

Guam Water Kids

Learning About Guam's Fresh Water

Module 4
Pollution Impact
On Fresh Water

A High School Service Learning Project
for
Guam Public Schools



The Water and Environmental
Research Institute
of the Western Pacific
University of Guam

Module 4: Pollution Impact on Fresh Water

Lesson Topic: Pollution **Grade level:** 9th – 12th

Subject: Earth Science / Physical Science

Length of lesson: 5 class periods

Content Standard(s): (Located in Section 1, Resources for All Modules)

Understandings/Goals:

Students will understand:

- Fresh water is an important natural resource because living things need water to survive.
- Contaminated surface water and ground water cause sickness and even death.

Enduring Understandings:

- Water is found almost everywhere on Earth but only a tiny fraction of the water is available for human consumption.
- Our lives rely on the availability of fresh water.
- Natural collection of surface water and ground water supplies are important.
- Surface water and ground water are vulnerable to natural and manmade pollution.

Essential Question(s):

- Could life on Earth exist without water?
- Why is water important?
- Why is water essential to all life?
- How does water become polluted or contaminated?
- Who is responsible for cleaning up dirty water?

Student objectives (outcomes):

Students will be able to:

- Tell examples of common contaminants and sources of surface water on Guam.
- Tell examples of common contaminants and sources of ground water on Guam.
- Define and describe drinkable water.
- Define and describe contaminated water.

Service Learning Performance Tasks

1. **Create a presentation** about safe vs. contaminated water on Guam explaining how a contaminated water area may impact people, animals, and plants. You may want to go to a local contaminated freshwater pond, river, stream, or lake with a notebook to write down observations. What do you see? Write down observations, draw pictures, or take photographs for use in the presentation.
2. **Design an exhibit** that can be used when you travel to schools with the purpose of teaching elementary age children about drinkable water on Guam and what can contaminate our drinking water. The presentation will:
 - a. provide something visual with detailed images to help demonstrate uncontaminated water and contaminated water such as a poster or a model.
 - b. explain safe water and contaminated water in detail and include locations on Guam.
 - c. show the importance of habits that will help to preserve our limited water source.
3. **Create a script** tracing *Drip the Raindrop's Journey* from rain water to contaminated water to safe drinking water

Differentiated Service Learning Performance Tasks:

1. **Create** a flyer to promote the Safe and Contaminated Water on Guam Educational Presentation
2. **Create** a poster with pictures showing where safe water and contaminated water can be found on Guam. These pictures may be from a book, the Internet, photographs you or your family have taken, or pictures you draw.
3. **Create** captions for the items you have put on your Educational Presentation posters. Write at least one sentence telling about each item on the poster.

Other Evidence:

- Socratic Dialogue
- Observation – Socratic Dialogue to serve as pre-assessment
- Brain Check – quick student self-assessment of their understanding of concepts so far
- Venn Diagram – compare safe water and polluted water
- T-Chart – agency and their role
- KWL Chart
- Water Needs Pre-Test
- Water Contaminants Pre-Test

Learning Activities:

Background

Please note that the supporting **Background** information for all modules is located in Section 1: Resources for All Modules, Resources for Modules 4 & 5.

Overview

Clean, drinkable fresh water is critical to our everyday lives. A person can go without food for several weeks if necessary, but without water life cannot last more than a few days. Unsafe drinking water can cause diseases, illness, and death. The purpose of this module is to raise awareness of the need for safe drinking water and the importance of keeping fresh water pollution free. This Module gives students an understanding of their local ecosystem, a problem solving method to help define personal actions that lead to effective participation in a democratic society, and a way to interact with the community.

Students not only become aware of the effects that we as individuals and as a community have on our ecosystem, but also learn a method for community and personal action planning that can be used to address these effects.

Vocabulary

Agricultural Waste – waste from agriculture activities such as fertilizer.

Animal Wastes – created fecal coliform from livestock and septic systems).

Contaminants –

Pesticide – An agent or chemical substance used to destroy insects and pests.

Herbicide – A chemical substance used to destroy or inhibit the growth of plants, especially weeds.

Microbial contaminants, such as viruses and bacteria, may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.

Inorganic contaminants, such as salts and metals, can be naturally occurring or result from urban storm water runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming.

Domestic Waste Products – household waste.

Energy Productions/Thermal Waste – waste from power plants.

Herbicide – A chemical substance used to destroy or inhibit the growth of plants, especially weeds.

Industrial Waste – by products from industries.

Inorganic contaminants – include salts and metals, can be naturally occurring or result from urban storm water runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming.

Microbial contaminants – include viruses and bacteria, may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.

Non-point Source Pollution – Pollutants detected in a concentrated water source such as a stream, river or lake that come from a wide range of sources. These pollutants come from sources the common person has control over.

Nutrients – created by fertilizer, animal wastes, sewage treatment plants.

Organic chemical contaminants – include synthetic and volatile organic chemicals that are byproducts of industrial processes and petroleum production. Organic chemical contaminants can also come from gas stations, urban storm water runoff, and septic systems.

Pesticide – An agent or chemical substance used to destroy insects and pests.

Pollution –

Point Source Pollution – Pollutants that are coming from a concentrated originating point like a pipe from a factory or a large registered feedlot with a specific point of discharge. Point Source Pollution is registered sources of potential pollution and is regulated by federal, state and local laws.

Non-point Source Pollution – Pollutants detected in a concentrated water source such as a stream, river or lake that come from a wide range of sources. These pollutants come from sources the common person has control over.

Radioactive contaminants – can be naturally occurring or the result of oil and gas production and mining activities.

Resin Pellets – Very small granules used in manufacturing some plastic products. They are easily released to the environment by accident then carried by surface run-off, stream, and river waters to the ocean. Resin pellets are distributed widely in the ocean and found on beaches all over the world. (See Resources for a website to learn more).

Sediment – soil created by wind and water erosion.

Toxics – manufactured and refined products like oil, paints, anti-freeze.

Materials: General

- Water Needs Pretest
- Guam Water Kids presentation **Available on the DVD provided or online at: www.Guamwaterkids.com*
- Guam Water Kids Graphic Organizer Worksheet (1 per student)
- Pencil (1 per student)
- Projection device
- Computer with speakers
- Chart Paper
- K-W-L Large charts
- K-W-L Worksheet (1 per student)
- GWK Brain Check (1 per student)
- Large 2 Circle Venn diagram
- Drinkable water and contaminated water Venn Diagram Worksheet (1 per student)

Materials: Who Dirtied The Water/Clean Water: Is It Drinkable?

- plastic containers with lids
- sand
- charcoal
- dry grass
- crushed shells
- shells
- organic garbage
- nails
- potting soil
- nylon line
- toilet paper
- colored paper
- newspaper
- plastic Styrofoam pieces
- dish detergent
- baking soda
- oil
- molasses
- vinegar
- bell jar

Materials: Clean Water: Is It Drinkable?

Supplies

- beakers
- rubber bands
- nylon mesh
- sand
- charcoal
- cotton balls
- water
- graduated cylinder
- test tubes
- ring stand
- filter paper
- dirty water

Activity:
Importance of Water K-W-L
Accessing Prior Knowledge

Show Visual: Large K-W-L

Teacher Pass Out: K-W-L worksheet (1 per student)

Teacher Asks:

Why is water important for humans?

Teacher Records: The class responses on the board

Students Take Notes: The class responses on their K-W-L worksheet

Use: Importance of Water K-W-L (worksheet)

Activity:
Human Need for Water Pretest
Accessing Prior Knowledge

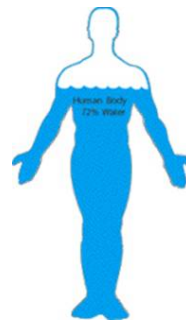
Teacher: Give each student a copy of the test to fill in on their own to determine attitudes and knowledge about water. Go over these answers to the test with the class and the related trivia that follows.

Use: Human Need for Water Pretest in the Student Organizer

Answer Key

Question 4. (Fill in the blanks section)

- A. H_2O
- B. 70 (Drawing shows about 70%)
- C. 97
- D. 70% (see figure at right)
- E. oxygen, nutrients
- F. waste
- G. 49.5 some may find 80
- H. urine, sweat and breath
- I. 2-3
- J. 3



Human Need for Water

The human body is 70% water:

- If you use 1% of your body's water, you feel thirsty.
- If you use 5% of your body's water, you will have a fever.
- If you lose 10% of your body's water, you will not be able to move.
- Losing 12% of your body's water results in death.

Staying sharp:

- Even MILD dehydration will slow down one's metabolism as much as 3%.
- Lack of water, the #1 trigger of daytime fatigue.
- Preliminary research indicates that 8-10 glasses of water a day could significantly ease back and joint pain for up to 80% of sufferers.
- A mere 2% drop in body water can trigger fuzzy, short-term memory, trouble with basic math, and difficulty focusing on the computer screen or on a printed page.
- The human brain functions clearly with 90% water

Source: Every Body Counts, Every Drop Matters, UN Classroom Resource Guide

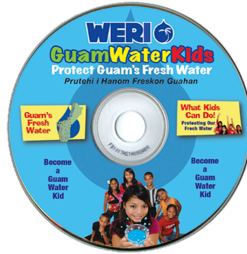


Brain Check

Human Need for Water

Use: Brain Check: Human Need for Water (Worksheet)

Activity:



Guam Water Kids Narrated Slide Presentation

Visual: Show excerpts from the Guam Water Kids presentation.

Review: Drinkable water: Slides #23-32

Review: Animated illustrations showing pollution of two key resources:

- a water shed with examples of common pollutants, slide #53-55
- the Northern Guam Lens Aquifer #65-68

Record: Students take notes on the Guam Water Kids Graphic Organizer.

Use: Guam Water Kids Water Pollutants Graphic Organizer (Worksheet)

Activity:

Water Contaminants K-W-L

Show Visual: Large K-W-L

Teacher Pass Out: K-W-L worksheet (1 per student)

Teacher Asks:

What are water contaminants?

Teacher Records: The class responses on the board

Students Take Notes: The class responses on their K-W-L worksheet

Use: Water Contaminants K-W-L Chart

Activity:
Water Contaminants Pretest

Teacher: Gives each student a copy of the pretest. Go over the answers in the pretest key with the class.

USE: Water Contaminants Pretest (worksheet)

Water Contaminants Pretest Answer Key

1	<p>Point Source Pollution Pollutants that are coming from a concentrated originating point like a pipe from a factory or a large registered feedlot with a specific point of discharge. Point Source Pollution is registered sources of potential pollution and is regulated by federal, state and local laws.</p> <p>Non-point Source Pollution Pollutants detected in a concentrated water source such as a stream, river or lake that come from a wide range of sources. These pollutants come from sources the individual people have control over.</p>
2	<ol style="list-style-type: none"> 1. Sediment (Wind and water erosion of soils) 2. Nutrients (Fertilizer, animal wastes, sewage treatment plants) 3. Animal Wastes (Fecal coliform from livestock and septic systems) 4. Pesticides (Herbicides, insecticides, fungicides, etc...) 5. Salt (Mostly from applied road salt) 6. Toxics (Manufactured and refined products like oil, paints, anti-freeze)
3	<p>Industrial Waste Agricultural Waste Domestic Waste Products Energy Productions/Thermal Waste</p>
4	<p>Microbial contaminants, such as viruses and bacteria, may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.</p>
5	<p>Cause: Fecal matter</p>
6	<p>Contaminants: Pathogenic viruses Bacteria Protozoa</p>
7	<p>Inorganic contaminants, such as salts and metals, can be naturally occurring or result from urban storm water runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming.</p>
8	<p>Pesticide - An agent or chemical substance used to destroy insects and pests. Herbicide - A chemical used to destroy/inhibit growth of plants, especially weeds.</p>

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9	Organic chemical contaminants include synthetic and volatile organic chemicals that are byproducts of industrial processes and petroleum production Organic chemical contaminants can also come from gas stations, urban storm water runoff, and septic systems.
10	Radioactive contaminants can be naturally occurring or the result of oil and gas production and mining activities.
11	Heavy Metals Resin pellets Organic toxins Oils Nutrients Solids Chemicals
12	Fertilizer Pesticides Herbicides
13	Cleaning Chemicals Soaps Detergent Food debris Grease
14	Arsenicosis Bilharzia Cholera Diarrhoea Elephantiasis Fluorosis Hookworm Malaria Schistosomiasis Trachoma Typhoid

Activity:



Brain Check

Water Contaminants

Teacher: Assign students to “check in” by using the worksheet provided.

Use: Water Contaminant Brain Check (Worksheet)

Activity

Play: Who Dirtied The Water?

Purpose:

These activities and projects are geared around the answer the following questions:

- Who is responsible for pollution of water resources and cleaning it up?
- What are some of the most effective ways to clean dirty water?

Preparation:

Label and fill the a plastic container of each contaminating substance. The filtration lab involves simply setting out the equipment for the students to select. Students may be enlisted to help gather these materials.

Class time needed:

"Who Dirtied the Water" = 1 period

"Clean Water: Is It Drinkable?" = 2 periods.

Notes: Be sure all students get to stir or to see how nasty the water looks. If you use molasses, you will not be able to get the filtrate from the systems to be colorless. The clarity of the water will improve, but the molasses will cause the water to remain a yellowish color.

Procedure:

WHO DIRTIED THE WATER? SCRIPT

As students enter the room, hand them a container that contains materials that will be added to the dirty water bell jar. The canisters will be labeled with only the entity the canister represents.

Storms: wood chips

River: sand

Runoff: charcoal

Wetlands: dry grass

Shellfish: crushed shells

Guamanians: shells

Settlers: organic garbage

Carpenters: nails

Farmers: potting soil

Fisherman: nylon line

Houses: toilet paper

Sunbathers: colored paper

Bar-B-Q Grillers: newspaper

Picnicers: plastic pieces

Boaters: Styrofoam

Laundromats: dish detergent

Merry Maids: baking soda

Ships: oil

Factories 1: molasses

Factories 2: Vinegar

Teacher:

Explains: Each student with a canister will come forward, tell the class who or what they represent, describe what they think is in the canister, and add it to the water in the bell jar.

Assigns: Gives each student **Who Dirtied the Water?** data table to record the substances and who or what is adding them.

Students are to record on their data table who or what is doing the adding and the actual substance that has been added to the bell jar. When the narrator reads the name of the entity such as “Storms” or “settlers”, the appropriate student brings the substance and adds it to the mix.

Use: Who Dirtied the Water? (Worksheet)

The Story: *Teacher or a student narrator reads:*

Who Dirtied The Water?

Once upon a time there was a beautiful land. It was almost an island, connected to the mainland by a narrow land bridge, and surrounded on three sides by a lake. The lake was filled with clear water and was dotted with a few small green islands. (*Point to the bell jar*). Fish and other aquatic life thrived in the water. The land was covered with trees and the land and the lake teemed with wildlife.

Chorus:

Would you want to swim in this lake?

Would you eat fish caught in this water?

Would you like to go boating on this lake?

Animal life flourished along a nearby river and **STORMS** were frequent. A **RIVER** ran along one side of the land, carrying sediment with it as it flowed into the lake. Periodically, after heavy rain showers, **RUNOFF** brought a variety of debris and dumped it into the lake.

WETLANDS developed along the edges of the lake. Grasses from the wetlands sometimes washed into the lake and became food for the fish.

In the shallow water, clams and other **SHELLFISH** flourished.

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A small group of people lived on this land, which they called Guam. The people were called **GUAMANIAN**. The native people fished for food and shellfish in the lake. They dumped some of their garbage near the lake. Even today, we find the piles of the shells they left.

Chorus:

Would you want to swim in this lake?
Would you eat fish caught in this water?
Would you like to go boating on this lake?

After many years **SETTLERS** from off island came to live in the area. The **SETTLERS** built a town much larger than the Guamanian villages. Some of the town's garbage was dumped into the lake.

CARPENTERS built houses, farms, and stores that filled the Inarajan Valley. As the town grew, the **SETTLERS** filled the wetlands to provide more land on which to build.

FARMERS cut down trees to clear their fields. Without the roots of trees and wetlands to hold the soil, rain carried soil into the lake.

Chorus:

Would you want to swim in this lake?
Would you eat fish caught in this water?
Would you like to go boating on this lake?

More and more **HOUSES** and shops were built, and the village of Inarajan grew into a city. Sewer pipes were constructed to remove the waste from houses and bathrooms. The sewage flowed through the pipes into the bay.

Since the wetlands had been filled in, **RUNOFF** water washed pollution from the streets directly into the lake. The water became less clear and some of the organisms certain fish and water dwelling creatures used to eat, were choked and died.

FISHERMAN found that nets made of plastic were stronger than those made of rope. Sometimes these nets got lost in the water. Sometimes water dwelling creatures got caught in them and perished.

Fisherman and other **BOATERS** sometimes threw their rubbish overboard.

Chorus:

Would you want to swim in this lake?
Would you eat fish caught in this water?
Would you like to go boating on this lake?

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The city built **LAUNDROMATS** where people could wash their clothes. The detergents went down the pipes with the sewage into the lake.

People hired **MERRY MAIDS** to clean their houses. They used poisonous tile and drain cleaners, which flowed into the sewage system.

Even swimmers and **SUN BATHERS, PICNICERS** and **BAR-B-Q GRILLERS** going to enjoy the lake sometimes left garbage on its beaches.

As the city grew, **SHIPS** came to unload their supplies. Sometimes these ships spilled oil into the lake.

FACTORIES built along the water's edge often dumped their toxic wastes and chemicals into the water.

Chorus:

Would you want to swim in his lake?

Would you eat fish caught in this water?

Would you like to go boating on this lake?

Teacher or Narrator: complete the story asking the following questions.

Socratic Dialogue

1. Who dirtied the water?
2. What did they dirty the water with?
3. What is the water like now?
4. Who do you think is responsible for cleaning it up?

Activity:
Water Educational Campaign

Overview: Students will learn a method for designing an educational campaign.

Teacher: Assign students to plan an educational campaign that helps educate young people learn about the greatest threats to Guam's supply of fresh, clean water and the most effective ways to combat them. *Give each student a copy of the Water Filter Design Process Worksheet.*

Students: Record the problems statement and other ideas on the Water Filter Design Process Worksheet.

Procedure: Show the brief slide show on the **Design Process**. * Set up the problem then review the slide show as a group and process step by step allowing students to take notes and complete their idea for a water filter on their own based on the procedure and the water pollution demonstrations they have seen in activities and observed in real life.

* A copy of the **Design Process** slide show is located on the DVD or can be downloaded at www.GuamWaterKids.com.

Use Water Filter Design Process (Worksheet)

Use Advertisement Design Process Rubric (Worksheet)

Activity:
Gallery Walk

Sentence Frame on Chart Paper - What I really liked about your project was...

Students can do a gallery walk to look at classmates' projects. Next to each project, post a graffiti board (chart paper) where students can provide positive feedback to each other's products

Explain

How does Harmful Run-Offs impact Guam fresh water supply ?

Student Reflection:

Why is Fresh water important to life on Earth?

Why do we have a global challenge to protect and keep our water supply clean?

Evaluate

Students' Service Learning Products:

Use: Performance Task Rubrics:

- Safe Water and Contaminated Water Flyer Rubric
- Safe Water and Contaminated Water Poster Rubric
- Safe Water and Contaminated Water Poster Caption Rubric

Resources

Guam Resources

WERI: Water & Environmental Research Institute of the Western Pacific at the University of Guam, www.WERIGUAM.org

Natural Resources Atlas of Southern Guam, Dr. Shahram Khosrowpanah,
<http://www.hydroguam.net/>

Guam Division of Aquatic and Wildlife Resources (DAWR)
<http://dawr.guam.gov/guams-water-resources/guams-freshwater-resources/>

Guam Water Kids
<http://guamwaterkids.com/teachers.html>

Design Slide Show
<http://guamwaterkids.com/teachers.html>

National/International Resources

U.S. Geological Survey / Educational Topics
<http://ga.water.usgs.gov/edu/sitemap.html>

National Oceanic and Atmospheric Administration (NOAA) Educational Resources
<http://www.education.noaa.gov/Freshwater/>

U.S. Environmental Protection Agency
<http://water.epa.gov/learn/kids/drinkingwater/index.cfm>

American Water Works Association

The challenges of providing clean, abundant tap water for home and commercial use, for community health and for safety including fighting fires. www.awwa.org

The State of the World's Freshwater: (Source: [The United Nations, Division for Sustainable Development](http://www.un.org/en/sustainability/)) <http://www.un.org/en/sustainability/>

International Pellet Watch (plastic resin pellets),
<http://www.tuat.ac.jp/~gaia/ipw/en/where.html>

Module 4

Graphic Organizer

This section includes “originals” to print or copy including:

- Worksheets for individual participants
- Teachers’ evaluation rubrics

Importance of Water K-W-L

Student Name: _____

Date: _____

Class: _____ Period: _____

Teacher: _____

Importance of Water K-W-L Chart

K (What I Know)	W (What I Want To Learn)	L (What I Learned)

Water Needs Pretest

Student Name: _____

Date: _____ Class: _____ Period: _____

Teacher: _____

1. What comes to mind when you think of water?

2. On a scale of 1-10 with 10 being most important, rate the importance of water by putting an X in the box:

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

3. How many glasses of water to you drink a day? Put an X in the box:

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

4. Fill in the correct answer to complete the statements below.

- A. _____ is the chemical formula for water.
- B. The Earth is _____% water.
- C. _____% of all of the Earth’s water is salt water.
- D. The human body is approximately _____ % water. Sketch the outline of a human body on the back of this sheet and shade in how much of the body is water.
- E. Water in the body delivers _____ and _____ to different parts of the body.
- F. Water in the body removes _____ from the body.
- G. Human blood is _____ % water. (10)
- H. The human body loses water through _____, _____, and _____.
- I. The average human body loses _____ quarts of water a day during normal activity.
- J. If a human doesn’t replace that lost water with any kind of fluids, he/she will die in approximately _____ days.



Brain Check

Human Need for Water

_____ **Name**

I really understand _____

I don't quite understand *or* I still wonder _____

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Guam Water Kids Presentation: Pollutants Graphic Organizer (Worksheet)

Student Name: _____ **Date:** _____

Class: _____ **Period:** _____ **Teacher:** _____

Water Pollutants	
If you wouldn't drink it, don't ...	
What are some common hazardous liquids?	
Things dumped on the ground can go to ...	
Drinking polluted water can make you ...	
Why is it important to take care of Guam's fresh water?	

Water Contaminants K-W-L Chart (Worksheet)

Student Name: _____ **Date:** _____

Class: _____ **Period:** _____ **Teacher:** _____

K (What I Know)	W (What I Want To Learn)	L (What I Learned)

Student Name: _____ **Date:** _____

Class: _____ **Period:** _____ **Teacher:** _____

Water Contaminants Pretest

Put an X in the box that fits your answer with 10 being the highest/most.

How pure do you think the water is coming from your kitchen sink?

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

How pure do you think the water is in bottled water?

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

How much effort do you put into research when trying to verify information on a topic?

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

Fill in the correct answer to complete the statements below. (36 pts.)

1. Identify the two classifications of water pollution. (2)

2.

Identify the six types of pollution that reduce water quality. (6)

3. Identify two sources of water pollution. (2)

4. Explain where microbial contaminants come from. (3)

5. Identify what causes microbial contaminants. (1)

6. Identify what is considered a microbial contaminant. (1)

7. Define herbicide. (3)

8. Define pesticide. (3)

9. Define organic chemical contaminants. (3)

10. Discuss how radioactive contaminants occur. (3)

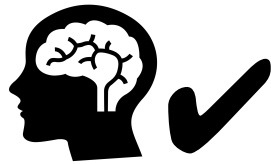
11. Identify two industrial contaminants found in water. (2)

12. Identify two contaminants caused by agricultural activity. (2)

13. Identify two contaminants caused by activity in the common household. (2)

14. Identify three diseases related to water contamination. (3)

15. Identify which question above has intrigued you the most and explain why.



Brain Check

Water Contaminants

Name

I really understand _____

I don't quite understand *or* I still wonder _____

Water Filter Design Process (Worksheet)

PROJECT TITLE:	Water Educational Campaign (advertising campaign)
STATEMENT OF THE PROBLEM:	
AVAILABLE RESOURCES: Time – Energy – Money- Materials – Tools – People – Knowledge –	
RESEARCH: (Cite Sources)	
BRAINSTORMED IDEAS: Include Appropriate Details Use Color as Necessary	
SELECT BEST IDEA: Include Appropriate Details Use Color as Necessary Justify Key Components of Solution	

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BUILD SOLUTION: Document Steps of Construction	
TEST SOLUTION: Show how it was tested Document the Results	
EVALUATE SOLUTION: Did it work as planned? What changes should be made for: Cost Savings Safety Performance Aesthetics Mass Production	

Water Filter Design Process Rubric

PROBLEM TITLE _____
DESIGNER/ENGINEER _____ **DATE:** _____

Overall Presentation 0 2 3 4 5

Portfolio is neatly organized and presented on time.
 A common theme exists throughout the portfolio (logo is included)

Statement of the Problem 0 2 3 4 5

Clearly identifies the specifics of the problem
 Details fundamental issues related to the problem
 Is neatly written using appropriate drawings and diagrams
 Utilizes factual information

Design Brief Specifications (Available Resources) 0 2 3 4 5

Details specific conditions, limitations, and requirements related to the problem.
 Is neatly written and includes appropriate details.

Research 0 3 6 9 12 15

Includes notes, sketches, letters, interview tapes, bibliography, photos, etc.
 Research should help formulate design solution(s).
 Is neatly written and may include photocopies of reference materials.

Brainstormed Ideas 0 3 6 9 12 15

Clear evidence of ideation and brainstorming.
 A wide range of ideas are considered.
 Appropriate attention to detail is evident.
 Color pencils and markers are used to accent details.
 Notes, drawings, sketches, developmental sketches, 2-D models, etc. are used.

Select Best Idea 0 3 6 9 12 15

Notes, Matrices, comparisons, checklists, etc. are used to substantiate selected idea.
 A presentation is made in color that provides appropriate attention to the dimensions and types of materials to be used.
 Attention is given to how the solution will function, including the specification of materials to be used
 Thorough consideration is given to how the solution interacts with the consumer.
 A detailed plan of action is presented, including a critical path chart so that key steps/components of the project are identified – along with projected deadline dates

Development of the Solution

0 3 6 9 12 15

A log/journal of work completed in the course of developing a working model/prototype is presented.

Photographs and sketches detailing key steps of the design process are included.

These may include comments about why the design needed to change.

Working drawing, schematics, and/or orthographic drawings are included.

The final solution is presented in a neat and aesthetically pleasing manner.

Test Solution

0 2 4 6 8 10

Photos and/or drawing of the testing procedure are included.

Appropriate attention to detail is provided (dimensions, testing steps, etc.).

Data is collected and assembled into meaningful graphs and or charts.

Evaluation of Solution

0 3 6 9 12 15

A thorough description of the test results is provided.

Sketches, drawings, and/or photos are included to illustrate key concepts.

A "self-critique" that includes what was good and bad about the solution is provided.

Social, environmental, and economic impacts related to the solution are noted.

TOTAL _____

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Performance Task Rubrics:

Pollution Impact on Fresh Water Rubric

Student Name: _____ **Date:** _____

Class: _____ **Period:** _____

Teacher: _____

Safe and Contaminated Water on Guam Educational Presentation Rubric

My Score	Information (Processes)	Information (Cycle)	Critical Thinking	Quality of Work	Final Result
4	I thoroughly explained about safe and contaminated water. I understand about safe and contaminated water so well that I can put it into my own words.	I can understand and explain the impact contaminates have on fresh water on Guam in a way that told a story that “flows” naturally.	I was really stretching my brain on this project! I connected and applied what I learned through research, and I effectively showed my understanding of why protecting fresh water is so important.	I was creative and presented my project in a unique way that people would enjoy seeing. I did my very best work and it looks polished.	I truly put my heart and my mind into my project. It contains valuable information that would entertain and really helps others understand the importance of protecting Guam Fresh water and persuading them to be a part of the movement on Guam to protect fresh water.
3	I understand about safe and contaminated water. I can explain about the issues but didn’t always go into	I showed that I know about safe and contaminated water. I presented them one at a time rather than as parts of a damaging	I put some thought into my project. I remembered the information that we learned and tried to	I was creative but I could have done better work. I know that my project would teach someone the information but I could	I am proud of my project. It has all the parts I needed to include and it could effectively teach someone

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	details.	cycle.	put it into my own words somewhere in my project. I tried to connect my ideas to come up with new ones.	have spent more time on it.	about safe and contaminated water. I can tell them about ways to protect fresh water.
2	I know that contaminants adversely impact the quality of fresh water. I did not explain about safe and contaminated water	I know that contaminants adversely impact the quality of fresh water, but I didn't demonstrate how contaminants adversely impact the quality of fresh water in an order that tells a story.	My goal was to finish the project. I made sure to complete all parts of it but didn't try to push my thinking. I included facts but didn't connect them very well with the information I've learned.	There are several mistakes and my work is quite sloppy. These mistakes and the quality of my work could make it hard for others to understand.	I finished the project. I put some important information about how contaminants adversely impact the quality of fresh water.
1	I know that contaminants adversely impact the quality of fresh water but I didn't explain how or why.	I don't quite understand how contaminants adversely impact the quality of fresh water so I had a hard time explaining it.	I didn't really understand the project and didn't ask questions so that I could put my best thinking into my work.	My work is messy and there are so many mistakes that others wouldn't be able to read or understand it.	I tried to complete the project. It is unfinished, but isn't work that I am very proud of. It won't help teach others about how contaminants adversely impact the quality of fresh water or help them to develop habits that will protect fresh water.

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Student Name: _____ Date: _____

Class: _____ Period: _____

Teacher: _____

Drip the Raindrop Journey on Earth Script Rubric

My Score	Information (Processes)	Information (Cycle)	Critical Thinking	Quality of Work	Final Result
4	Drip the Raindrop thoroughly explained about safe and contaminated water. Drip the Raindrop understands about safe and contaminated water so well that it can put it into his own words.	Drip the Raindrop understand the impact contaminates have on fresh water on Guam. Drip the Raindrop can clearly explain how contaminants impact Guam Fresh water in a way that told a story that “flows” naturally.	I was really stretching my brain on this project! I connected and applied what I learned through research, and I effectively showed my understanding of why protecting the water is so important.	I was creative and presented my project in a unique way that I knew people would enjoy seeing. I did my very best work and it looks polished.	I truly put my heart and my mind into my project. It contains valuable information that would entertain and really helps others understand how contaminants impact Guam Fresh water and successfully persuade them to conserve water.
3	Drip the Raindrop understand about safe and contaminated water. Drip the Raindrop explained how most of the issues but didn’t always go into details.	Drip the Raindrop showed that he know about safe and contaminated water. Drip the Raindrop presented them one at a time rather than as parts of a damaging cycle.	I put some thought into my project. I remembered the information that we learned and tried to put it into my own words somewhere in my project. I tried to	I was creative but I could have done better work. I know that my project would teach someone the information but I could have spent more time on it.	I am proud of my project. It has all the parts I needed to include and Drip the Raindrop could effectively teach someone about safe and contaminated water. Drip

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			connect my ideas to come up with new ones.		the Raindrop can tell them about ways to protect fresh water.
2	Drip the Raindrop did not explain about safe and contaminated water	Drip the Raindrop didn't demonstrate how contaminants adversely impact the quality of fresh water in an order that tells a story.	My goal was to finish the project. I made sure to complete all parts of it but didn't try to push my thinking. I included facts but didn't connect them very well with the information I've learned.	There are several mistakes and my work is quite sloppy. These mistakes and the quality of my work could make it hard for others to how contaminants adversely impact the quality of fresh water.	I finished the project. I put some important information about how contaminants adversely impact the quality of fresh water.
1	Drip the Raindrop didn't explain how or why contaminants adversely impact the quality of fresh water.	Drip the Raindrop had a hard time explaining how or why contaminants adversely impact the quality of fresh water.	I didn't really understand the project and didn't ask questions so that I could put my best thinking into my work.	My work is messy and there are so many mistakes that others wouldn't be able to read or understand it.	I tried to complete the project. It is unfinished, but isn't work that I am very proud of. It won't help teach others about contaminants adverse impact on the quality of fresh water or help them to develop habits that will protect fresh water.

Safe Water and Contaminated Water Flyer Rubric

Weights	4	3	2	1
Creativity (x1)	The flyer is creative. Its design clearly represents the area it explains. Color is used meaningfully.	The flyer is somewhat creative. Its design represents the area it explains. Color is used.	The flyer uses little creativity. Its design somewhat represents the area it explains. Some color is used.	The flyer is not creative. Its design does not represent the area it explains. Little if any color is used.
Content Information (x1)	The flyer includes two true facts about the area. A picture that looks like the area is included.	The flyer includes one true fact about the area. A picture that resembles the area is included.	The flyer includes inaccurate facts about the area. Picture is not included or does not look like the area.	The flyer does not include facts about the area. Picture is not included or does not look like the area.
Conventions (x1)	All words are spelled correctly in the title, labels and caption.	All familiar words are spelled correctly in the title, labels and caption. One or two scientific words may be misspelled.	Most of the words are spelled correctly in the title, labels, and caption.	Few of the words are spelled correctly in the title, labels, and caption.
Penmanship (x1)	Writing is very neat and easy to read.	Writing is neat.	Writing is somewhat sloppy.	Writing is very sloppy.
Art Connection (x1)	Invitation clearly shows an understanding of the use of symbols in art to communicate meaning	Invitation shows an understanding of the use of symbols in art to communicate meaning.	Invitation somewhat shows an understanding of the use of symbols in art to communicate meaning.	Invitation does not show an understanding of the use of symbols in art to communicate meaning.

Safe Water and Contaminated Water Poster Rubric

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Weights	4	3	2	1
Labeling (x1)	Every item that needs to be identified has a label. Drawing includes an accurate title.	Most items that need to be identified have labels. Drawing includes an accurate title.	Some items that need to be identified have labels. Includes a title.	Few of the items that need to be identified have labels. Title is missing or not suitable for drawing.
Content and Accuracy (x2)	Poster includes all assigned information including: pictures of the area. All information is correct.	Poster includes most assigned information including: pictures of the area. Most information is correct.	Poster includes some assigned information including: pictures of the area. Some information is correct.	Poster includes little of the assigned information including: pictures of the area. Information is incorrect.
Conventions (x1)	All words are spelled correctly in the title, labels and caption.	All familiar words are spelled correctly in the title, labels and caption. One or two scientific words may be misspelled.	Most of the words are spelled correctly in the title, labels, and caption.	Few of the words are spelled correctly in the title, labels, and caption.
Penmanship (x1)	Writing is very neat and easy to read.	Writing is neat.	Writing is somewhat sloppy.	Writing is very sloppy.
Science Connection (x1)	Information included on the poster clearly demonstrates an understanding the area ecosystem.	Information included on the poster mostly demonstrates an understanding of the area ecosystem	Information included on the poster somewhat demonstrates an understanding of the area ecosystem.	Information included on the poster does not demonstrate an understanding of the area ecosystem.

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Safe Water and Contaminated Water Poster Caption Rubric

Weights	4	3	2	1
Content and Accuracy (x1)	Caption contains many true facts about the picture.	Caption contains some true facts about the picture.	Caption contains few true facts about the picture.	Caption does not contain true facts about the picture.
Conventions (x1)	Few or no errors in grammar, spelling, capitalization, and punctuation.	All familiar words are spelled correctly, some errors in spelling of content words. Some errors in capitalization, and punctuation, but the errors do not affect understanding.	Has many errors in grammar, spelling, capitalization, and punctuation, and somewhat affects understanding.	Shows little evidence of understanding correct grammar, spelling, capitalization, and punctuation.
Penmanship (x1)	Writing is very neat and easy to read.	Writing is neat.	Writing is somewhat sloppy.	Writing is very sloppy.
Science Connection (x1)	Caption contains information that clearly shows an understanding of the relationship between the health of human, animals, and plants and contaminated water.	Caption contains information that shows some understanding of the relationship between the health of human, animals, and plants and contaminated water.	Caption contains information that shows minimal understanding of the relationship between the health of human, animals, and plants and contaminated water.	Caption does not contain information that shows an understanding of the relationship between animals and the things they need in order to survive. the health of human, animals, and plants and contaminated water.

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Student Name: _____ Date: _____ Class: _____
Period: _____ Teacher: _____

Student Reflection
(In Class – After Each Module)

My point of confusion was ...	
What I learned was	
I gained a new/greater understanding of _____ by/when	
This learning is important because it connects to my previous learning/experience, myself, and/ or my world (<i>circle one</i>), in the following way...	
What I found meaningful about this module is...	