Imagine a Day Without Clean Water:

Middle School English Language Learners Advocate for Clean Water for All

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Abstract

American citizens often take having access to clean water for granted. However, this is not the case for many immigrant students who have come to the United States. In this curriculum unit, English Language Learners will learn about the water contaminants and the health risks associated with contaminated water worldwide. Also, they will appreciate the drinking water treatment process in the United States.

Moreover, students will learn about lead which can enter tap water through plumbing; specifically lead pipes, faucets, and fixtures. Students will learn strategies to reduce lead exposure in their homes and be empowered to educate and advocate for lead free pipes in their homes as well as in their local cultural communities.

Key Words: water contaminants, water scarcity, lead, English Language Learners, clean water, water treatment plant

"Clean water and access to food are some of the simplest things that we can take for granted each and every day. In places like Africa, these can be some of the hardest resources to attain if you live in a rural area " (Samuelsson, 2001).

-Marcus Samuelsson

Unit Content

Problem Statement

Can you imagine a day without clean drinking water? Most United States citizens cannot. We take it for granted. We turn on the kitchen faucet and clean water comes out. Then, we go about our day cooking with it, bathing in it, and drinking it. We flush our toilets and the dirty water goes away. The efficiency of that process is almost like magic! Americans don't think about the infrastructure that brings water into our homes and safely returns water to the environment (2023).

Unfortunately, that is not the experience of many people across the globe. More than 2 billion people do not have access to clean water (Bayram, 2023). For example, in some parts of India, children stand in long lines to get clear plastic jugs of dirty water to drink from the roadside (Kurup, 2017). Scientist, Deepika Kurup describes the water as " too dirty to touch" (Kurup, 2017).

I am classified as an English to Speakers of Other Languages (ESOL) teacher at the Robert B. Pollock School. It is a public school in the northeast section of Philadelphia. In the 2022-2023 school year, more than 22% of our school population were English language learners who collectively speak more than 18 different languages (*Student Enrollment and Demographics 2022-2023*). Although I am referred to as an ESOL teacher in my school district, there are many different names for the students I serve. They are also referred to as English Language Learners (ELL), English Learners (EL), and Multilingual Lingual Learners (MLL). For the purposes of this curriculum, I will refer to my students as ELL students.

I have the honor of teaching students in grades 6th, 7th, and 8th grade from all over the world. I especially enjoy talking with them about their experiences in America as well as their experiences in their home countries. Many are fleeing political turmoil, persecution, and drastic poverty. To make things worse, clean water scarcity has been a factor in many of their young lives.

To further illustrate, my 7th grade student from Colombia informed me that she is worried about Philadelphia water. She is accustomed to using bottled water for everything including brushing her teeth. She said that the drinking water was not safe in her area. Healing Waters International confirms my student's experience and further asserts that parts of Colombia do not have safe drinking water. In fact, only 84% of the country has access to a sewage system (Bensen, 2023). This access is usually in the urban areas. When there is no sewage system, rivers and other bodies of water can become contaminated by runoff from human waste.

Although there is heavy rainfall and abundant sources of freshwater in Central and South America, there are many pockets in the rural regions that are still without clean water. This accounts for over three million people in Columbia not having access to basic bathroom facilities such as toilets or hand-washing sinks (Bensen, 2023).

For many students such as my student from Colombia, it is natural to think that all water is too polluted to drink. It is all that she and her family have known. However, this couldn't be further from the truth. Our water supply in Philadelphia is safe to use for bathing, drinking, and cooking. However, due to the plumbing fixtures in some pipes, lead exposure in the drinking water is an issue that immigrants to Philadelphia should be aware of but may not be.

This curriculum unit aims to describe the scenarios that ELL students come from, their experience with drinking water and what they encounter in Philadelphia. Lastly, this curriculum unit will explain how ELL students can help manage the lead problem in the Philadelphia drinking water and become advocates and teachers in their own communities.

One curriculum unit can't be easily applied to all ELL students. Because of the language requirements in the areas of reading, writing, listening and speaking for this curriculum, this unit will be geared toward ELL students at an emerging level of English language and above (Level 2.0-5.0). These classifications were established by World-class Instructional Design and Assessment which is commonly referred to by the acronym WIDA (Jordan School District, 2012). 41 U.S. states and territories have adopted the WIDA Consortium's standards, assessments, and professional learning regarding ELL students. Pennsylvania is among those WIDA states (Wisconsin Center for Education Research, 2023).

Content Objectives

ESOL Students

My ESOL students fall into the following categories. It is important to keep this in mind as ESOL students come from varied backgrounds and challenges. These factors can impact their ability to learn as well as the lens through which they are inputting information in school.

ESOL students are not native speakers of English. In fact, most ESOL students are US born citizens. However, there are other ways students meet the criteria.

Newcomer

A newcomer is an English Language Learner (ELL) who was born outside of the United States and within 2 years of entering United States schools.

Refugee/Asylee

An ELL student who was forced to leave their homeland.

SIFE

An ELL student with interrupted or limited education

LTEL

An ELL student who has not met the criteria to exit/reclassify for 6 years or more.

Dually Served

An ELL student who also qualifies for special education services (Snyder et al., 2021).

Philadelphia Water

The water in the City of Philadelphia is sourced from two rivers: the Delaware River and the Schuylkill River. 58% of the water is sourced from the Delaware River and the rest is sourced from the Schuylkill River. This water serves 1.58 million Philadelphians (Philadelphia Water Department, n.d.).

The Schuylkill River runs northwest to southeast in eastern Pennsylvania. It flows for 135 miles from Pottsville to Philadelphia, where it joins the Delaware River as one of its largest tributaries. Several of its tributaries drain the Coal region section of Pennsylvania. (Schuylkill Action Network, n.d.). It should be noted that a tributary is a stream or river that flows into a larger stream or parent river. However, tributaries do not flow directly into seas or oceans (Merriam-Webster, 2023).

Comparatively, The Delaware River is a major river in the Mid-Atlantic region of the United States. It is the longest undammed river in the Eastern United States. From the tributary in Hancock, New York, the Delaware River flows for 282 miles or 454 km along the borders of New York, Pennsylvania, New Jersey, and Delaware, before emptying into Delaware Bay (Csebestyen, 2023).

The National Wildlife Federation has recognized the Delaware River as one of the country's Great Waters. It has been referred to as the “Lifeblood of the Northeast” (National Wildlife Federation, 2011).

However, rivers in the United States can become contaminated. The majority of freshwater contamination cases result from nutrient pollution; farm waste and fertilizer which enter bodies of water. This creates zones with depleted oxygen levels.

Moreover, we do have some combined sewer overflow which puts sewage into rivers when it rains but mostly pollution comes from run off of rainwater carrying roadway chemicals, fertilizer, agricultural chemicals and industrial wastes into rivers (American Geosciences Institute, 2016).

The Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply. This law was amended in 1996 to ensure greater drinking water protection by protecting water sources which include lakes, rivers, reservoirs, springs and ground wells (Environmental Protection Agency, 2004).

The Environmental Protection Agency, (EPA) sets the national limits on over 90 contaminants in our drinking water. These contaminants include: microbial contaminants, lead, nitrates and nitrites, arsenic, disinfection byproducts, pesticides, and solvents (EPA, 2023). This agency also sets the water testing schedules and methods that water systems must abide by (EPA, 2023).

The EPA uses the unregulated contaminant monitoring program to collect data of contaminants thought to be present in the drinking water supply but don't have health-based standards governed by the SDWA (EPA, 2023). Every five years the EPA reviews the list of contaminants framed on the Contaminant Candidate List (United States Environmental Protection Agency, 2023) and determines if new ones need to be added or existing ones should be removed.

The Safe Drinking Water Act (SDWA) allows individual states to determine and enforce their own standards for drinking water quality. As long as the standards are at least as stringent as the EPA's national standards (EPA, 2023).

The EPA sets legal limits on over 90 contaminants in drinking water. The legal limit for a contaminant reflects the level that protects human health and that water systems can achieve using the best available technology. EPA rules also set water-testing schedules and methods that water systems must follow.

The Philadelphia water department states that their methods and practices exceed the Environmental Protection Agency (EPA) standards (Philadelphia Water Department, n.d.). Moreover, The Philadelphia Water Department submits water quality test results to the state to prove that they are meeting the water quality standards (Philadelphia Water Department, n.d.). Furthermore, the Philadelphia Water Department (PWD) boasts that they use a watershed protection method that tracks and evaluates any incidents or actions that could impact water quality.

Philadelphia Drinking Water

PWD uses three drinking water plants named Baxter, Queen Lane and Belmont. The PWD website explains "Baxter pulls water from the Delaware River. Queen Lane and Belmont pull from the Schuylkill. Each plant has a service area. Some areas in Philadelphia can receive a mix from multiple treatment plants." (Philadelphia Water Department, n.d.).

Consumers can be assured that all Philadelphia drinking water is tested for approximately 100 contaminants such as bacteria and nitrate before it leaves the treatment plants. This is done

because the EPA requires this practice. To boost water quality PWD adds Chlorine and Ammonia, Fluoride, and Zinc orthophosphate (Philadelphia Water Department, n.d.).

PWD further explains that both chlorine and ammonia chlorine are useful to protect against organisms found in untreated water that can cause disease. Also, ammonia is added to make the chlorine last longer and lessen the bleach-like smell. It should be noted that all drinking water contains some fluoride; however, PWD adjusts the natural levels slightly to help protect consumers' teeth against decay. Furthermore, the compound zinc orthophosphate is used to provide a protective coating inside pipes. It prevents corrosion and reduces the leaching of lead from pipes and solder into the water. (Philadelphia Water Department, n.d.).

PWD's plan seems to be working. The most recent water quality studies reveal that there was not a single violation according to state and federal regulations (Philadelphia Water Department, n.d.).

"Schuylkill Punch"

Philadelphians joke about the water quality of the Schuylkill River. They jokingly refer to it as the "Schuylkill Punch". It is obvious that many have caught on to the joke; as there are many recipes online to make Schuylkill River Punch (Jenny, 2008).

This humor is derived from the smell and taste of the water which is the result of chlorine treatment that was previously described. However, the water is safe to drink (Henninger, 2023). In fact, it exceeds the Environmental Protection Agency EPA standards (Philadelphia Water Department, n.d.).

Unfortunately for some people, Schuylkill Punch is not a joke. They fear the water and that results in lower water consumption levels because they are relying on bottled water which

is more expensive. This fear of local water seems to concern particular demographic groups in Philadelphia.

A recent Philadelphia Water Department survey revealed that minority groups, and Philadelphians with lower levels of income and education were found to be the greatest consumers of bottled water, not tap water (Michaela Winberg, 2018).
This data reflects many Philadelphia residents, as Philadelphia remains the poorest big city in America (Project HOME, 2023).

Simply put, there is a great distrust among people of color that the government is adequately cleaning up the dirty river water.

(Michaela Winberg, 2018)

Community Distrust

There are well documented reasons why communities of color should be weary of trusting the Philadelphia government .These issues include: inequities in policing, criminal justice, housing, health care, public transportation, fresh food availability and education (Rhynhart, 2020)

In addition to communities of color, many immigrants have reasons to distrust the water supply. Immigrants comprised 15% of the city's residents. 24% of immigrants live below the poverty level. This percentage is slightly lower than the poverty rate for native Philadelphians(The Pew Charitable Trusts, 2018).

Further, according to Pew Trusts, "1 in 5 Philadelphians in the labor force have an immigrant background, and 1 in 5 children live in a household with a foreign-born person" (The Pew Charitable Trusts, 2018).

Many immigrants and refugees are coming from countries with poor quality drinking water for a variety of reasons. For example, due to the war in Ukraine, the clean water supply and electrical networks have been ravaged. This violence has left more than 6 million people in Ukraine struggling daily to get drinking water (English, 2022).

In other countries, it is their custom to use bottled water for all cooking and hygiene activities due to water quality concerns. Some immigrants who have heard the jokes about the dirty Schuylkill River take the information as fact and now they too distrust the water. For many, dirty drinking water is all that they have known, so it may make sense that our water is dirty too. Furthermore, immigrants would benefit greatly from spending less money on bottled water. As many live in poverty.

Drinking Water Treatment Plants

When we enjoy our first glass of water in the morning, few of us fully appreciate the many steps that are involved to make our drinking experiences safe and pleasurable. This process can take days to complete.

Once river water is pumped into reservoirs. The heaviest sediment settles. Sediments are tiny pieces of soil, rock, and other solid particles that are either washed or blown from the land into the river. From this point, 5 water treatment steps must occur before you use your faucet water to brush your teeth in the morning.

Step 1: Coagulation

During coagulation, Sodium Hypochlorite, aluminum, or iron are added to the water. These chemicals provide a positive charge to the water. Those chemicals neutralize the negative charge which includes dirt and other dissolved particles in the water. This process kills harmful organisms (Centers for Disease Control and Prevention, 2022).

Step 2: Flocculation

Flocculation occurs when gentle mixing of the water forms larger heavier particles called flocs. It is common for water treatment plants to add additional chemicals during the flocculation step to facilitate the formation of flocs. Also, the acidity is adjusted (Centers for Disease Control and Prevention, 2022).

Step 3: Sedimentation

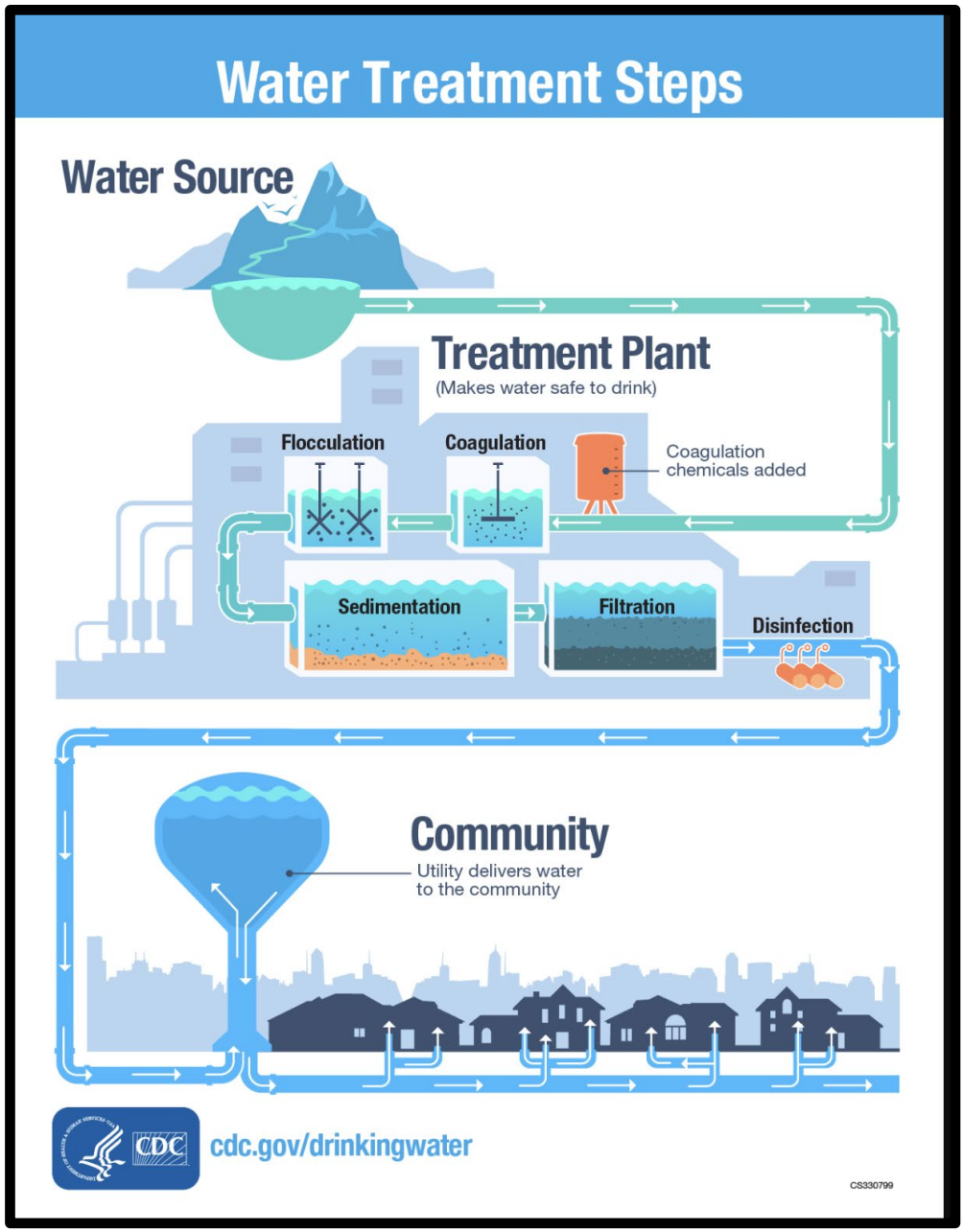
During the sedimentation process, solids are separated from the water at the water treatment plant. Then, flocs settle to the bottom of the water due to their weight (Centers for Disease Control and Prevention, 2022).

Step 4: Filtration

After the sedimentation process, the clear water on top is filtered even more. This clear water passes through filters that have varied pore sizes. They are made of a variety of materials which include sand, gravel, and charcoal. These powerful filters remove any remaining contaminants, such as dust, chemicals, parasites, bacteria, and viruses. Additionally, the use of carbon filters removes bad odors (Centers for Disease Control and Prevention, 2022).

Step 5: Disinfection

When filtration is complete, water treatment plants may use one or more chemical disinfectants such as chlorine, chloramine, or chlorine dioxide to kill any remaining parasites, bacteria, and viruses to keep the drinking water supply safe. Drinking water treatment plants ensure that only low levels of chemical disinfectant are used as the water leaves the treatment facilities. The remaining disinfectant is used to kill germs that live in the pipes between the water treatment plant and the tap water in our homes (Centers for Disease Control and Prevention, 2022).



(Centers for Disease Control and Prevention, 2022)

Health Effects of Lead

Clearly, the Philadelphia Water Department has established excellent procedures for maintaining a healthy supply of water. Despite this, there is still one danger that creates a health risk factor for Philadelphians; the lead service lines that can carry the cleaned water from the treatment plants into our homes, schools, and community.

A lead service line (LSL), is a pipe made of lead which is used in potable water distribution to connect a water main to a consumer's premises (Plumbing Manufacturers International , n.d.)

Philadelphia is one of the oldest cities in one of the oldest states in the union. Therefore, many Philadelphia homes received drinking water through wood service lines. Wood is the predecessor of lead lines. They were installed in the 1800s to transport water into Philadelphia homes (Maher, 2020). According to utility records, they were likely taken off line in 1832 and out of service in 1858 (Highlights_admin, 2017). Wood service lines fell out of favor because the wooden pipes leaked and made the wood swell which made them watertight. Unfortunately, the metal pieces holding the wood together would rust. That created leaks which only gave wood pipes a short life of use (Maher, 2020).

Lead pipes are certainly an upgrade from wood pipes in terms of stability and functionality, but they are not without their problems. Lead gets into the tap water through corrosion in a home's plumbing which includes the lead pipes, fixtures and solder. This toxic material is more common in homes that were built prior to 1986 in Philadelphia(City of Philadelphia, 2022). Since Philadelphia is one of the oldest cities in the nation, it is not surprising that many of our residents potentially have lead in their pipes.

According to the City of Philadelphia, roughly 20,000 homes may have a water service line that is made of lead. The lead pipe runs from the water main to the home. Moreover, older

brass fixtures, valves and the solder where the pipes join may also contain lead (City of Philadelphia, 2022).

Moreover, there are serious health risks associated with consuming lead. Dr. Mona Hanna-Attisha, a pediatrician who helped expose the lead water crisis in Flint, Michigan, asserts, “When a pediatrician hears the word "lead," we just, there's nothing more to say than we freak out” (Hanna-Attisha, 2020). This emotion is very understandable because physicians who have taken an oath to protect the public know that lead is one of the most neurotoxic-poisons known and studied. There have been centuries of study.

There is no safe level of lead. Lead is a potent, irreversible neurotoxin. It impacts almost every organ system, and really, every age population. Children are the most developmentally vulnerable, especially children under the age of six. Once lead is in the body, it impacts the nervous system, development, and cognition. It lowers children's IQ levels. It impacts behavior, how kids act. Lead exposure can lead to attention problems and behavioral problems, conduct disorders, and has been linked to criminality. When a child consumes more lead than they can excrete that day, lead is stored in bones and teeth. Once it is in your bones, fractures, pregnancy and poor nutrition can lead to it leaving the bones and going back into the blood causing more damage. Lead has no useful purpose in people and very low levels have been shown to be toxic. But unfortunately, we continue to live with the legacy of lead, layers of paint, soil from gasoline contamination, and in our drinking water infrastructure (Centers for Disease Control and Prevention, 2023).

The harms that we know about lead are absolutely frightening. However, there are many things that Philadelphians can do to protect themselves from lead exposure.

First, Philadelphians need to determine if you have lead pipe infrastructure in your homes. The water mains are not made of lead. However, the water service line running from the water main to your home may be made of lead or steel. In addition, older brass fixtures and valves, old solder or epoxy and where the pipes are joined can all contain lead and contribute it to water (City of Philadelphia, 2022).

Fortunately, there is an easy way to determine if you have lead service lines. The following common household objects are needed to test for lead: a key or a coin, and a strong refrigerator magnet.

First, locate and look at the pipe that comes through the outside wall of your home and connects to your meter.

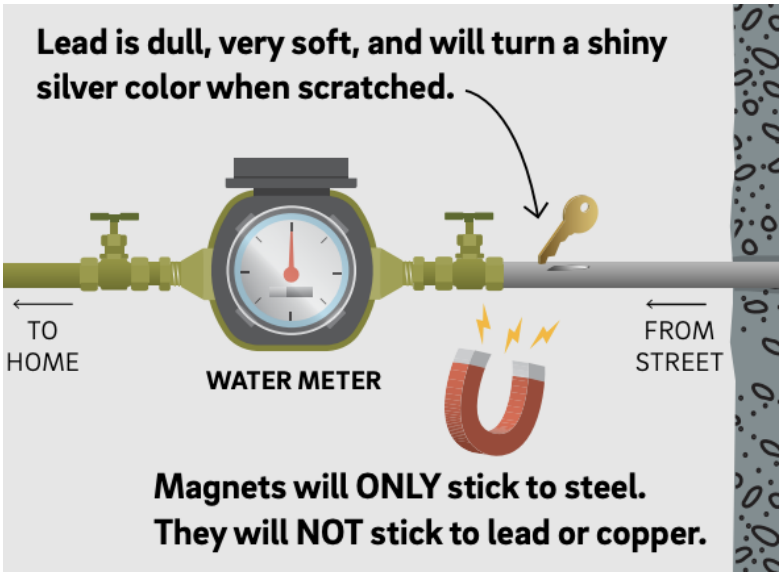
Second, scratching the pipe like a lottery ticket is scratched with a key or coin. If the scratched area turns a shiny silver color, it could be lead or steel. If the pipe has been painted, use sandpaper to expose the metal first. If a gold color emerges, the pipe is likely copper and not lead.

Last, place the magnet on the pipe, if the magnet sticks, it is a steel pipe (Philadelphia Water Department, 2021).

Another way to check for lead in your home is purchasing an EPA approved kit from a hardware or home improvement store. The kit will identify what the pipe is made from, not the water inside the pipe. Some of these kits cost as little as $15.00 and as much as $100.00 (Philadelphia Water Department, 2021).

A third method for checking for lead in your pipes is probably the most costly; employing the expertise of a licensed and insured plumber. This professional can inspect the

pipes in homes for lead or steel. Moreover, replacing an older brass faucet or valve may reduce the lead in the drinking water Philadelphia Water Department, 2021).



(City of Philadelphia, 2022).

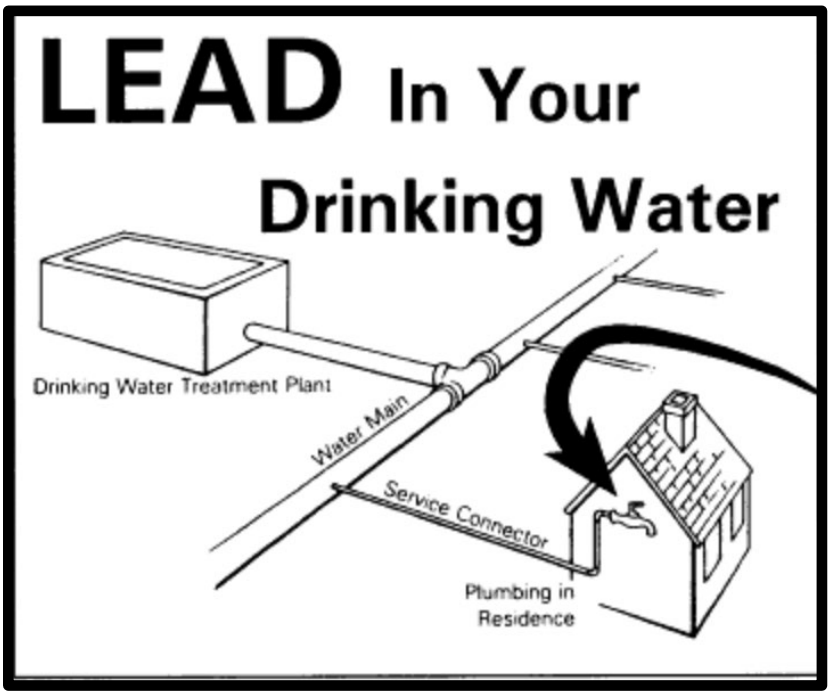
How to Reduce Lead Exposure in Drinking Water

There are two simple immediate actions that Philadelphians can take to reduce potential lead exposure in water.

First, do not immediately consume water that has been sitting in your home's plumbing for more than 6 hours. Typically, this would describe overnight while sleeping or after being away while working. Before using the water for drinking or cooking, "flush" or allow the cold water to run until water reaches the greatest cold temperature to touch. This procedure must be done for each drinking water faucet. Running the bathroom shower, will not flush the kitchen tap (United States Environmental Protection Agency, 1993). Usually this will take 1 minute for every 50 feet that the faucet is from the center of the street where the water main is located.

The longer the water is exposed to lead pipes the greater the possible risk for lead contamination. Therefore, the water that is used after appropriate flushing will not have had extended contact with lead pipes or solder and should have much lower lead levels. (United States Environmental Protection Agency, 1993)

Second, never cook or consume water from the hot- water tap (United States Environmental Protection Agency, 1993). In fact, hot water dissolves more lead much more quickly than cold water. Cooking, drinking, and making baby formula should never involve using water from the hot-tap. Instead, when hot water is needed for consumption, draw cold water from the cold water faucet and heat it on the stove. Even in this process use only cold water that has been thoroughly flushed (United States Environmental Protection Agency, 1993).



(United States Environmental Protection Agency, 1993)

Teaching Strategies & Classroom Activities

Lesson 1

Essential Questions:

1. How old is water?
2. What is the water cycle?
3. How do the processes in the water cycle relate to weather?

Strategies for Teaching About the Water Cycle

Identify	Identify the processes involved in the water cycle
Discuss	Discuss water cycle process in a think-pair share
Match	Match Google images to vocabulary terms in word bank dictionary
Summarize	Summarize the water cycle in 3-5 sentences
Draw	Draw and label the water cycle
Identify	Identify part of speech for each vocabulary word
Compose	Compose a sentence for each vocabulary word

Introduction

In this lesson students realize that water from billions of years ago has been cycling around the Earth and is being used by each one of them today. From watching videos, participating in peer and class discussion as well as digital photographic research students are introduced to various forms or states of water and the processes that make up the water cycle; evaporation, condensation, transpiration, precipitation and accumulation. At the conclusion of the lesson, students will illustrate the water cycle and write a short paragraph which will be on display during a carousel activity.

ELL accommodations:

- *The entire lesson is crafted for advanced beginning and above ELL students*

- YouTube videos will be placed in each student's Google classroom. Students can adjust the language's closed caption and speed on the video to facilitate enhanced understanding.

- Google translate or peer to peer translation will be permitted in the class on an as needed basis to facilitate writing assignments and contributions to class discussions. The teacher will use Google translate as needed to facilitate instructions and facilitate student oral language.

Day 1

Learning Objective: Students will be able to (SWBAT) learn about the processes involved in the water cycle

Language Objective: SWBAT complete a KWL chart IOT demonstrate increased understanding of the water cycle

Materials:

- KWL Water cycle chart
- Smartboard
- Chromebooks with access to Google Classroom the internet, and Google translate
- pencils
- Drawing paper
- Coloring pencils (optional)
- Online picture dictionary (optional)
- Post-Its

Background Information:

- Water we use has been on our planet for billions of years.

  Water is found on, above, and just below the surface of the Earth
- in its liquid state as the ocean, lakes, rivers, and other bodies of water; in its solid state as ice and snow; and in its gaseous vapor state as clouds and humidity.
- The water cycle describes the continuous processes of evaporation, condensation, transpiration, and precipitation.
- No matter where you live on Earth, the water cycle always involves the same processes of evaporation, condensation, and precipitation.
- The processes of the water cycle play a role in the weather around the world

Vocabulary:

accumulation: the collection of water on land.

atmosphere: the mass of air surrounding the Earth.

condensation: the transformation of water vapor back into liquid water by cooling.

evaporation: the process in which the sun heats up water in rivers or lakes or the ocean and turns it into vapor. The water vapor goes into the air where it becomes a cloud.

infiltration: the process of water passing into, or through land by filtering.

precipitation: rain, hail, or snow falling from the clouds due to the condensation of water.

runoff: water from rain or snow that flows over the surface of the land and into streams, rivers, lakes, ocean.

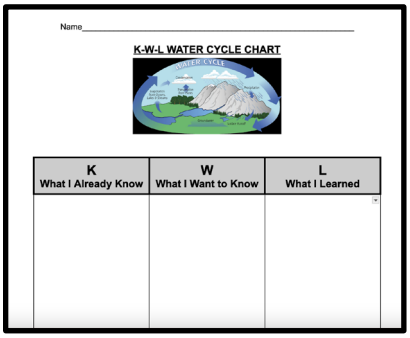
transpiration: the process by which plants release water through the pores in their leaves.

water cycle: the constant movement of water from oceans and lakes, evaporating into the air as water vapor condensing into clouds and precipitating as rain or snow onto land and back into oceans and lakes.

water table: location of the underground water, and the vertical distance from the surface of the Earth to this underground water.

watershed- an area of land that drains water into a specific water body

Teaching Procedures Day 1 (45 minutes)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K-W-L WATER CYCLE CHART

K What I Already Know	W What I Want to Know	L What I Learned

T- will distribute a K-W-L Chart titled *The Water Cycle.*

T- will display the chart on the Smartboard and ask the students What they all already know about the water cycle, what they want to know about the water cycle.

S-Students will share orally and write their responses in the chart.

T- will show the video: *The water cycle | Weather and climate | Middle school Earth and space science | Khan Academy* https://www.youtube.com/watch?v=r2dnUvP1JgM

T- will also show the video The Water Cycle

https://www.youtube.com/watch?v=xrYiH0vTXHQ

S- After the video, students will share what they learned and write their responses in the chart.

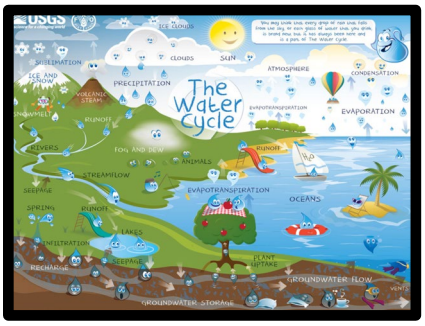
Teaching Procedures Lesson 1 Day 2 (45 minutes)

Learning Objective: SWBAT distinguish and define the processes of the water cycle and

Language Objective: SWBAT define, and obtain pictures of the water cycle

T- will introduce the water cycle vocabulary to students.

T- will distribute a diagram of the water cycle

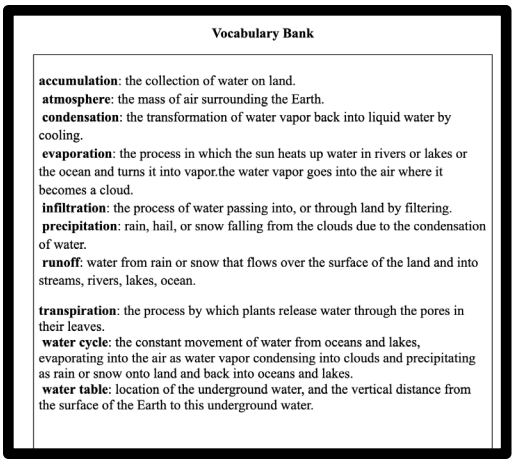


(Howard Perlman, 2022)

S- will engage in turn and talks to share what they notice and wonder about the water cycle

T-will write students' noticings on the board

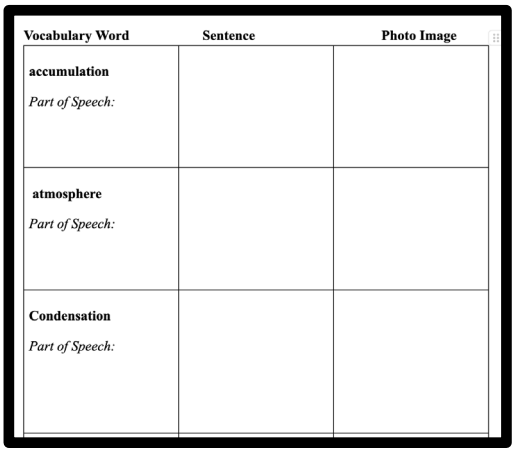
S- will use Google images to match the water cycle vocabulary word to the Google image and write a sentence using the vocabulary word correctly in a sentence. Students will also identify the part of speech for each vocabulary word (noun, verb, adjective, etc.)



Vocabulary Bank

accumulation: the collection of water on land.
atmosphere: the mass of air surrounding the Earth.
condensation: the transformation of water vapor back into liquid water by cooling.
evaporation: the process in which the sun heats up water in rivers or lakes or the ocean and turns it into vapor.the water vapor goes into the air where it becomes a cloud.
infiltration: the process of water passing into, or through land by filtering.
precipitation: rain, hail, or snow falling from the clouds due to the condensation of water.
runoff: water from rain or snow that flows over the surface of the land and into streams, rivers, lakes, ocean.

transpiration: the process by which plants release water through the pores in their leaves.
water cycle: the constant movement of water from oceans and lakes, evaporating into the air as water vapor condensing into clouds and precipitating as rain or snow onto land and back into oceans and lakes.
water table: location of the underground water, and the vertical distance from the surface of the Earth to this underground water.



Vocabulary Word	Sentence	Photo Image
accumulation *Part of Speech:*		
atmosphere *Part of Speech:*		
Condensation *Part of Speech:*		

Teaching Procedures Lesson 1-Day 3 (45 minutes)

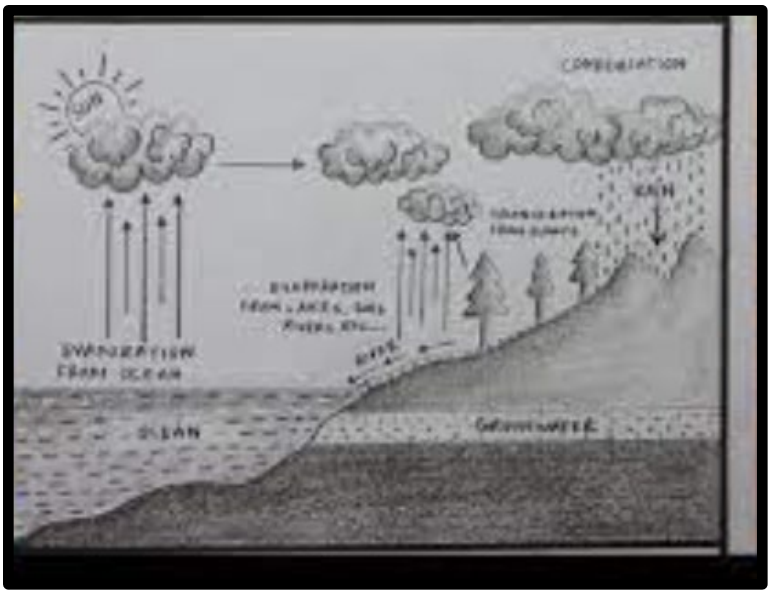
Learning Objective: Students will be able to (SWBAT) explain how the water cycle is related to weather and climate.

Language Objective: SWBAT illustrates the water cycle and writes a short paragraph in order to (IOT) explain its relationship to weather and climate.

T- will create a Kahoot! that uses all 10 of the water cycle words for a review

S-will watch a video to draw the water cycle accurately. *How to draw water cycle with pencil sketch easily - step by step | Drawing of water cycle*

https://www.youtube.com/watch?v=yfi0zEnTd3A



(Perhaps Bidesh, 2020)

S- on an index card students will summarize the water cycle in 3 -5 sentences

S-will hang up their pictures and index cards on the wall and students can take a carousel walk around the room to look at all the drawings and summaries.

S- as students walk around, they will place post-it notes around each drawing and summary.

S- will make thoughtful and positive observations about each student's work.

Lesson 2

Essential Questions:

1. How prevalent is access to safe drinking water?

2. How do water sources become contaminated?

3. What are the effects of inadequate access to safe drinking water?

4. How does conflict arise from unequal access to safe drinking water?

5. How does access to safe drinking water differ in different areas of the world?

Strategies for Teaching about Water Contamination

Brainstorm	Brainstorm a list of factors that may affect developing countries about providing water to its citizens.
Discuss	Discuss experiences with clean water in students home country
Interpret	Interpret a water scarcity map
Write	Write a research report about water contamination.
Investigate	Investigate the contributing factors that create water contamination in developing countries.

Introduction:

The goal for this lesson is for students to see that water quality and access are worldwide issues that need to be addressed. Students will learn that delivering clean, fresh water to citizens around the world involves and affects many factors including politics, economics, and international relations.

ELL Accommodations:

- *The entire lesson is crafted for advanced beginning and above ELL students*

- YouTube videos will be placed in each student's Google classroom. Students can adjust the language's closed caption and speed on the video to facilitate enhanced understanding.

- Google translate or peer to peer translation will be permitted in the class on an as needed basis to facilitate writing assignments and contributions to class discussions. The teacher will use Google translate as needed to facilitate instructions and facilitate student oral language.

Materials:

- Smartboard
- Chromebooks with access to Google Classroom, the internet, and Google translate
- Water scarcity map
- Water contamination Report
- Sentence Strips
- Post-Its
- pens/pencil

Background Information:

- There are 1.1 billion people who do not have access to safe drinking water.
- About 2.6 billion people do not have access to basic sanitation (toilets, sinks, laundry facilities).
- Ten years ago, 31% of the world's population did not have enough water to meet basic human needs.
- By 2025, it is expected that two-thirds of the world's population could experience severe water stress.

Vocabulary:

- Groundwater
- Pollution
- Fresh water
- Water scarcity
- Runoff

Learning Objective: SWBAT discuss the factors that contribute to water contamination and scarcity in and outside of the United States

Language Objective: SWBAT brainstorm about discussing water contamination factors and read a water scarcity map.

Teaching Procedures: Lesson 2 Day 1

T- will ask students what water contamination is.

T-will ask students how water gets contaminated in countries in and out of the United States.

S- will use a think pair share model to respond to questions.

T- will write their answers on the board.

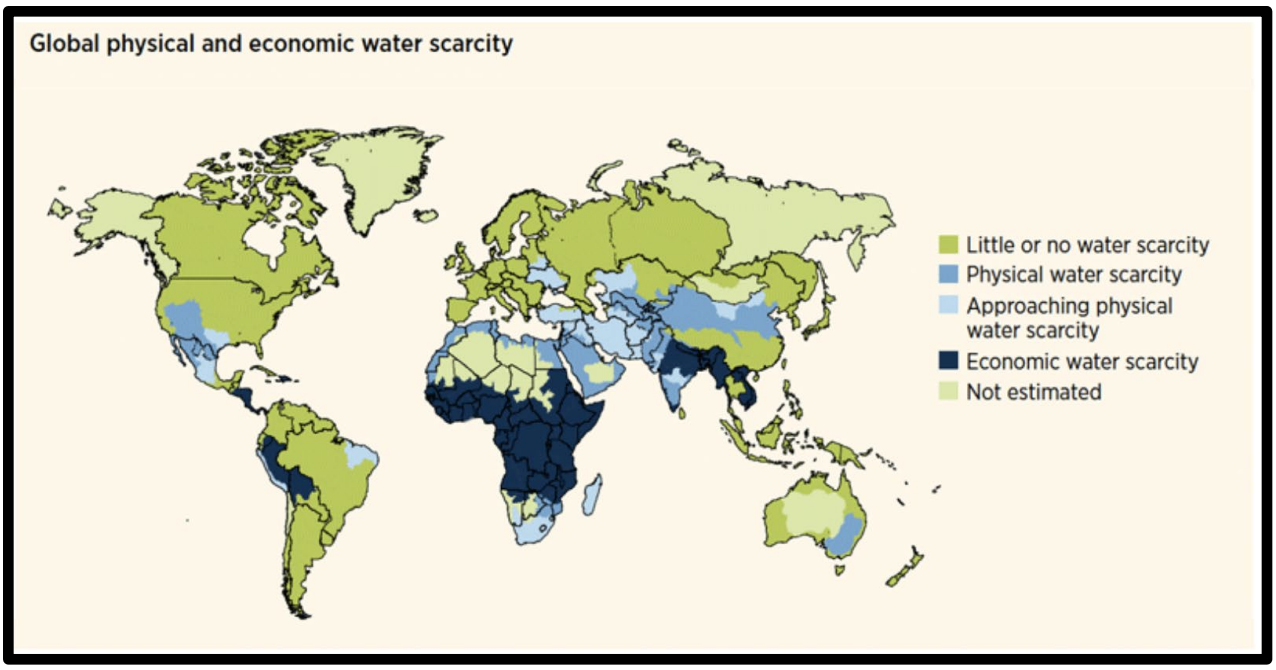
T- will ask students to share their experiences with access to clean water and water contamination in their home countries. Think pair share model will be used for student discussions. Teacher will write their answers on the board.

S- will brainstorm a list of factors that might affect their home counties' ability to provide water to its citizens. Students will share their responses.

S- will watch a shot video The Journey Episode 2: Life without Clean Water
https://www.youtube.com/watch?v=yPxMOzN0Uq4
T- will lead a discussion about the video.

T- will discuss other factors that students did not list or discuss and show pictures of those issues on the smart board. Examples include wildlife, gold mining, deforestation, industry, trash and fecal dumping, and fuel spillages

T will ask students what countries have a clean water scarcity problem. Then will distribute a map of the world that showing the countries



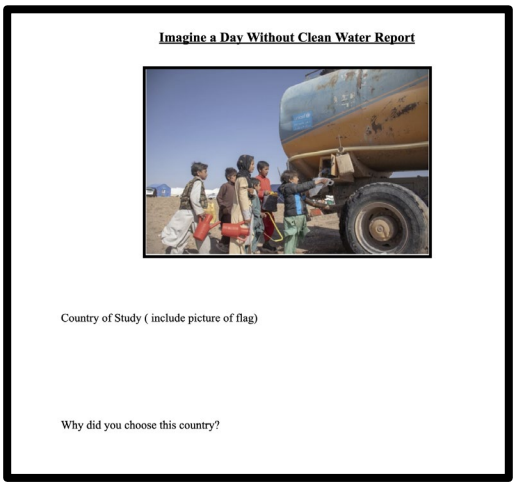
(World Water Development Report 4. World Water Assessment Programme (WWAP), 2012)

Day 3

Learning Objective: SWBAT research the issues that affect water contamination in developing countries and in the United States.

Language Objective: SWBAT research , write and present a report about water contamination in developing countries and the US.

Teaching Procedures- Research Project Lesson 2 (Days 2-Days 5)



- In small groups or individually students will select a developing country from the teacher's list or students may choose their own home country. Students will learn that delivering clean fresh water to citizens around the world involves and affects politics, economics, international relations and technology.
- Project will be completed and submitted in Google Classroom. Students can use Google translate and other online tools for language assistance if needed.
- After submission, teams or individuals will present their projects to the class.
- T- will display the titles/countries of selected countries on a sentence strip on the walls around the classroom. Each listening student will write one fact that they learned about each country on a post-It.

Lesson 3

(Days 1-5 45 minutes a session)

Essential Question:

1. What type of health issues can be related to water quality?

Strategies for Teaching about Health Effects of Water Contamination

Match	Match contaminate vocabulary words to corresponding pictures
Investigate	Investigate the difference between bacterial and chemical water contamination
Research	Research the health consequences of water contamination
Create	Create a digital picture dictionary of illness associated with water contamination.
Create	Create a Google Slide about water contaminated and the health risks associated with the contaminate.

Introduction:

In this lesson, students will explain the consequences and risks associated with water contamination from both bacterial and chemical sources.

Students will learn that water contamination occurs when substances pollute the water and make it unusable for cooking, drinking and other uses. Contamination can occur from agriculture, industrial chemicals, overflowing sewers and more. Knowing the signs of water contamination will help keep you and your family safe.

ELL Accommodations:

- The entire lesson is crafted for advanced beginning and above ELL students
- YouTube videos will be placed in each student's Google classroom. Students can adjust the language's closed caption and speed on the video to facilitate enhanced understanding.
- Google translate or peer to peer translation will be permitted in the class on an as needed basis to facilitate writing assignments and contributions to class discussions. The teacher will use Google translate as needed to facilitate instructions and facilitate student oral language.

Materials

- Smartboard
- Chromebooks with access to Google Classroom, the internet, and Google translate
- Pencils
- Google Slides

Background Information

- Only 37% of people living in rural communities in developing countries have access to sanitation facilities.
- 81% of people living in urban communities in developing countries have access to sanitation facilities.
- About 90% of sewage and 70% of industrial wastes in developing countries are dumped right into water sources without treatment.
-

Vocabulary

- Rural
- Urban
- Bacterial contamination
- Chemical and industrial contamination

Learning Objective: SWBAT differentiate between bacterial and chemical water contaminants and correlate the health risks associated with specific contaminants .

Language Objective: SWBAT conducts research IOT (in order to) create Google Slide presentations about water contaminants and the health risks associated with specific contaminants.

Teaching Procedures:

T- will discuss bacteria sources of poisoning in the water and chemical poisoning in the water.
T- will inform students that there are many serious health effects as a result of exposure of contaminated water.

S- students will watch a video about lead poisoning in the water in America and watch a PowerPoint about bacteria in drinking water.

T-will lead discussions about both videos.

The legacy of the Flint water crisis

When Water Goes Bad

https://static1.squarespace.com/static/583ca2f2d482e9bbbef7dad9/t/58ae1c8b414fb5cf16d775e6/1487805581951/CaseStudiesPowerPointLesson5OWH.pdf

S- will draw a Venn diagram and compare the health effects of chemical contamination vs. bacterial contamination in drinking water.

S- will present a Google Slide Presentation about the health risks associated with water contamination. Each student will be assigned one slide within the presentation. Each student will research and select a water contamination source and add Google images collage style on the slide. Then they will write a short paragraph about the health effects associated with that contaminate. As a class students will present their slide to the class.

Possible choice of contaminants for research include:

- Animal fecal waste containing bacteria, viruses and other pathogens.
- Antibiotics, hormones, salts and heavy metals excreted by livestock.
- Fertilizers, herbicides and pesticides.
- Marine Corps Base Camp Lejeune water contamination
- Flint Michigan Water Crisis
- Industrial activities, such as mining and foundries.
- Runoff from soil, air pollution and automobile emissions.
- malfunctioning wastewater treatment systems, such as septic tanks.
- Leaking underground storage systems and pipes.
- Landfill leakage.
- Sewer overflows.
- Radiation leaks from nuclear power plants.

Students will create a digital alphabetical picture dictionary on Google Slides about leading causes of waterborne disease outbreak according to CDC. These illnesses include: *Giardia, Legionella, Norovirus, Shigella, Campylobacter, copper, Salmonella, Hepatitis A, Cryptosporidium, and E. coli and excessive fluoride.*

Lesson 4

Essential Questions

1. Is our water supply safe for human consumption?
2. What steps are necessary to make water safe to drink?

Strategies for Teaching about Drinking Water Treatment Plants

Match	Match vocabulary words to corresponding pictures
Create	Create a visual dictionary using Google Slides
Perform	Read and perform a play
Investigate	Investigate the meaning of water treatment vocabulary words.

Introduction

Students will learn the basics of tap water treatment. The water treatment process is a series of steps including pumping water from freshwater sources, coagulation, sedimentation, filtration, disinfection and storage. Students will learn that all of these steps make water safe enough to drink and use at their homes.

ELL Accommodations:

- *The entire lesson is crafted for advanced beginning and above ELL students*

- YouTube videos will be placed in each student's Google classroom. Students can adjust the language's closed caption and speed on the video to facilitate enhanced understanding.

- Google translate or peer to peer translation will be permitted in the class on an as needed basis to facilitate writing assignments and contributions to class discussions. The teacher will use Google translate as needed to facilitate instructions and facilitate student oral language.

Materials:

- Smartboard
- Chromebooks with access to Google Classroom, the internet, and Google Translate
- Pencils
- *Admission Impossible* (a water treatment play)

Background Information

Roughly 70 percent of the earth's surface is covered in water. Even though water seems to be everywhere, not all of it is suitable for use as drinking water. Of all the water on earth, only 3 percent is freshwater, with much of it frozen or underground. And less than one percent of the water on earth can be used as drinking water. Before we drink it and before it is released back into surface waters (such as rivers and lakes), our water must go through a variety of treatment processes.

Vocabulary:

- Prokaryotes
- Mitosis
- E coli
- Binary fission
- Strep
- Eukaryote
- Coagulation
- Electrons
- Flocculation
- Charcoal
- Disinfection
- Chlorine
- Cistern
- Pesticides

- Snarky
- Mitochondria

Learning Objective: SWBAT gain knowledge of the 5-step water treatment process for tap water.

Language Objective: SWBAT read and perform a play about the water treatment process.

Teaching Procedures:

Day 1 (45 minutes)

T- will explain to students that before they enjoy their first sip of water in the morning, there is a 5-step treatment process involved in delivering fresh drinking water. The teacher will explain the process.

S- will watch the video *How Do Water Treatment Plants Work?*

How Do Water Treatment Plants Work?

T- will lead a discussion about the video.

Day 2 (45 minutes)

The Fairmount Water Works will come to the class to do a presentation about Drinking Water Treatment. In this program, the students will explore Philadelphia's water supply system and learn how our drinking water is cleaned today.

S- After the presentation, students will complete an Exit Ticket. They will write three things that they learned from the presentation.

Day 3 - Day 4

(45 minute classes)

Students will create a visual digital dictionary using the vocabulary words. Google Slides is recommended. Students should also use visual online dictionaries to complete the assignment. Each Google slide will feature a vocabulary word, definition, and digital image of the vocabulary word.

Teacher will create a *Kahoot* using the vocabulary words. Students will demonstrate their mastery of the vocabulary words and their definitions.

Day 5-Day 7

(45 minutes)

Students will practice and perform the play Admission Impossible by Jeff Dunne.

ADMISSION IMPOSSIBLE

Lesson 5

Essential Questions:

1. How does lead get into the drinking water?
2. How can lead exposure be reduced in drinking water?

Strategies for Teaching about Lead in Water Pipes

Explain	**Explain in a brochure and to local communities about lead exposure and strategies to reduce vulnerabilities with lead.**
Investigate	**Investigate how lead gets in drinking water supply and how to reduce exposure**
Translate	**Translate research from home language to English**
Create	**Create a brochure**

Introduction:

Students will learn that lead can enter drinking water when plumbing materials that contain lead corrode, especially where the water has high acidity or low mineral content that corrodes pipes and fixtures. The most common sources of lead in drinking water are lead pipes, faucets, and fixtures. In homes with lead pipes that connect the home to the water main, also known as lead services lines, these pipes are typically the most significant source of lead in the water.

Also, students will learn strategies to reduce lead exposure. As a result they will feel empowered to educate and advocate for their community based language community.

ELL Accommodations:

- *The entire lesson is crafted for advanced beginning and above ELL students*
- YouTube videos will be placed in each student's Google Classroom. Students can adjust the language's closed caption and speed on the video to facilitate enhanced understanding.
- Google translate or peer-to-peer translation will be permitted in the class on an as-needed basis to facilitate writing assignments and contributions to class discussions. The teacher will use Google translate as needed to facilitate instructions and facilitate student oral language.

Materials:

- Smartboard
- Chromebooks with access to Google Classroom, the internet, and Google Translate
- Pencils
- Copy paper , printer (color printer is best for ELL students) , ink

Background Information

Lead was a commonly used metal for drinking water pipes until negative human health impacts, particularly on the brain, were understood. There are still many lead pipes in use, especially as service lines that connect the main water pipe to the individual home. To help prevent lead poisoning, the Environmental Protection Agency (EPA) requires orthophosphates to be added to drinking water. The orthophosphates create a barrier on the inside of the pipe, which helps keep pipes from corroding. Unless the orthophosphate barrier is constantly replenished through on-going additives, the barrier will degrade and disappear and the pipes will corrode. Corroded lead pipes allow the lead to leach into the drinking water. Water can be made more corrosive by the addition of other chemicals or a change in pH, so if the orthophosphate barrier is gone, the increased corrosivity means increased lead leaching.

Vocabulary:

- Lead service line
- Solder
- Zero water pitcher
- Lead
- Environmental Protection Agency
- Lead poisoning

Learning Objective: SWBAT learn about lead in the home.

Language Objective: SWBAT research how to reduce exposure to lead and document findings in a bilingual brochure.

Teaching Procedures:

Lesson 5- Day 1 (45 minutes)

S- will watch the video How to check if your pipes are lead pipes

S- will take notes while watching the video and participate in a group discussion afterwards.

Lesson 5 -Day - Day 3

S- will research or review their notes on the following key points:

- Why the water in the US is cleaner than other countries
- Drinking water treatment plant- why is the water clean and safe to drink
- Lead poisoning- discuss lead service line, solder, and fixtures
- Home solutions to lead pipes- flush water, kitchen sink filter, zero water pitcher, cooking with cold water

Lesson 5

Day 4-Day 7
(45 minutes)

S- will work in groups divided by their home languages and create a bilingual brochure (English and home language) that covers all of the bulleted points.

S- will share their brochures in their language communities and become advocates and educators in their families and their local cultural communities in Philadelphia.

Resources

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Water/PublicDrinkingWater/pages/lead-in-drinking-water.aspx#:~:text=Water%20systems%20are%20required%20to,are%20above%20the%20action%20level.

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Reading List for Students & Materials for Classroom Use

60 Minutes. (2021, January 12). The legacy of the Flint Water Crisis. YouTube. https://www.youtube.com/watch?v=GYiVHh4U4pE

A video segment about lead that seeped into the tap water in Flint, Michigan, while state and local officials said everything was fine. Now, the same doctor who proved something was wrong is taking the first comprehensive look at the thousands of kids exposed to lead in Flint.

charity water. (2016, August 9). The journey episode 2: Life without clean water. YouTube. https://www.youtube.com/watch?v=yPxMOzN0Uq4

In this video, Tarik Haftay, one of many young girls who puts in hours each day walking to collect dirty water for her family.

Concerning Reality. (2018, November 21). How do water treatment plants work?. YouTube. https://www.youtube.com/watch?v=0_ZcCqqpS2o

This video discusses how a drinking water treatment plant functions.

Dunne, J. (2023, December 10). Admission Impossible. Drama Notebook. https://www.dramanotebook.com/

A play about the 5 steps of the drinking water treatment process.

Howard Perlman, U. (2022, November 7). Interactive Water Cycle Diagram for Kids (Advanced). Interactive water cycle diagram for kids (advanced). https://water.usgs.gov/edu/watercycle-kids-adv.html

The water cycle describes how Earth's water is not only always changing forms, between liquid (rain), solid (ice), and gas (vapor), but also moving on, above, and in the Earth. This process is always happening everywhere.

Kahoot! (2023). Kahoot! https://kahoot.it/

A game-based learning platform that makes it easy to create, share and play learning games or trivia quizzes in minutes.

Khan Academy. (2022, March 1). The water cycle | weather and climate | middle school earth and space science | khan academy. YouTube. https://www.youtube.com/watch?v=r2dnUvP1JgM

This video about the water cycle explains how the water cycle continuously moves between Earth's surface and the atmosphere. This occurs through processes such as evaporation and transpiration, condensation, and precipitation. The water cycle is driven by solar energy and gravity.

Next Generation Science. (2020, July 1). The water cycle. YouTube. https://www.youtube.com/watch?v=xrYiH0vTXHQ

An explanatory video on the water cycle on Earth. Includes a detailed narration and clear animation of the process.

Perhaps Bidesh. (2020, July 22). How to draw water cycle with pencil sketch easily - step by step | drawing of the water cycle. YouTube. https://www.youtube.com/watch?v=yfi0zEnTd3A

Step by step easy directions for drawing the water cycle

Severn Trent Water. (2013, August 20). How to check if your pipes are lead pipes. YouTube. https://www.youtube.com/watch?v=j4mQMYvORsU

A short video that demonstrates a quick and easy way to check if your pipes are made from lead.

World Water Development Report 4. World Water Assessment Programme (WWAP). (2012, March). Scarcity, decade, Water For Life, 2015, UN-Water, United Nations, MDG, water, sanitation, financing, gender, IWRM, human right, transboundary, cities, quality, food security. United Nations. https://www.un.org/waterforlifedecade/scarcity.shtml

Information about water scarcity and water stress around the world.

Appendix

English Language Arts Standards » Science & Technical Subjects » Grade 6-8

- CCSS.ELA-LITERACY.RST.6-8.1

Cite specific textual evidence to support analysis of science and technical texts.

- CCSS.ELA-LITERACY.RST.6-8.2

Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

- CCSS.ELA-LITERACY.RST.6-8.4

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.

- CCSS.ELA-LITERACY.RST.6-8.7

Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

- CCSS.ELA-LITERACY.RST.6-8.8

Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.

- CCSS.ELA-LITERACY.RST.6-8.9

Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Pennsylvania Common Core Standards English Language Arts Grade 6–12

CC.1.4.6.F Demonstrate a grade appropriate command of the conventions of standard English grammar, usage, capitalization, punctuation, and spelling.

CC.1.4.6.I Use clear reasons and relevant evidence to support claims, using credible sources and demonstrating an understanding of the topic.

CC.1.4.8.U Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas efficiently as well as to interact and collaborate with others.

CC.1.4.6.V Conduct short research projects to answer a question, drawing on several sources and refocusing the inquiry when appropriate.

CC.1.4.6.W Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources.

CC.1.5.7.A Engage effectively in a range of collaborative discussions, on grade-level topics, texts, and issues, building on others' ideas and expressing their own clearly

CC.1.5.7.C Analyze the main ideas and supporting details presented in diverse media formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.

CC.1.5.7.D Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

CC.1.5.8.E Adapt speech to a variety of contexts and tasks

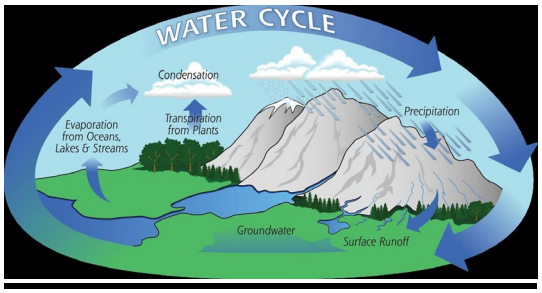
CC.1.5.8.F Integrate multimedia and visual displays into presentations to add interest, clarify information, and strengthen claims and evidence.

CC.1.5.6.G Demonstrate command of the conventions of standard English when speaking based on Grade 6 level and content.

CC.1.3.6.K Read and comprehend literary fiction on grade level, reading independently and proficient

Name_____

K-W-L WATER CYCLE CHART



K What I Already Know	W What I Want to Know	L What I Learned

Name_____

Vocabulary/Dictionary Bank

accumulation: the collection of water on land.
atmosphere: the mass of air surrounding the Earth.
condensation: the transformation of water vapor back into liquid water by cooling.
evaporation: the process in which the sun heats up water in rivers or lakes or the ocean and turns it into vapor. The water vapor goes into the air where it becomes a cloud.
infiltration: the process of water passing into, or through land by filtering.
precipitation: rain, hail, or snow falling from the clouds due to the condensation of water.
runoff: water from rain or snow that flows over the surface of the land and into streams, rivers, lakes, and oceans.

transpiration: the process by which plants release water through the pores in their leaves.
water cycle: the constant movement of water from oceans and lakes, evaporating into the air as water vapor condensing into clouds and precipitating as rain or snow onto land and back into oceans and lakes.
water table: location of the underground water, and the vertical distance from the surface of the Earth to this underground water.

Direction: Use Google images to find an image that makes the vocabulary word
Write a sentence using each vocabulary word
Identify the part of speech for each vocabulary word.

Vocabulary Word	Sentence	Google Image
accumulation *Part of Speech:*		
atmosphere *Part of Speech:*		
Condensation *Part of Speech:*		

Evaporation *Part of Speech:*		
Infiltration *Part of Speech:*		
Precipitation *Part of Speech:*		
Runoff *Part of Speech:*		
Transpiration *Part of Speech:*		

water cycle *Part of Speech:*		
water table: *Part of Speech:*		