade 7: Geography- **Natural Resources Around the World- Use and Sustainability**

Grade 8: Understanding Matter and Energy- **Fluids**

Grade 8: Geography- **Global Inequalities: Economic Development and Quality of Life**

Pollution Solution Challenge

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