

Lesson 1.3: Earth and Space Science – Water Pollution

Weekly Focus: Compare and Contrast
Weekly Skill: Reading for Main Idea

Lesson Summary: This week students will read and report in a jigsaw fashion on the main points of water pollution. Students will then read two articles on ground water contamination and use a graphic organizer (Venn Diagram) to compare and contrast.

Materials Needed:

- Jigsaw reading for main idea **Unit 1.3 Handout 1**
- Compare and contrast reading with Venn diagram **Unit 1.3 Handout 2**
- Homework (optional) **Unit 1.3 Handout 3** (Spectrum Science, Gr. 6, pages 114-115)

Objectives: Students will be able to...

- Understand the main sources of water pollution.
- Compare and contrast sources of ground water contamination using primary source documents.

College and Career Readiness Standards: RI, RST, SL

ACES Skills Addressed: EC, LS, AL, CT, SM

Notes: There is a lot of reading for this lesson. Students need to read for the main idea to report to others. They are also using evidence from the readings (primary source documents – news articles) to compare and contrast using a graphic organizer (Venn Diagram). These skills used in class are needed in many areas of the GED® 2014. Also, please note that **Routine 4** is used in this lesson.

GED 2014 Science Test Overview – For Teachers and Students

The GED Science Test will be 90 minutes long and include approximately 34 questions with a total score value of 40. The questions will have focus on three content areas: life science (~40%), physical science (~40%), and Earth and space science (~20%). Students may be asked to read, analyze, understand, and extract information from a scientific reading, a news brief, a diagram, graph, table, or other material with scientific data and concepts or ideas.

The online test may consist of multiple choice, drop down menu, and fill-in-the-blank questions. There will also be a short answer portion (suggested 10 minutes) where students may have to summarize, find evidence (supporting details), and reason or make a conclusion from the information (data) presented.

The work students are doing in class will help them with the GED Science Test. They are also learning skills that will help in many other areas of their lives.

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Activities:

Warm-Up:

Time: 5 – 10 minutes

As students enter the class, have students write in their journals, on a piece of notebook paper, or discuss with small groups the following: “What are some sources of water pollution?” Note: write the question on the board or overhead. If students are comfortable, you can ask them to share out their responses and write them on the board.

Activity 1: Jigsaw Reading and Reporting (Lesson 3 Handout 1)

Time: 50 minutes

- 1) Put students into 5 groups labeled A, B, C, D, E. 2) Hand out one section A of the reading (**Unit 1.3 Handout 1**) to group A, handout out section B to group B and so on so each of the 5 groups has their own labeled reading. **Note:** the last page of the handout is for step # 6 – so keep it until the appropriate time. 3) Ask each group of students to read their section (A, B, C, D, E) silently and then share their findings within their group. Explain how they are reading to become experts of the material and then to share their knowledge from their section with the other groups.
- 4) Tell students when they are done reading silently, they should turn their papers over and discuss what their section is about to others in their group. They should also discuss how they would like to present the materials to the other groups. Explain that the other groups will have to take notes in order to understand. 5) After groups have read and discussed their section, each group will present their section of the reading to the class. The other groups will take notes of the material presented on last page of **Unit 1.3 Handout 1**. 7) If there is time, students can write a 3 – 5 sentence summary of the material presented and compare it to the review summary on the last page, use **Routine 4 Summarizing Techniques Handout**

Break: 10 minutes

Activity 2: Compare and Contrast (Unit 1.3 Handout 2) with Venn diagrams

Time: 45 minutes

- 1) Ask students what they remember about using a Venn Diagram from the last class. Ask them why it is helpful to study?
- 2) Hand out reading two (**Unit 1.3 Handout 2**) to students. Explain how they will read for information and use evidence from the two articles to compare and contrast in a Venn diagram. This is similar to what they did in the lesson on Atmosphere, only there are more diagrams in order to compare more information from the readings.
- 3) Explain to students that they should read articles silently and then use evidence from the readings to fill out portions of the Venn diagram.
- 4) Model how to fill in the first of the Venn diagrams (*cause of the water pollution*) with the whole class. Ask guiding questions, “What is the cause of the water pollution in the first article?” (answer: underground oil storage tanks) and have students underline the evidence from the reading. It is okay to have students take time to find the answer. Use the same guided question practice with the second article and have students underline the evidence. Then ask if the cause of water pollution is the same. If it is the same, they will write it in the space in the middle where the two circles overlap. If it is different, they will write it in the circle corresponding to the article. (The cause

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is the same: leaking underground storage tanks). Explain to students that if there is not a prevention method stated, they may have to make a conclusion with evidence

5) If students seem to understand, have them finish the other 3 diagrams and then compare with a partner or a table group. Circulate the classroom to see that students are finding the evidence and putting it in the appropriate Venn diagram

6) When all are finished and if there is time, the teacher reads the articles aloud and checks with students for overall comprehension

7) Bring the class together and ask for volunteers to share the information and evidence they have in the compare and contrast parts of the Venn diagram.

Wrap-Up: Summarize

Time: 5 minutes

Have students turn to a partner (or write in their journals) and discuss what are the main sources of water pollution and what are 2 ways to prevent it from occurring. You could also have an “exit ticket” – where students write down one source of water pollution and a possible solution and give you their ticket as they exit class. This will help to inform what they learned from the lesson. See **Routine 4 Summarizing Techniques Handout** for more ideas and information on this.

Extra Work/Homework: Groundwater Demo or Unit 1.3 Handout 3

Time: 40 minutes

A good groundwater demo would be in order if you have the materials. For example, using an acrylic groundwater box (rectangle with a drain hole in one side) with gravel and sand in it, fill partially with water and make a ‘pond’ by moving sand aside in the middle (add enough water to fill the pond but not go above the rest of the sand and gravel). Put some food color drops on the gravel on the side opposite the plugged drain. Have students watch the food color spread down and into the groundwater. Then pull the plug on the other end. The food color will very rapidly move toward the drain and into the pond. The pond will quickly fill with the food coloring and head out the drain. This will help students realize how pollution will move through groundwater.

or

Homework can also be given to students – see **Unit 1.3 Handout 3**

Differentiated Instruction/ELL Accommodation Suggestions	Activity
If students arrive late for the jigsaw readings, they can take notes from others and try to summarize the information.	Unit 1.3 Handout 1
Teachers should be aware that it may be necessary to review steps to using a Venn diagram with students. This lesson uses 4 Venn diagrams to search for different questions from two readings. Explain to students it is a complex task, but is one that may be on a GED 2014 test.	Unit 1.3 Handout 2

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Online Resources: <http://www.geosociety.org/positions/position17.htm>

Suggested Teacher Readings:

http://www.geosociety.org/educate/lessonplans/E_envir.htm

- GED Testing Service – GED Science Item Sample (to get an idea of what the test may be like)

<http://www.gedtestingservice.com/itemsamplerscience/>

- Assessment Guide for Educators: A guide to the 2014 assessment content from GED Testing Service:

<http://www.riaepdc.org/Documents/ALALBAASSESSMENT%20GUIDE%20CHAPTER%203.pdf>

- Minnesota is getting ready for the 2014 GED test! – website with updated information on the professional development in Minnesota regarding the 2014 GED.

http://abe.mpls.k12.mn.us/ged_2014_2

Unit 1.3 Handout 1

Group A.

Water Pollution

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Assignment 1: Reading Jigsaw – groups will research the following questions and report back to the whole class.

A. What is water pollution and what are two sources of pollution?

- B. What are examples of point sources of pollution?
- C. What are examples of non-point sources of pollution?
- D. What are the different types of water pollution?
- E. How can water pollution be prevented?

A. What is water pollution and what are two sources of pollution?

Water pollution is water that has been contaminated with harmful wastes. There are some forms of water pollution that occurs through natural processes, but it is mainly the result of human activity.

Everyone uses water on a daily basis in their homes and industries. The water that is used is taken from lakes, rivers and underground, which is known as **groundwater**, and after we have used and contaminated the water it is returned to the lakes, rivers and underground.

Wastewater is the water that is used by a community, and can also be referred to as **sewage**. If the water is left untreated before being released into the waterways, serious problems will occur. Humanity has taken its time to come to the realization of this serious problem. Water pollution also happens when rain water runoff from industries, rural, urban areas, and from mining operations and agricultural makes its way back into the lakes, rivers, streams, and oceans, which are **receiving waters**, and into the ground.

The two sources of pollution are **point** and **non-point**. Point source pollution is when the source of pollution comes from only one point to the rivers. Non-point source pollution is when the source of pollution comes from the disturbance of the earth or from land that has been contaminated. Pinpointing these sources is hard to find.

Unit 1.3 Handout 1

Group B.

Water Pollution

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Assignment 1: Reading Jigsaw – groups will research the following questions and report back to the whole class.

A. What is water pollution and what are two sources of pollution?

B. What are examples of point sources of pollution?

C. What are examples of non-point sources of pollution?

D. What are the different types of water pollution?

E. How can water pollution be prevented?

B. What are examples of point sources of pollution?

Point Sources

1. Industry: Industry plays a big part in the occurrence in point source pollution. The wastewater and industrial discharges consist of greases, oils, metals, and chemicals like PCB's, pesticides, and debris that will, at some point, make their way back to the rivers.

2. Oil and Grease: Oil spills and dumping play a serious role in point source pollution. Grease spills, oil and the other hazardous substances that result from leaking cars, overturned trucks and oil tankers have a serious impact on the rivers and sewers because they will eventually end up as runoff and flow back into the water. When used motor oil or grease is disposed of, it will affect the water by running into storm sewers that overflow back into the rivers, or it is deposited directly into the rivers.

3. Additional Point Sources: The water is affected by overflow pipes from companies, industries, and other building that is depositing their wastes back into the rivers and lakes. This is referred to as thermal pollution, which causes the waters ability to hold oxygen to decrease.

Unit 1.3 Handout 1

Group C.

Water Pollution

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Assignment 1: Reading Jigsaw – groups will research the following questions and report back to the whole class.

- A. What is water pollution and what are two sources of pollution?
- B. What are examples of point sources of pollution?
- C. What are examples of non-point sources of pollution?**
- D. What are the different types of water pollution?
- E. How can water pollution be prevented?

C. What are examples of non-point sources of pollution?

Non-point Sources

- 1. Waste:** Rivers, lakes and streams serve as a dumping ground for wastes. The types of wastes being dumped without a permit include raw sewage, paint, debris, natural debris, private and public litter, oils, scums, chlorides metals (lead, zinc, copper, cyanide, iron, chromium, and nickel), toxins from home use and industries, organic pollution (pet wastes, grass, leaves, human sewage, and dead organisms), and inorganic pollution (dissolved or suspended solids).
- 2. Sediment:** Sediments come from many different sources which are highly traveled open spaces that are not vegetated, abused stream banks, wetlands and streams that have been modified, other bodies of water, farm land that has been highly tilled and has caused the soil to erode and materials that are decomposed.

The problem that is caused by sediment is that it destroys the aquatic habitat by removing the riparian vegetation and alters the stream's natural hydrology. Not all of these particles sink and results as a muddy appearance. Some of the sediment particles may be contaminated and when they come in contact with the fish, can cause death.

Unit 1.3 Handout 1

Group C.

Water Pollution

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3. **Runoff:** Runoff consists of liquid substances that flows from one place to another and is not absorbed by the ground. In rural and urban areas the runoff from streets and buildings consists of trash, oil, grease, road salts, lead, metals, lawn fertilizers, bacteria, and PCB's.

Agricultural storm runoff comes from melting snow and rain that carries pesticides, animal wastes, nutrients and sediments into ground and surface waters. Other contributing sources of storm runoff are timber cutting, logging, and construction sites.

4. **Leakage:** Leakage occurs from abandoned sawmills, surface mining and waste piles that leak sediments, chemicals and acids. Without proper disposal of these wastes, serious groundwater contamination can result.

5. **Sewers:** Sewers are combined overflows that consist of storm water and untreated sewage and sanitary sewer overflows are a major problem if overflowing occurs into the lakes and rivers. The overflowing deposits trash, bacteria, wastes, and other harmful pollutants into the water sources.

Unit 1.3 Handout 1

Group D.

Water Pollution

page 1/2

Assignment 1: Reading Jigsaw – groups will research the following questions and report back to the whole class.

- A. What is water pollution and what are two sources of pollution?
- B. What are examples of point sources of pollution?
- C. What are examples of non-point sources of pollution?
- D. What are the different types of water pollution?**
- E. How can water pollution be prevented?

D. What are the different types of water pollution?

Different Types of Water Pollution

The different types of water pollution are **microbiological, chemical, suspended matter, nutrients, and oxygen-depleting substances.**

- 1. Microbiological:** Microbiological is the disease causing microorganisms that include bacteria, viruses, and protozoa that can cause anyone who swims in the water to become sick. The shellfish and fish that become contaminated and the people who ingest them may become ill.

- 2. Chemicals:** Chemicals from industrial wastes that include solvents and metals and chemicals that are formed by the breaking down of natural wastes, example: ammonia is poisonous to aquatic life and fish. Materials like detergents and oils that remain on top of the water destroys its appearance and the chemical pollutants will cause an unpleasant odor. If chemical waste that is flammable is dumped into the water, there is a risk that the river may catch on fire.

Unit 1.3 Handout 1

Group D.

Water Pollution

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- 4. Suspended Matter:** Suspended matter is the tiny particles that are suspended in the water. They may be kept in suspension by the movement or turbulence, when in the receiving water, they will at some point in time settle out and form mud or silt at the bottom of the water. These sediments decrease the depth of the body of water.

- 5. Nutrients:** Phosphorous and nitrogen are the elements necessary for the growth of plants and are found in abundance in wastewater. In lakes and streams they cause an over growth of aquatic weeds, referred to as **blooms**, which are microscopic plants, and can present lots of problems. The accumulation of these weeds makes lakes and rivers unsuitable for swimming and boating. When this water is used as a drinking water source, the algae can clog the filters and cause unpleasant odors and tastes to finished water.

- 6. Oxygen-Depleting Substances: Biodegradable waste** is wastes that is broken down and used as food by the microorganisms like bacteria. If there is too much biodegradable material, then this can cause a serious problem, oxygen depletion, in the receiving waters. Fish and aerobic microorganisms that live in the water use oxygen gas that is dissolved in the water when they ingest their **food**.

The clean-up of water pollution can be expensive. If we do our part by using preventive measure at home and work then the water resources will be returned to their natural state, free of waste and usable.

Unit 1.3 Handout 1

Group E.

Water Pollution

Page 1/1

Assignment 1: Reading Jigsaw – groups will research the following questions and report back to the whole class.

- A. What is water pollution and what are two sources of pollution?
- B. What are examples of point sources of pollution?
- C. What are examples of non-point sources of pollution?
- D. What are the different types of water pollution?
- E. How can water pollution be prevented?**

E. How can water pollution be prevented?

Ways to Prevent Water Pollution

- Never throw wastes into drains because of convenience.
- Dispose of garbage in a bin, landfill or by composting.
- Never wash animal waste into trenches. Scoop up the waste and place it in a plastic bag and dispose of in a trashcan or bin.
- Never dispose or wash pesticides or toxic chemicals into storm drains or trenches.
- Find out where to take harmful waste in your area.
- Use fertilizers in small quantities and do not apply them if rain has been forecasted.
- Dispose of hazardous waste like asbestos, car batteries, and sewage from septic tanks, in a sanitary landfill. To do this you must obtain a permit from the town, state or city.
- Dispose of used motor oil at recycling centers. These are usually located at an area gas station or check to see where the nearest recycling center is located.

Unit 1.3 Handout 1

This page is for all groups to write notes from presentations.

Summarize the information presented by each group in the space below to answer the question. Make sure you have the information needed for understanding the key concepts and answer the questions completely.

- A. What is water pollution and what are two sources of pollution?

- B. What are examples of point sources of pollution?

- C. What are examples of non-point sources of pollution?

- D. What are the different types of water pollution?

- E. How can water pollution be prevented?

Review: In this lesson we have read that water pollution is contamination by harmful wastes and the main cause is human activities. Water pollution comes from point and non-point sources. Point source is easy to locate because it comes from one point of river, lake or stream, but non-point is hard to locate because it can come from anywhere within a distribution pipeline system. Many different types of water pollution exist, which include microbiological, chemical, suspended matter, nutrients, and oxygen-depleting substances. To prevent water pollution we must properly dispose of wastes and hazardous chemicals. If we follow the guidelines for disposal then our water resources will remain free of contamination.

References

EPA: Information on point and non-point sources, International Water Law 1989: Groundwater

Unit 1.3 Handout 2 – page 1 of 3

Assignment 2: Cause and Effect

Name _____

Date: _____

Groundwater Contamination

Groundwater is one of our most valuable drinking water resources. It is also very important to many agricultural areas. Since it is filtered through the ground, it is often fresh and cold, and usually cleaner than surface water. Unfortunately, groundwater is threatened every day by people who do not even realize what it is or how they are affecting it. More and more states are adopting laws that govern sources of contamination, like storage tanks, but there is no national policy.

Storage tanks are used to hold all sorts of materials, but most often for gasoline, oil, or other hazardous chemicals. The tanks can be located above the ground or below ground. The latter is referred to as an underground storage tank or UST. They cause the most problems because, unless carefully monitored, leaks can go undetected for days or for months, until the contents of the tank have seeped into the ground. And where do the chemicals go? Often they seep right down into the groundwater, and can affect the drinking water of any nearby properties using it.

ASSIGNMENT 2:

The following two articles are about two real problems with leaking storage tanks. Read the articles carefully and compare them. *What is the cause of the pollution? What are some of the effects of this pollution? What is a possible solution to the problem? Are there ways to prevent further contamination?* Keep these questions in mind as you read the articles. You will use a graphic organizer to analyze these ideas.

There are other sources of contamination of groundwater as well. For years, some industries would dump toxic wastes into ponds or swampy area, not realizing that the waste could eventually get into someone's drinking water. Some agricultural areas have trouble with pesticides and herbicides from farm runoff that seeps into the drinking water. Even sewage from toilets or livestock can contaminate water with dangerous bacteria.

Vocabulary List: Look up and understand these terms as you read:

aquifer

hazardous chemicals

plume

solvents

toxic waste

underground storage tanks (USTs)

Unit 1.3 Handout 2 – page 2 of 3

Article #1

TANKS A LOT!

You can't see them. They're buried underground. But they're ready to cause havoc and fear among the populace. No, "they" are not zombies or the living dead in a horror movie. We're talking about the rusty, leaky, underground oil storage tanks found beneath towns and cities big and small throughout the United States. What's really scary is the fact that no one knows for sure how many of these tanks exist.

Whatever the number, it's clear these tanks pose a problem. How big a problem? One Environmental Protection Agency (EPA) estimate says that 11 million gallons of gasoline alone seep into the ground annually. That's the equivalent of the Exxon Valdez oil spill happening every year without our even seeing it!

Because the spills occur underground, it's easier for the pollution to reach sources of drinking water. And it only takes a single gallon of gasoline to make 1 million gallons of water undrinkable.

Fortunately, technology has provided some solutions for the problem. One approach is to use double-walled tanks with special monitoring systems between the walls. If the first wall springs a leak, an alarm goes off. Then, the second wall traps the leak until help arrives. Tank makers are also using fiberglass and other nonmetal materials to eliminate rust and corrosion that could cause leaks.

Replacing old tanks with the new tanks is expensive. But it is one sure way to clean up a continuing source of oil spills.

From Current Health 2, October 1992

Article #2

Danger Below the Sands

Over several decades, millions of gallons of aviation fuel, solvents, and other toxic chemicals were dumped or spilled on the grounds around Otis Air Force Base on Massachusetts' Cape Cod. Leaky underground storage tanks, sewage systems, and other sources of contamination throughout the Cape also released hazardous chemicals into the ground.

These chemicals have now seeped underground into the aquifer, from which cities, towns, and individuals on the Cape draw their water. Cape Cod rests on hundreds of feet of sand left after the last Ice Age. Far below the surface, this sand holds rainwater that has seeped down through the sand. Once in the aquifer, the water travels toward the sea, following underground contours in the aquifer.

Unfortunately for the people of Cape Cod, the underground pollution has reached the aquifer and is on its way to the ocean. This means that municipal and private wells throughout the island are becoming contaminated. What's more, the underground pollution is traveling outward toward the sea in plumes. These plumes are found at different depths, depending on the kind of pollutant. Solvents are heavy and sink deeper in the aquifer before they spread outward. Organic pollutants may stay at shallower levels. So simply changing the depth of wells will not solve the problem.

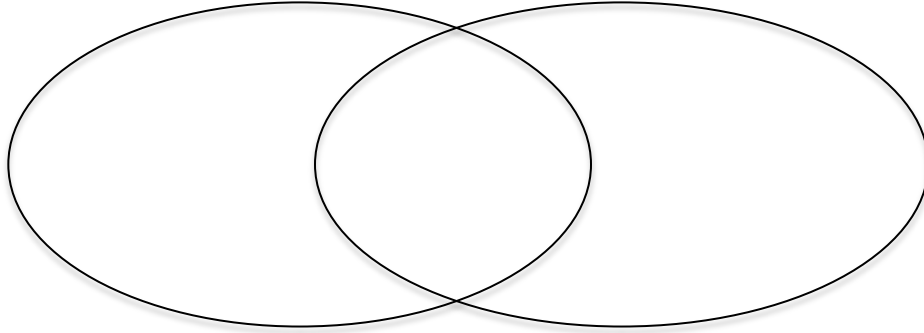
Scientists estimate that it may take 100 years for the toxic materials to work their way through the Cape Cod aquifer.

From Current Health 2, March 1993

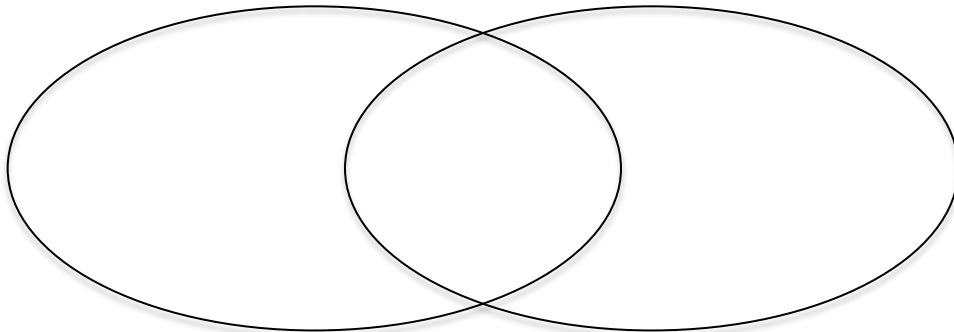
Article 1.

Article 2.

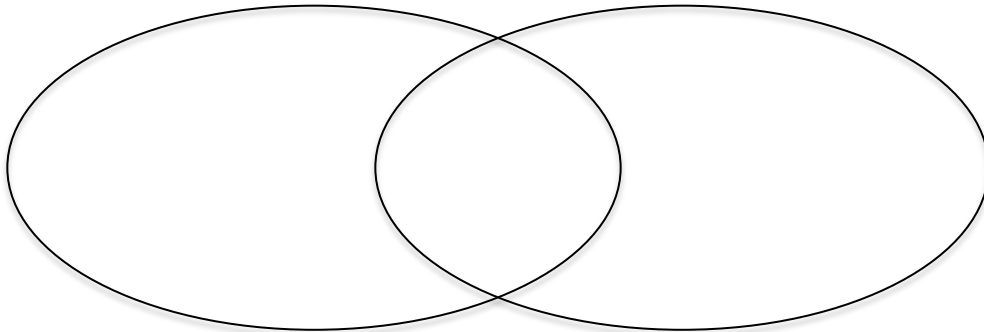
Cause: *What is the cause of the pollution?*



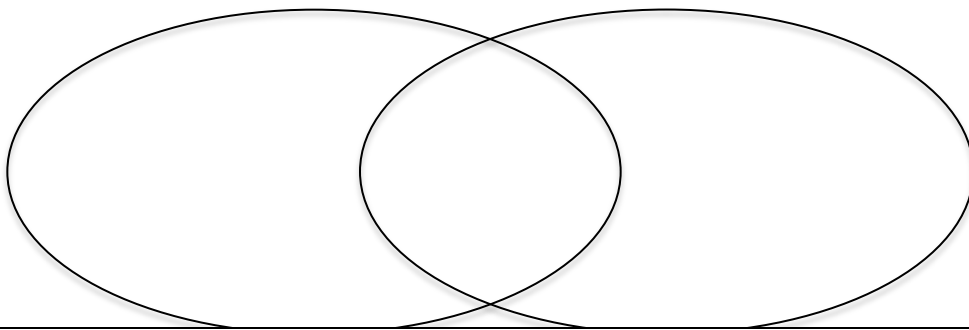
Effect: *What are some of the effects of the pollution?*



Solution: *What is a possible solution to the problem?*



Prevention: *Are there ways to prevent further contamination?*



Unit 1.3 Handout 2

Lesson adapted from: http://www.geosociety.org/educate/lessonplans/groundwater_contamination.pdf

Teacher Instructions and Answer Key (two pages)

Explain that the students should find the following in each article:

- **cause** of the water pollution in each article
- the **effect** of the contamination
- **solution** to the present contamination
- and **prevention** of future contamination

They should put the information in the appropriate oval in each Venn diagram.

If the articles have the same answer, it should go in the middle part that overlaps. Each article does not necessarily address all four issues. There may be blank areas in the ovals. For example, both articles have the same cause, leaking underground storage tanks (USTs), so students should put that in the overlapping area of the ovals by "Cause" and the second article also states there are other contamination sources from dumping and sewage systems, so these causes would only be on the Article 2 side of oval.

It takes some time to use and become proficient with graphic organizers, however, the payoff will be better overall comprehension of the different reading materials.

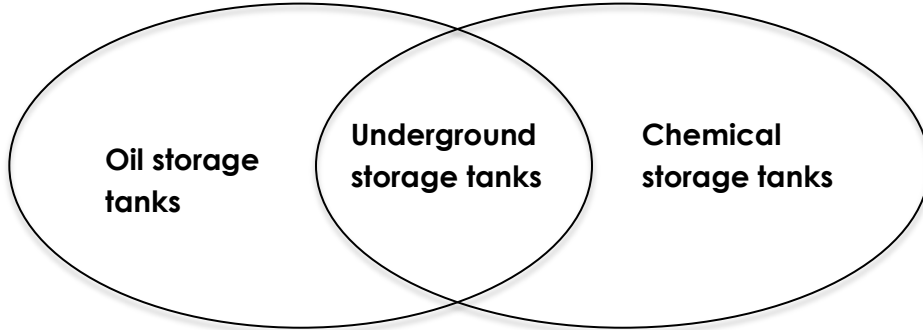
Unit 1.3 Handout

Cause and Effect with Venn Diagrams – ANSWER KEY

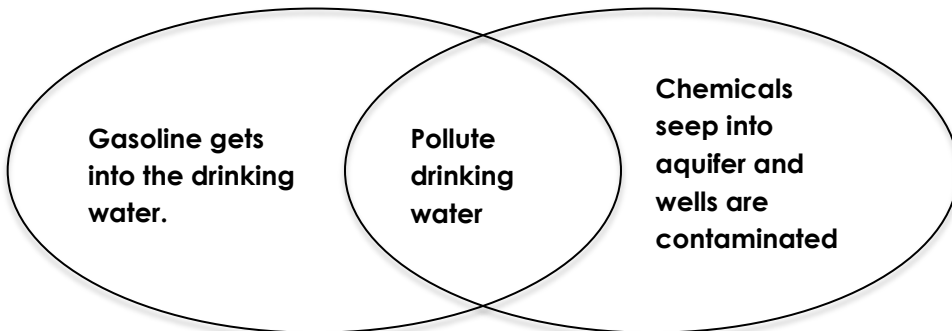
Article 1.

Article 2.

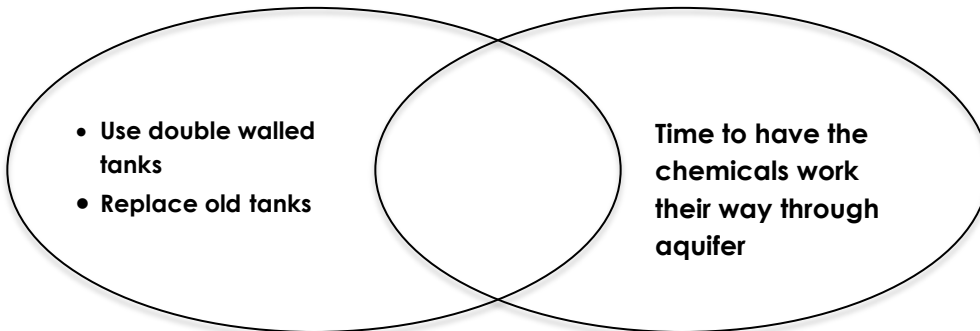
Cause: *What is the cause of the pollution?*



Effect: *What are some of the effects of the pollution?*



Solution: *What is a possible solution to the problem?*



Prevention: *Are there ways to prevent further contamination?*

