



Quench

curriculum
grades 9-12





Teachers,

WaterStep believes that all people in the world deserve to have access to a safe water supply and that the global water crisis can be solved by people just like you. Our goal is to see the day when no child has to drink unsafe water. Water promotes the ability for more children to attend school worldwide. We train individuals to provide solutions through water treatment, health and hygiene, and sanitation.

What Can You Do To Help?

- » Students need to know the facts about water. They need to know the importance of water and how greatly it effects life.
- » Use our standards based lessons to teach your students water facts.
- » Get your students involved in a community program service project. Help support global water projects by giving and recycling used shoes.
- » Demonstrate your enthusiasm by forming your own WaterStepper dance or step team routine.
- » Participate in an International Communication Exchange with other students in your classroom via live telecommunications

Our Best,
The WaterStep Team

Teacher's Guide

Curriculum and Web Highlights

- » Standards Based/Cross-Curricular
- » Differentiated Tasks/ECE/ELL
- » Grades: 9-12 Lesson Plans
- » Dual-Language
- » Extension: Community Connections-Program Service Learning
- » Helpful Educational Links
- » Lessons Written by Teachers

Table of Contents



Lesson I: Amazing Water

- » Lesson is based on real life experiences of the properties of water as observed in nature and determined by the structure of the water molecule. [LS 1A](#) (Structure and Function). [SEP 2](#) Lesson includes model of the water molecule.



Lesson II: Water Problems

- » NGSS Disciplinary Core Ideas: [LS2.A](#) (Interdependent relationships in ecosystems), [LS2.B](#) (Cycles of matter and energy transfer in ecosystems), [LS4.D](#) (Biodiversity and humans), [ESS2.C](#) (The roles of water in Earth's surface processes), [ESS3.C](#) (Human impacts on Earth systems).



Lesson III: Water Solutions

- » [K-LS1-1](#). Use observations to describe patterns of what plants and animals (including humans) need to survive.
- » [K-ESS3-3](#). Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.



Lesson IV: We Can Help!

- » (5-ESS2.C) Communities are doing things to help protect Earth's resources and environments.
- » (4-Ess3-2) Students who demonstrate understanding can generate and compare multiple solutions to reduce impact of natural Earth processes on humans.
- » W.3.1 Write an opinion piece on topics or texts suggesting a point of view with reasons.

Lesson I: Amazing Water

Objective



Students Will:

- » Recall from life experiences water's states of matter. Students will illustrate water molecules and understand that molecules interact distinctly in each state of matter.
- » Learn that water molecules have specific chemical and physical properties due to polar bonding.
- » Demonstrate water's properties of cohesion and adhesion.
- » Explain why water is a versatile solvent.
- » Understand that all living things are dependent on water for good health and survival.

Materials/Resources Needed

- » True/False Entrance/Exit Slip (p. 3, TE 1a)
- » Video: <http://science.howstuffworks.com/environmental/458-how-water-works-video.htm> (1:55 min.)
- » Student Reading Text p. 4–5; Collaborative Group Assignment and Writing (p. 6)
- » Tagxedo/wordle (www.tagxedo.com or www.wordle.net) and Class List of Unfamiliar Terms p. 6 (Supplement or Differentiation)

Anticipatory Set

Build background knowledge by asking students to complete the True/False Entrance Slip. No more than two or three minutes should be given for this task. Collect the Slips. The same Slip can be used as an Exit Slip for assessment at the end of this lesson.

Video: [Properties of Water](#)

Practices

- » **Guided Practice (Large group):** Students will read text in their collaborative groups of four or five students. (The day before, if possible, assign members to groups including strong and weak readers in each.) Allow about ten minutes at the beginning of class for students to read quietly to themselves before reading aloud in groups. Each group should record unfamiliar terms to be compiled into a class list. This list can be used for a Tagxedo (www.tagxedo.com) or Wordle (www.wordle.net) to be created. (Supplement or differentiation p. 8)
- » **Indepented Practice:** Students will reflect on learning as they explain properties of water and give examples of each on p. 3 (Collaborative Assignment). Students will share their responses in their collaborative groups and then with the class if time allows. Activity on p. 8 can be used as needed for supplemental work or differentiation. Students will use the Class List of Unfamiliar Terms to create a tagxedo or a wordle. (p. 8) Students can send their work as an attachment to the teacher or through some other form of media such as a class blog, Edmodo, or Google Docs.
- » **Differentiated Instruction:** Students will use the class list of unfamiliar science terms to identify those they are unsure of. Ask students to create flashcards using <http://quizlet.com> using their cell phone, iPad, or other personal device. The cards can be used as a reference and as a continued support for science content reading and writing. Quizlets can be shared with other students in the class by providing the name of the set of flashcards made by any classmate. Also, the teacher can use a student's set of words/definitions from Quizlet to produce an assessment. In addition, the supplement on p. 4 can be used for ELL students. The following short videos can be used as needed for extra support:
 - » http://www.youtube.com/watch?v=HVT3Y3_gHGg (Crash Course Biology: Water 11:16)
 - » <http://www.bozemanscience.com/water-life> (10:44)
 - » <http://www.bozemanscience.com/water-a-polar-molecule> (8:36)
 - » http://www.nsf.gov/news/special_reports/chemistrynow/chem_water.jsp (4:46)

Closure

Students will make corrections to the True/False Slip they completed prior to the lesson using a different color pen or pencil. This will serve as an Exit Slip assessment (p. 1). Ask students to describe any remaining questions they have regarding the lesson. Ask students to share with the class how their understanding of the importance of water to life has changed. This could also be used as an independent writing assignment or assessment.



Lesson I: Amazing Water

Student Reading Text

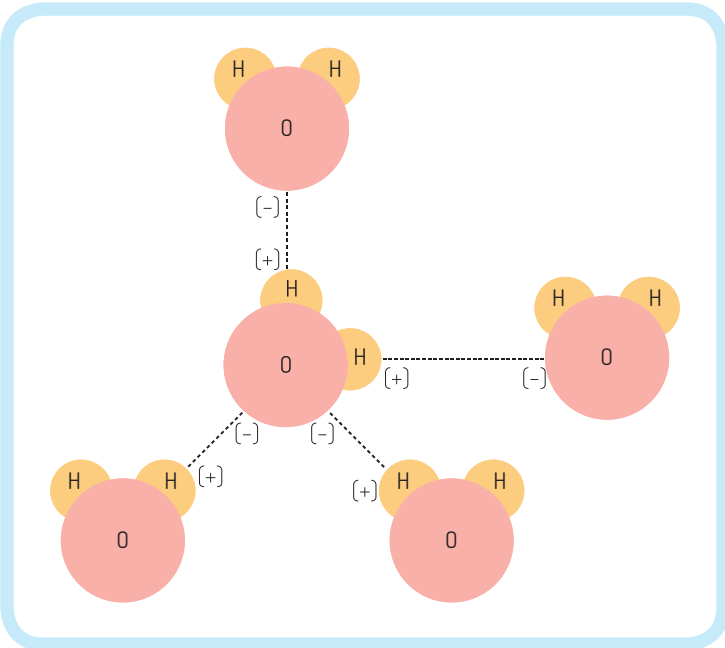


Entrance Slip/Exit Slip

Evaluate each of the following statements regarding water. Decide if the statement is true or false and write **T** or **F** on the line as directed by your teacher. You will have 2-3 minutes to complete.

Statements	Entrance	Exit
1. 70% to 75% of Earth's surface is covered by water.		
2. Water is a "dependent" solvent.		
3. Pure water has a pH of six.		
4. About 40% of an adult's body is made up of water		
5. A water molecule consists of one oxygen atom and two hydrogen atoms		
6. The oxygen and hydrogen atoms are held together by ionic bonds.		
7. The water molecule is polar, meaning that it there is a partial negative charge on one end of the water molecule and a partial positive charge on the opposite end.		
8. The water molecule is polar because the two hydrogen nuclei attract electrons more strongly than the oxygen's nucleus.		
9. The bonds that form between two water molecules are called hydrogen bonds.		
10. Hydrogen bonds are very strong compared to covalent bonds		
11. Because water is polar, it can form multiple hydrogen bonds with other water molecules, which account for many of water's special properties		
12. Without water, life would not exist		
13. Water is able to dissolve ionic and other polar molecules due to its polarity.		
14. Virtually all life on Earth needs liquid water to survive		
15. Ice floats because it is lighter than liquid water.		

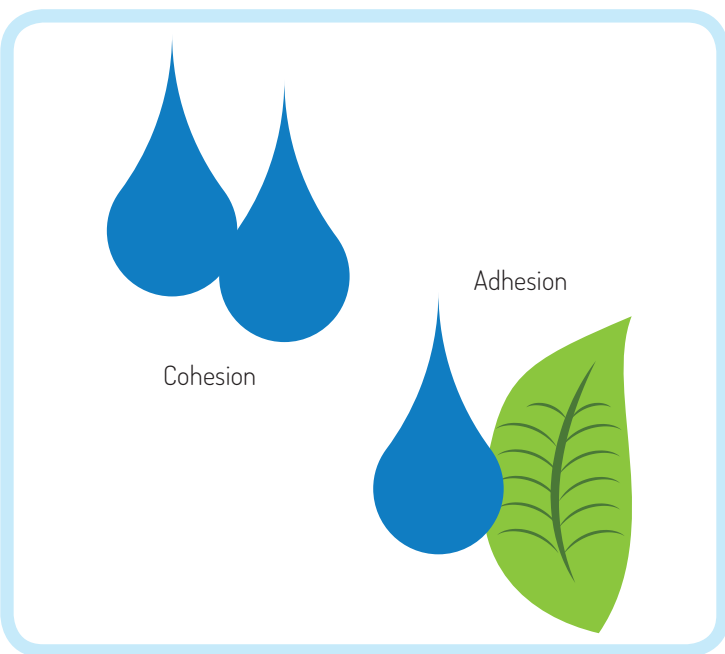
Hydrogen Bonding



Did you know the water you drink today was formed when Earth was formed? Without water there would be no life on Earth. Water is necessary for photosynthesis in plants, keeping Earth's surface cool, and to carry substances in the blood stream. Water has unique properties that make it invaluable to life.

Water is a molecule in its simplest form. It is made up of two atoms of hydrogen (#1) and one atom of oxygen (#8). The hydrogen atoms are covalently bonded to the oxygen atom with the hydrogen atoms sharing one electron each with oxygen. The oxygen atom shares one electron with each hydrogen atom. In this way, each valence shell of each atom is filled and the molecule is stable and neutral. The water molecule takes on a 'V' shape because the oxygen atom is more electronegative than the hydrogen atoms. This means that all the electrons in the molecule are closer to oxygen's nucleus than either of the hydrogen nuclei. Therefore, the oxygen atom has a slight partial charge on it (-) and the hydrogen atoms have a slightly positive charge (+). Because of these partial charges, intramolecular forces do not allow the water molecules to exist in a linear configuration. A water molecule is thus considered polar. It is this polarity that allows hydrogen bonds to form between water molecules, other polar molecules, and ions.

Cohesion and Adhesion



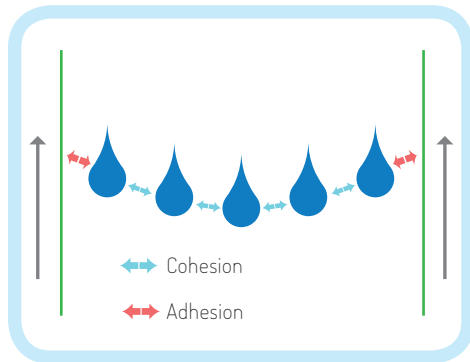
Water's unique properties are due to its polarity. Two of these properties are adhesion and cohesion. The hydrogen bonds formed between water molecules allow them to stick together - cohesion. This property results in surface tension, or the tendency for water molecules to stick together. They are at the boundary of a gas and a liquid or a solid and a liquid, etc. This accounts for the 'skin' you see on the surface of water. Compared to other liquids, water's surface is pretty hard to break. This explains why it hurts when you "belly flop" into a pool and why certain things can float on water even if they are denser.*

*Cohesion between the molecules in water makes surface tension that is difficult to break.

Adhesion occurs when water molecules stick to unlike surfaces. That is why water forms a thin film when it spreads out on certain surfaces such as glass. In this case, the adhesive forces are stronger than the cohesive forces causing a water droplet to spread out instead of staying intact. Water drops form when the cohesive forces of the water molecules are stronger than the adhesive forces causing surface tension. What would cause the droplet to "break" and spread out in a thin film?*

*Breaking the surface tension of the droplet.

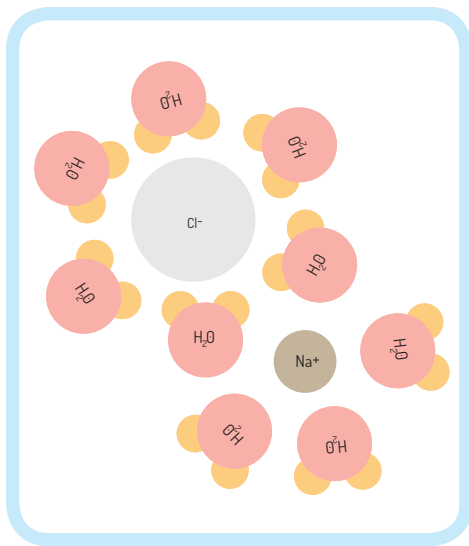
Capillary Action



Capillary action is also a result of surface tension. Plants depend on this property to “pull” water up through the stem to the leaves where photosynthesis takes place. The water adheres to the inside of the plant’s vascular tubes (xylem and phloem), but the surface tension attempts to flatten it out. This makes the water rise and cohere to itself again, a process that continues until enough water builds up to make gravity begin pulling it back down. Can you think of other examples where capillary action is used?*

*One example might be in a lab to draw blood for testing after a finger prick. Another could be paper toweling absorbing water from a spill.

Water Acting as a Solvent



Water’s ability to act as a solvent for many substances is another unique property. We often refer to water as a “versatile” solvent for this reason. Remember that a solution is a mixture in which two substances are equally distributed, such as salt water. In this case, water is the solvent and salt is referred to as the solute. Because salt (**NaCl**) is formed by an ionic bond between sodium (**Na+**) and chlorine (**Cl-**), water molecules attract the sodium atoms away from the chloride atoms. The negatively charged oxygen atom in water molecules are attracted to the positively charged sodium atoms and the positively charged hydrogen atoms are attracted to the negatively charged chloride atoms. This is how salt dissolves in water creating a solution. Is salt dissolving in water a physical or chemical change?

In order for a substance to dissolve in water, it must be an ion or polar. Substances that do not demonstrate these chemical properties, such as oil or wax, will not form a solution in water. Molecules that are not attracted to water molecules are considered hydrophobic. Those that are attracted to water are considered hydrophilic. Can you think of other substances that are hydrophilic?*

Water’s Thermal Properties



Water’s thermal properties are significant to living organisms. It has a high heat capacity, meaning it takes a lot of energy to heat water up and it loses a lot of energy when it cools. Water boils at 100°C and freezes at 0°C. Water resists a change in temperature and thus helps to regulate the surrounding air and land temperature. Hydrogen bonding accounts for this property. Can you think of an example to demonstrate the significance of high heat capacity to living things?*

High heat of vaporization is also due to hydrogen bonding. It takes a lot of heat energy to change liquid water to a gaseous state. As a result, solar heat absorbed by tropical seas dissipates as the water evaporates (evaporative cooling). As the tropical air moves toward the poles, water vapor releases heat as it condenses into rain. Can you think of an example of evaporative cooling in humans?*

*Temperature moderation on land and in oceans and other bodies of water, as well as gradual temperature changes helps living organisms to survive.

**Sweating helps cool the body as it evaporates from the skin.

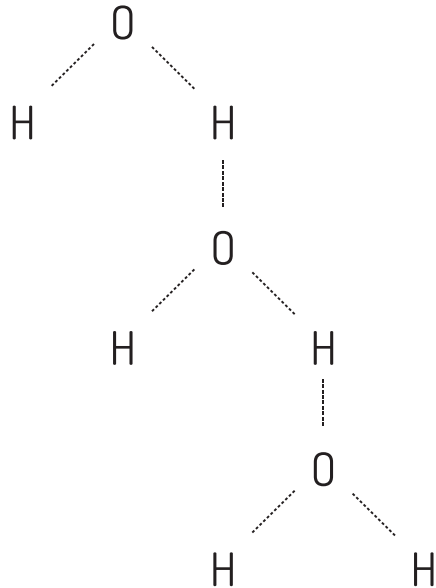
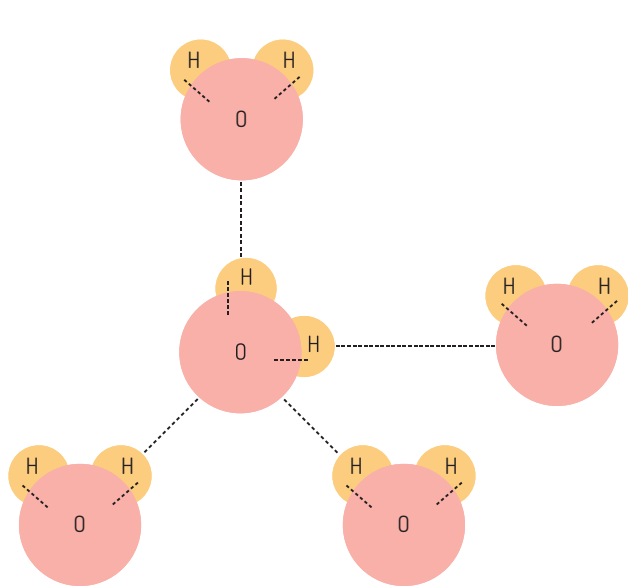
Student Writing Activity

All of life is dependent on water. The unique properties of water due to polarity and hydrogen bonding account for these properties. Living organisms can only survive with steady access to water in the form of rain, lakes, streams, etc. Write atleast three paragrapgs explaining the differents ways that you use water in your everyday life

[illegible]

Collaborative Group Activity Sheet

Examine the diagrams of a water molecule below. In your small group, determine which bonds are hydrogen bonds and which are covalent bonds. Use a red pencil to trace over the hydrogen bonds and a blue pencil to trace over the covalent bonds. Complete the molecules in Diagram A and B by drawing in the missing bonds. Indicate the oxygen (O) atoms and the hydrogen (H) atoms in each molecule of water. Using the Greek letter delta (δ) and a (+) or (-) sign, indicate the partial negative charges and the partial positive charges on each water molecule.



Explain how the structure of the water molecule accounts for 3 properties of water.
Site a specific example of each property and its impotance to life.

Go to www.wordle.net. Click on “Create Your Own.” In the first box that states “Paste in a bunch of text.” Type in the words or phrases you or your group have chosen from the reading to study. In order to keep words in a phrase together, use the tilde key (~) between each word. Type in a word multiple times to make the word larger than others. For example, one one two two two. The word “two” will be three-times larger than “one”. Using color and printing with a color printer will produce the most interesting wordle.

[illegible]

Lesson II: Water Problems

Objective



Students will:

- » Identify the major contributing factors of the global water crisis.
- » Identify the overall effects on a community that lack adequate access to clean water.

Materials/Resources Needed:

- » Cup of tap water for each student or one to use as visual for entire class
- » Zip-lock bag of 400 M&Ms (optional)
- » Five 1-gallon milk jugs filled with water or a 5-gallon container filled with water

Anticipatory Set

Tell students that today they will be learning about the causes and effects of one of the biggest problems faced in the world today: the global water crisis. Give each student a cup of tap water and a student packet (or one glass of water could be placed at the front of the class). Have students work individually to answer Student Brainstorm Questions. Briefly share and discuss student answers as a class.

- » Discuss how the water on our planet is billions of years old and the same water in their cup was around when dinosaurs walked the earth. Water is not created or destroyed, but it changes states of matter and moves through the water cycle. Therefore, the overall amount of water has not changed on our planet. However, the global population and amount of water used per person has increased.
- » Discuss how drinking water has to come from a fresh water source and be filtered/purified in order to be safe. Review the facts about where water comes from and have them label the pie graphs. (Also have a student volunteer to label a demo graph on a SmartBoard or dry erase whiteboard.)

Optional Visual Demonstration: To give an idea of the relative amount of available fresh water on our planet, show students a zip-lock bag of 400 M&M's. Tell students that the 400 M&M's represent all of the water on our planet. 390 M&M's represent the salt water. Pull out 10 M&M's and tell students that these represent fresh water and say the others cannot be used because salt water dehydrates people. Take 7 of the 10 M&M's and say these cannot be used because they represent water frozen away in glaciers and ice-caps. Take 2 M&M's away and say that those represent water used for agriculture and industry. Now we are left with just 1 M&M available to be used for drinking and other daily uses.

Practices

Guided Practice

1. Have students read over questions in Part B: "Where We Get Our Fresh Water From." Show video on class projector and have students answer the questions. Briefly go over questions and discuss as a class.
2. Read Post-Video Question and give students one minute to answer. Discuss as a class (i.e., drinking water, cooking, laundry, dishwashing, showering/bathing, toilet flushing, watering garden/lawn, cleaning, etc.)
3. Go to http://www.waterfootprint.org/files/SWF_InfoGraphics.php (embedded as QR code and tinyurl in Student Packet). Point out that there are different ways of looking at water usage and show that the United States has the highest overall water footprint per capita at 2,483,000 liters of water per inhabitant per year (includes agriculture, industry, and domestic needs). Click on National Water for Domestic Needs and compare statistics for a few countries. Point out the low values in Sub-Saharan African countries. Read the water use statistics in the student packet. (If you have gallon jugs or a 5-gallon container, hold up and tell students to imagine using 80-100 gallons a day.)

Independent Practice:

Put students into groups of three to four. Have students independently read Student Reading in Part C to learn about the effects of not having enough clean water in a community. They should circle unfamiliar terms. Next, have them go through the reading as a group and identify three causes of the global water crisis as well as the health, education, and poverty effects that are identified in the reading. Have them record these on the Graphic Organizer.

Differentiated Instruction

For some lower level groups, it may be desirable to skip Step 3 of the Guided Practice and/or to read the Student Reading in the Independent Practice aloud as a class and complete the cause and effects Graphic Organizer as a class.

For advanced cases, choose one of the three Optional Extension Assignments or allow students to choose between the first two. Students may work independently, in partners, or in groups. Students may be asked to share their product with the class.

Closure

As a class, discuss the information the students filled in on their Graphic Organizer and the unfamiliar terms. (It is recommended to have students write responses on board or projector.) Have groups add in information they did not already have in another color. Collect Response Sheets.

If desired, use gallon jugs or 5-gallon container filled with water to carry down the hall to get an idea of what the health/physical effects of that labor would be.

Lesson II: Water Problems

Student Reading Text



Part A: Student Brainstorm Questions

Directions: Work individually to answer the following questions, then discuss as a class.

- » How old is the water in the cup?
- » Where did the water in the cup come from?

Water Facts

- » Water covers nearly 71% of Earth's surface.
- » About 97.5% of water on earth is salt water and only 2.5% is fresh water.
- » About 69% of fresh water is frozen in glaciers/ice-caps and inaccessible. The remaining fresh water mostly lies far below ground in aquifers too deep to access (30%).
- » Less than 1% of fresh water is accessible below ground or available in lakes, soil, atmosphere, wetlands, rivers, etc.
- » Only 0.007% of all water on earth is accessible for direct human use!

Part B: Video – “Where We Get Our Fresh Water From”

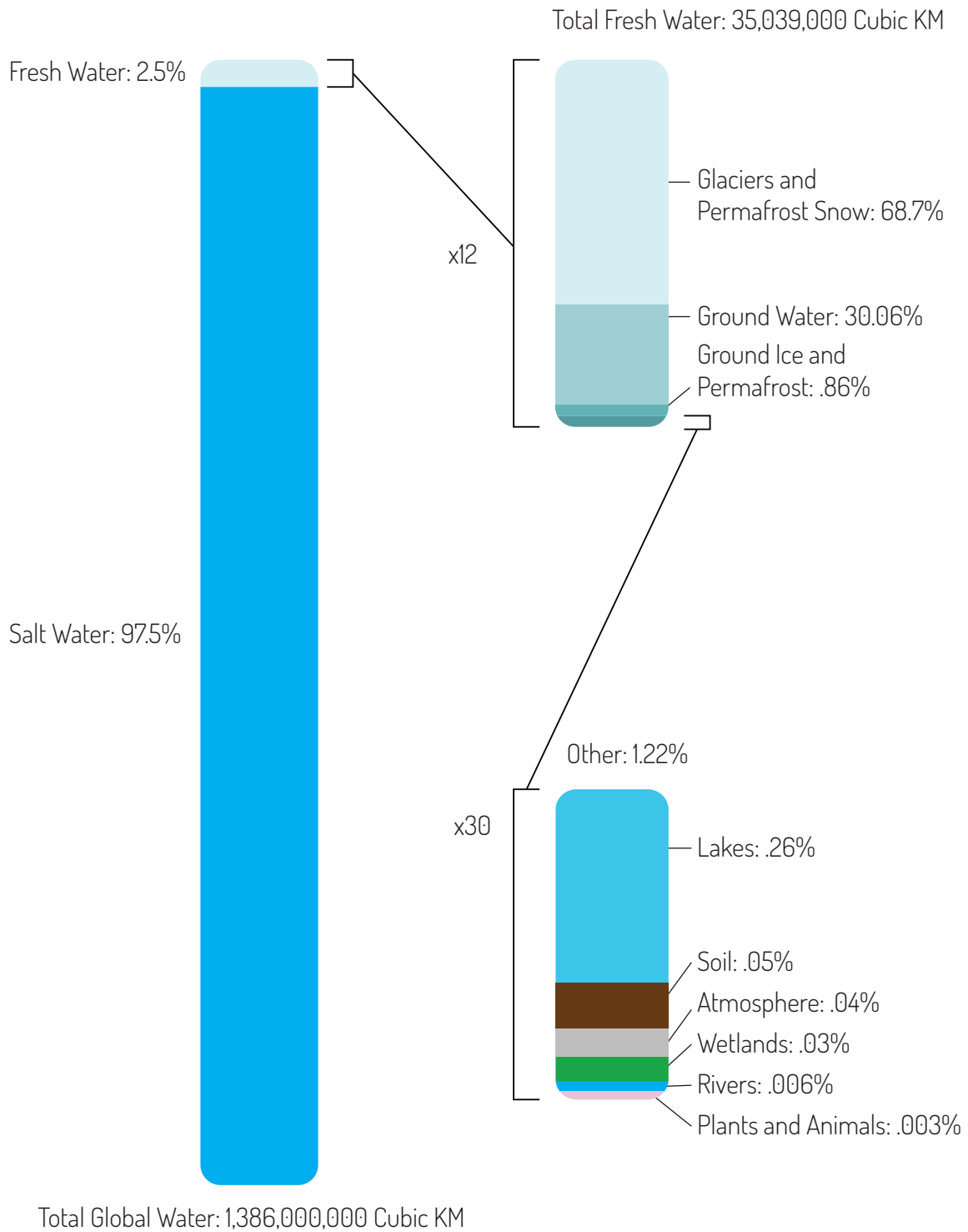
Directions: Answer the following questions as you watch this TED video (<http://ed.ted.com/lessons/where-we-get-our-fresh-water-christiana-z-peppard#review>).

- At birth, _____ of our bodies are made of water.
A. 25% B. 50% C. 75% D. 100%
- What percentage of water on earth is fresh?
A. 2.5% B. 4.0% C. 5.5% D. 0.75%
*Circle this value on the Infographic on the next page.
- The world's fresh water is divided into three categories. Which accounts for the LEAST amount of water?
A. Polar regions B. Reservoirs C. Ground water D. Surface water
- What accounts for nearly 70% of global fresh water consumption?
A. Urban areas/cities B. Agriculture C. Manufacturing D. None of the above
- What country consumes more fresh water per capita than any other country in the world?
A. United States of America B. Brazil C. China D. India

Post-Video Question: 8% of our global water use goes to domestic consumption. In what ways do you and your family use water on a daily basis? [Global Water Use Infographics website: http://tinyurl.com/lglrfpd](http://tinyurl.com/lglrfpd)

Each person in the United States uses about 80-100 gallons of water a day that has been filtered and purified. Residents of Sub-Saharan Africa and other water-poor regions use only 2-5 gallons of water a day that is often unclear and they have walked miles to obtain.

The Water of Planet Earth



Part C: Student Reading

Directions: Read through the entire text once independently, circling any unfamiliar or new terms. Go through the text a second time as a group and identify three causes of the global water crisis as well as fill in the Graphic organizer identifying effects of the water crisis on health, education, and poverty.

What Happens When There Is Not Enough Clean Water In A Community?

People need water for survival. We always have and we always will. Although a person may survive for weeks without food, a person will not last more than a few days without water. We use fresh water every day for critical daily activities including drinking, cooking, bathing, washing, and sanitation. And we indirectly rely on massive amounts of water used in agriculture and industry.

However, fresh water is a limited resource and we are currently in the midst of a global water crisis. The problem is not that we are running out of water on Earth: there is the same amount of water on our planet today as there has been for billions of years. The problem is that due to physical scarcity of fresh water, economic disparities, increasing populations, mismanagement and overuse of water resources, and poor infrastructure, many communities around the world face lack of adequate access to safe, fresh water on a daily basis.

1 in 8 people worldwide do not have access to clean and safe drinking water, which adds up to nearly a billion people



The reality is that 1 in 8 people worldwide do not have access to clean and safe drinking water, which adds up to nearly a billion people, and the numbers are growing. Moreover, approximately three billion people on our planet have no access to sanitation, meaning they lack access to proper toilets and facilities for managing human waste. The effects of this combined lack of access to clean drinking water and proper sanitation are devastating and far-reaching.

In many developing countries, water is not directly available in the communities. In these situations, a family member will have to make a long trek, often multiple miles away, to gather water and lug the heavy load back home. Girls and women are twice as likely to be the family member responsible for fetching the water as boys or men. Oftentimes the person making the trip will not have proper shoes or no shoes at all. Jerry-can water jugs often hold about 5 gallons of water, which weighs over 40 pounds (water weighs 8.34 lbs/gallon). The jug is often balanced on the person's head or back, which can result in long-term neck and spinal column injuries, and even interfere with childbirth. Besides the heavy physical toll this takes on the person, the time commitment also interferes with both education and employment opportunities for the family member responsible for finding and transporting water. According to the World Health Organization, an estimated 200 million hours are spent each day globally collecting water. Imagine how much these people could do in school and at jobs with this time!



Jerry-can water jugs hold about 5 gallons of water, which weighs over 40 pounds



Even after the water is fetched from the source, it is often unclean, meaning it is contaminated with pathogens that may result in a waterborne disease or may contain harmful levels of pollutants that may also cause sickness. Infectious waterborne diseases, such as diarrhea, typhoid, and cholera are responsible for 80% of illnesses and deaths in the developing world, and half of the world's hospital beds are filled with people suffering from a water-related disease. Those with underdeveloped or compromised immune systems are especially vulnerable to getting sick, such as children, people with HIV/AIDS or cancer, and the elderly. Worldwide, one out of every five deaths of children under 5 is due to a water-related illness.

The sickness caused by dirty water is quite debilitating and often students who suffer from waterborne illness are not well enough to stay in class. Additionally, if teachers are sick, classes may get cancelled for everyone. Missing out on the chance to learn and obtain a full education increases the likelihood of the cycle of poverty continuing. Also, sick individuals often require a caretaker, which means a second person cannot work either, and money spent on medicine may result in less to spend on food or school supplies.

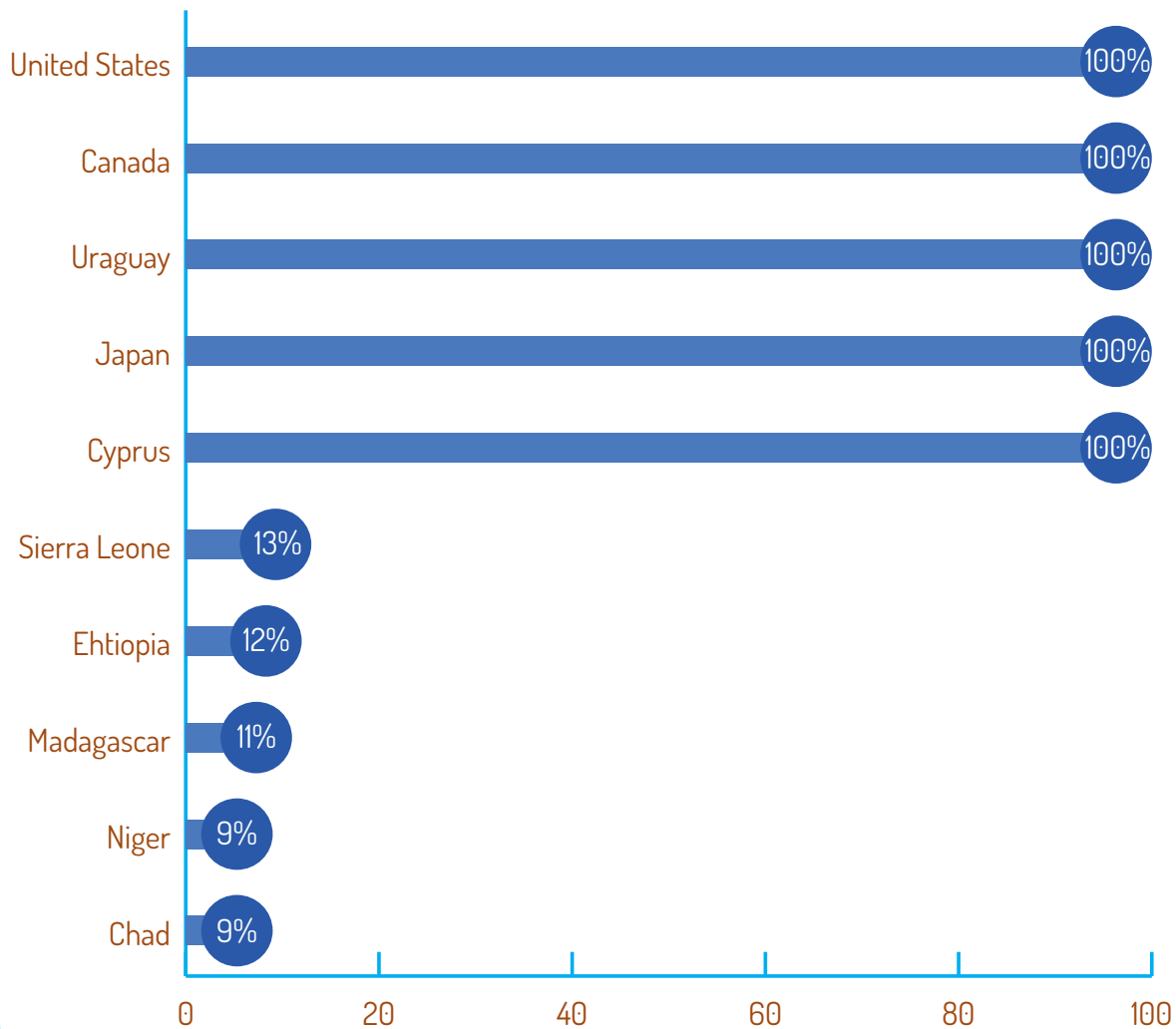
Also, due to the fact that there is such a limited supply of water and drinking water is the top priority, there is often very little water left for other important hygiene practices, such as hand washing, bathing, laundry, dish-washing, teeth-brushing, latrine usage, etc. Inadequate

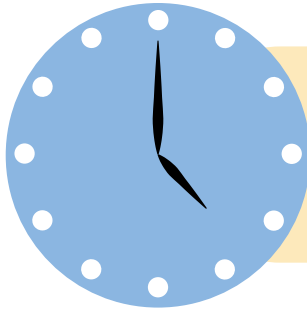
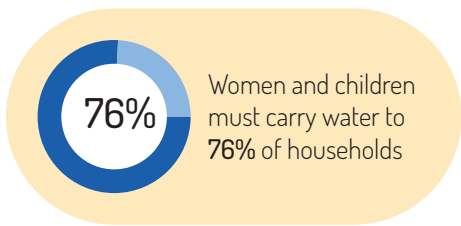
sanitation often results in hygiene-related diseases such as ringworm, lice, lymphatic filariasis, scabies, trachoma, and more. Although having a limited water supply makes it difficult to maintain cleanliness, there are ways to improve hygiene practices without depleting water supplies. Educating communities about these practices is an important part of the mission of organizations like WaterStep who desire to help eliminate suffering and disease in water poor regions.

The demand for water is higher than it has ever been before, and people are never going to stop needing water. The current status of our global distribution and usage of fresh water leaves many in a dire situation, suffering severe consequences. However, there are solutions that can help alleviate the ravaging effects due to the lack of access to safe drinking water and improper sanitation. These solutions will require that people take responsibility and look critically at their water usage habits on a personal and national level and recognize the local and global effects. Changes will need to be made to stop the current over-usage and pollution of fresh water sources that is occurring. Innovative solutions will be key to finding ways to bring fresh water to all.

Water Infographics

National Percentages of Populations
with Access to Clean Water

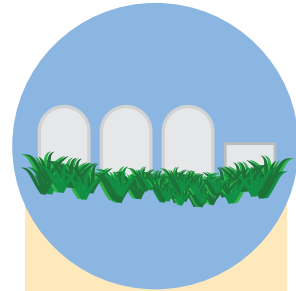




200 Million work hours are spent on a daily basis by women collecting water for their families

443 Million school days are lost every year due to water related illness

Jan	Feb	Mar	Apr
May	Jun	Jul	Aug
Sep	Oct	Nov	Dec



3.58 Million people die each year from water related illness

66% of those who lack safe drinking water live on less than \$2 a day

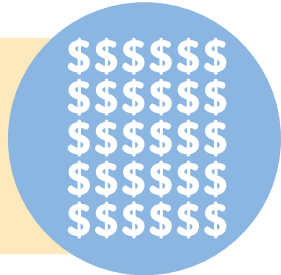


33% of those who lack safe drinking water live on less than \$1 a day



The average African uses 2.64 gallons of water a day

The U.N. estimates a cost of **\$30 Billion** to provide global access to safe water



Those who live in slums often pay **five to ten times more** than people living in wealthier parts of a city



2.5 Billion gallons of water is needed to support **4.7 Billion** people at the U.N. daily water minimum



Water often costs more than **25%** of their income

Part C Continued: Causes and Effects of the Global Health Crisis

Graphic Organizer

Causes		
1		
2		
3		
Effects		
Health	Education	Poverty

Part D: Optional Extension Assignments

Extension #1: Personal Account

You will assume the identity of a person living in a community in a water poor region (child, mother/father, teacher, political leader, etc.) Write a personal story chronicling the challenges of coping with a lack of adequate access to safe water. Be creative in choosing the format of your story and making it descriptive and realistic.

Examples: diary entries, letter to a family member, college admission letter, letter to a student from a school that has partnered to help your school, letter to a community leader, letter to a world leader, etc.

Extension #2: Global Health Conference

Scenario: You will be taking on the role of an epidemiologist presenting at a world health conference taking place in Geneva, Switzerland and is focused on gathering leaders from around the world who are dedicated to finding solutions to the current global water crisis: politicians, business leaders, educators, medical physicians, and more.

As an epidemiologist, you specialize in investigating the patterns and causes of water-related diseases in water poor regions. Water-related diseases can be divided into three categories: waterborne diseases, sanitation/hygiene-related diseases, and vector/insect-borne diseases related to water. Go to http://www.cdc.gov/healthywater/wash_diseases.html to read an overview of water-related diseases. Choose one of the following diseases and write a persuasive speech educating the conference attendees on the illness and importance of developing solutions.

Topics:

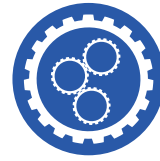
- | | |
|-----------------|---------------------|
| » Cholera | » Schistosomiasis |
| » Typhoid Fever | » Cryptosporidiosis |
| » Hepatitis A | » Onchocerciasis |
| » Giardiasis | » Dengue fever |
| » Ring worm | » Malaria |

Extension #3: Public Awareness via Infographics

You will perform independent research to gather additional information about the global water crisis. Select a topic that you would like to share with your class and the school. Create an infographic design about the information that will be hung in the school. (Inspiration at <http://waterstep.org/why-water/infographics/>)

Lesson III: Water Solutions

Objective



Students will:

- » Explain that technology has been developed to clean water and save lives.
- » Create a product that explains the differences clean, (SAFE) water can make to a community.

Materials/Resources Needed:

- » Map showing water access around the world
- » Video on WaterStep: <https://www.youtube.com/watch?v=mcX0IVw-EYU&list=UUkwkGiuy8EHv30YncIvNw&index=21>
- » Handout with assignments
- » Handout with an explanation of WaterStep technology
- » Rubric for assignments
- » Computer access

Anticipatory Set: Think, Pair, Share

Students will look at the map showing water “rich” and “poor” countries. Give students five minutes to examine the map and respond to the following questions:

1. How would life be different in the United States if we did not have 100% access to clean (SAFE) drinking water?
2. Why do you think countries like Chad and Niger have very low access to clean, (SAFE) drinking water? How do you think this affects people living in these countries?
3. Do you think access to clean, (SAFE) water and sanitation is a basic human right? Explain.

Take five minutes to allow students to discuss responses with others and then share answers with the class. List the answers the class comes up with for the second question.

Practices

Guided Practice

- » Introduce WaterStep and its innovative technology by showing the following video: <https://www.youtube.com/watch?v=mcX0IVw-EYU&list=UUkwk-Giuy8EHv30YncIvNw&index=21>
- » Pass out Handout on WaterStep purifier technology and as a class read over the information and discuss how having this technology might change lives in countries like Chad and Niger. (Refer to the list on the board from question 2).

Independent Practice

Hand out the WaterStep Technology Assessment. Explain that students can either chose the Mild, Medium or Spicy Option to show they understand the life-changing importance of WaterStep technology. Pass out the Rubric for how the assignment will be graded.

Differentiated Instruction:

Students have the option to choose an assignment. There are assignments geared for kinesthetic, written/linguistic, and visual/special learning. The teacher has the option to allow students to create their own assignment to show competency as long as it is approved by the instructor.

Closure:

Reflection in notebook: If water is scarce in much of the world, what can you do to conserve water? Anything not finished is homework and turned in the next day at the beginning of class.

Lesson III: Water Solutions

Student Reading Text



WaterStep Technology Assignment

This assignment asks you to look at a village and assess the change clean (SAFE) water brings. You can pick from several different ways to portray this information. Pick Mild, Medium, or Spicy Option (or with help from your teacher create your own assignment with “other”). Anything not completed today in class will be homework tonight.

Spicy

Create a script and film (or perform) a newscast detailing the difference WaterStep technology has made in a village. Talk about life in the village when there was no clean water (detailing at least three problems faced by the village because they did not have clean, (SAFE) water). Then discuss the training WaterStep offers (find more information at <http://waterstep.org/what-we-do/water-health-hygiene/>). Finally, discuss the positive impact having clean, (SAFE) water has had on the village. You must have at least three interviews. You can work in groups of three for this option. Make sure your teacher approves your group before you begin. Your script must be turned in with the project (although it can be a rough draft). See the Rubric for more instructions and how you will be graded.

Medium

Create a comic strip that is at least six boxes that shows life in a village that does not have access to clean, (SAFE) water. Show at least three problems the village faces, the training WaterStep offers (see <http://waterstep.org/what-we-do/water-health-hygiene/> for more details on this), and the long-term positive impact clean, (SAFE) water had on the village. The comic strip needs to include color. See the Rubric for more instructions and how you will be graded.

Mild

Create three journal entries. The first entry needs to be from the point of a villager in a country who does not have access to clean, (SAFE) water. The entry needs to explain at least three problems faced by your author because she/he does not have access to clean, (SAFE) water. The second entry needs to detail WaterStep coming into the village and discussing the training the village received. More information can be found here: <http://waterstep.org/what-we-do/water-health-hygiene/>. The final entry needs to explain the long-term positive impact that clean, (SAFE) water had on the village. See the Rubric for more instructions and how you will be graded.

Other

Pick your own assignment to prove you understand the importance of this technology and the impact it makes on the village. Write down a proposal and get it approved by your teacher before you begin. Make sure it includes: a) at least three problems a village might face without clean (SAFE) water, b) the training WaterStep offers, and c) the long-term positive impact that clean, (SAFE) water has on the village. This could include a rap/song, poem, poster etc.

Rubric For Assignments

	Excellent: 3 Points	Good: 2 Points	Poor: 1 Point
Before clean (SAFE) water	Students provide at least three solid examples of problems faced by villages without access to clean, (SAFE) water. These examples are explained in detail in the final product.	Students provide at least three examples of problems faced by villages without access to clean, (SAFE) water. These examples are stated but are not explained well in the final product.	Students provide less than three examples of problems faced by villages without access to clean, (SAFE) water.
During training with WaterStep	Students provide at least two solid examples of the training WaterStep conducted while in the village. The importance of the training is explained in detail in the final product.	Students provide two examples of the training WaterStep conducted while in the village. The importance of the training is not explained well in the final product.	Students provide less than two examples of the training WaterStep conducted while in the village.
After clean (SAFE) water	Students provide at least three solid examples of the difference clean, (SAFE) water made in the village. These examples are explained in detail in the final product.	Students provide three solid examples of the difference clean, (SAFE) water made in the village. These examples are stated but are not explained well in the final product.	Students provide less than three examples of the difference clean, (SAFE) water made in the village.
Product	The final product is clean and professional looking. It has no or few spelling or grammar errors.	The product is good but is not professional and does not show the best work of the student.	The product is poorly constructed and does not show the best work of the student.
Instructions	Students read the directions for their project and followed all directions.	Students read the directions for their project and followed most of the directions.	Students read the directions for their project but did not follow several of the directions.
Work Ethic	Students worked well in groups or individually. Student stayed on task throughout the lesson.	Students worked well in groups or individually. Student stayed on task throughout 90% of the lesson.	Students did not work well in groups or individually. Student had trouble staying on task throughout the lesson.

Total points: ____ /18

Lesson IV: We Can Help!

Objective and Student Reading Text



Students will:

- » learn how to improve water quality in their community and world through volunteering their service and making others aware of the issue.
- » understand how WaterStep depends on local communities to collect shoes to use to help global communities obtain clean (SAFE) water.
- » write a persuasive letter to the editor of the local newspaper, or elected official, promoting attention to pollution issues and the need for clean water.

Materials/Resources

WaterStep video hyperlinks: [Youtube video on How to Change Shoes into Water](#).

- | | |
|---|---|
| » http://www.usgbkentucky.org/green-apple-day-of-service/ | » http://www.volunteermatch.org |
| » https://www.facebook.com/GiveADayLouisville | » WaterStep.org |
| » www.louisvilleky.gov/mayor | » www.lennntech.com |
| » www.energizeinc.com/prof/events/eventsNA.html | » www.who.int |
| » www.afsusa.org/serviceday | » www.unicef.org |

Anticipatory Set

Click on video link: How to change shoes into water.

Practices

Guided Practice:

- » Separate students into small groups, review some of the video links, then have them discuss the impact of not having available water sources nor clean water. Have them discuss what they would do if they were in an environment where they had to contend with polluted water, and then share with the class.
- » Also have them discuss water issues in the immediate vicinity, the causes, and possible solutions. Have small groups draw up priorities of action that they could take to improve the environment.
- » Examine sanitation issues with septic tanks, septic fields, sewage overflows, and the local waterways.
- » Have them also discuss and present ways that, through service organizations or projects, that they can make a difference in the quality of the water or reduction of pollution.
- » Discuss how the class or school can undertake a project to improve clean, (Safe) water availability and reduce pollution along waterways in the community.

Independent Practice

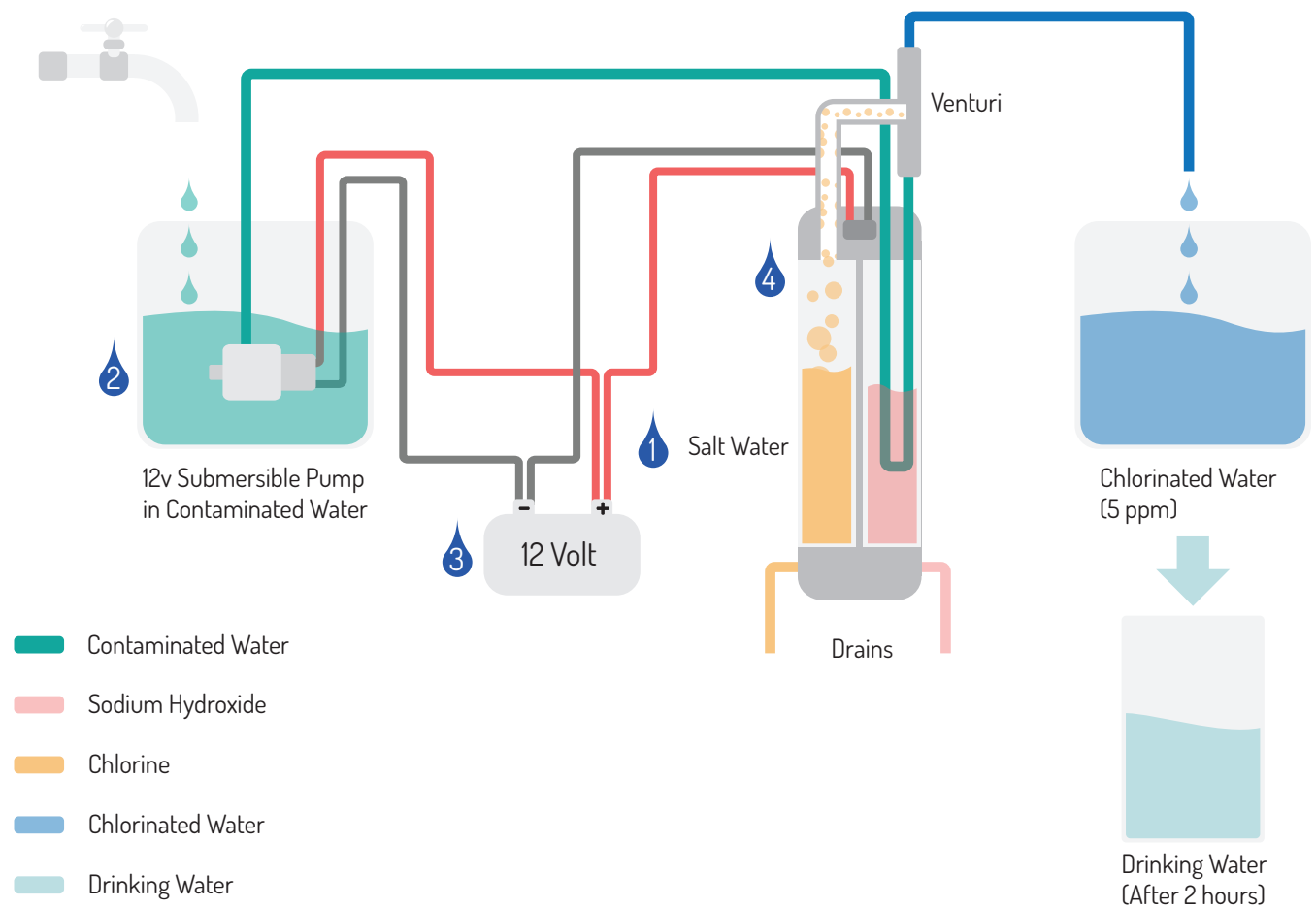
- » Students will write a letter to the editor of a local paper, or a letter to an elected representative, drawing attention to issues pertaining to clean, (Safe) water.
- » Groups can also undertake projects to make the community aware of issues and solicit support in addressing and trying to alleviate the problems.

M-100 Water Purifier



M-100 Water Purifier

Water Source
(well, stream, river, lake, etc.)



How The M-100 Works

1. A handful of salt is mixed into the water and poured into the left side of the M-100. Regular water is poured into the right side.
2. A pump is placed into the dirty water and pumps this water through the M-100 and into a drinkable water container.
3. A 12 volt battery is attached to the pump and the M-100. The water purification process now begins.
4. The M-100 turns salt water into chlorine gas, which is mixed into the dirty water. This process kills 99.99% of contaminants and makes the water safe to drink.

Benefits of Our Water Chlorinator

- » Operational in only five minutes.
- » Chlorinates more than 10,000 gallons of water per day.
- » Weighs less than 15 lbs and fits into most carry-on bags.
- » Purifies drinking water at a cost of less than \$1 per person annually.
- » Produces virtually no waste.
- » By-products form a cleaning solution which can be used to sterilize medical equipment and disinfect latrines.

Accessories are available to build a complete mini-water treatment plant. This includes pumps, filters, solar panels, tanks, and more. Visit WaterStep.Org for all of our safe water solutions!

Master Vocabulary List

Adhesion

Noun; The molecular attraction exerted between the surfaces of bodies in contact.

Atom

Noun; The smallest particle of a substance that can exist by itself or be combined with other atoms to form a molecule.

Capillary Action

Verb; The movement of a liquid along the surface of a solid caused by the attraction of molecules of the liquid to the molecules of the solid.

Cholera

Noun; Any of several diseases of humans and domestic animals usually marked by severe gastrointestinal symptoms, especially: an acute diarrheal disease caused by an enterotoxin produced by a comma-shaped gram-negative bacillus (*Vibrio cholerae* syn. *V. comma*) when it is present in large numbers in the proximal part of the human small intestine .

Clean Water

Noun, Adjective; Water free of particulates, but not necessarily potable.

Cohesion

Noun; Molecular attraction by which the particles of a body are united throughout the mass.

Covalent Bond

Noun; A chemical bond formed between atoms by the sharing of electrons.

Cryptosporidiosis

Noun; Infection with or disease caused by cryptosporidium.

Dehydration

Noun; An abnormal depletion of body fluids.

Dengue Fever

Noun; marked by hemorrhagic symptoms (as hemorrhagic lesions of the skin, thrombocytopenia, and reduction in the fluid part of the blood), also called Hemorrhagic Dengue.

Diarrhea

Noun; Abnormally frequent intestinal evacuations with more or less fluid stools.

Electronegative

Adjective; Having a tendency to attract electrons.

Fresh Water

Noun; Inland water, such as ponds, lakes, and streams, that does not contain a large amount of salt.

Giardiasis

Noun; Infestation with or disease caused by a flagellate protozoan of the genus *Giardia* (especially *G. lamblia*) that is often characterized by diarrhea. Also called lambliasis.

Hepatitis A

Noun; An acute, usually benign, hepatitis caused by a picornavirus (species Hepatitis A Virus of the genus Hepatovirus) that does not persist in the blood serum and is transmitted especially in food and water contaminated with infected fecal matter. Also called also infectious hepatitis.

Hydrogen

Noun; Chemical element that has no color or smell and is the simplest, lightest, and most common element.

Hydrogen Bonding

Noun; Bonding caused by the physical and electrical asymmetry of water molecules.

Hydrophilic

Adjective; Having a strong affinity for water.

Hydrophobic

Adjective; Lacking affinity for water.

Hygiene

Noun; The things that you do to keep yourself and your surroundings clean in order to maintain good health.

Intramolecular

Adjective; Existing or acting within the molecule. Also: formed by reaction between different parts of the same molecule.

Ion

Noun; An atom or group of atoms that has a positive or negative electric charge from losing or gaining one or more electrons.

Liquid

Noun; Capable of flowing freely like water: Not a solid or a gas.

Malaria

Noun; An acute or chronic disease caused by the presence of sporozoan parasites of the genus *Plasmodium* in the red blood cells, transmitted from an infected to an uninfected individual by the bite of anopheline mosquitoes. Characterized by periodic attacks of chills and fever that coincide with mass destruction of blood cells and the release of toxic substances by the parasite at the end of each reproductive cycle. (malaria remains the greatest single cause of debilitation and death throughout the world.)

Matter

Noun; The substance of which a physical object is composed.

B. noun; Material substance that occupies space, has mass, and is composed predominantly of atoms consisting of protons, neutrons, and electrons. Constitutes the observable universe and is interconvertible with energy.

Molecule

Noun; The smallest particle of a substance that retains all the properties of the substance and is composed of one or more atoms.

Onchocerciasis

Noun; Infestation with or disease caused by filarial worms (genus *Onchocerca*) especially: a human disease marked by subcutaneous nodules, dermatitis, and visual impairment. Caused by a worm (*O. volvulus*) found in Africa and tropical America which is transmitted by the bite of a female blackfly.

Oxygen

Noun; Chemical found in the air that has no color, taste, or smell, and is necessary for life.

Particle

Noun; Very small piece of something; a very small amount of something.

B. Noun; Physics: any one of the very small parts of matter (such as a molecule, atom, or electron).

Polar

Adjective; Completely different or opposite.

Potable

Adjective; Suitable for drinking.

Ring Worm

Noun; Any of several contagious fungal diseases of the skin, hair, or nails of humans and domestic animals that are characterized by ring-shaped discolored skin patches covered with vesicles and scales.

Safe Water (Potable Water)

Noun, adjective; High quality water that is free from harmful microorganisms or substances.

Sanitation

Noun; The process of keeping places free from dirt, infection, and disease.

Scarcity

Noun; Shortness of supply.

Schistosomiasis

Noun; A disease caused by parasitic worms. Also known as Bilharzia. The worms that cause schistosomiasis are not found in the United States, more than 200 million people are infected worldwide. In terms of impact, this disease is second only to malaria as the most devastating parasitic disease.

Solid

Adjective; Firm or hard. Not having the form of a gas or liquid.

Typhoid Fever

Noun; A communicable disease marked by fever, diarrhea, prostration, headache, splenomegaly, eruption of rose-colored spots, leukopenia, and intestinal inflammation. Caused by a bacterium of the genus *Salmonella* (*S. Typhi*).

Valence Shell

Noun; The outermost shell of an atom consisting of electrons.

Vapor

Noun; Substance that is in the form of a gas or consists of very small drops or particles mixed with the air.

Vascular Tubes (Tissue)

Noun; Plant tissue concerned mainly with conduction, especially: the specialized tissue of higher plants consisting essentially of phloem and xylem.

Waterborne Illness

Noun, adjective; A disease transmitted via contaminated water sources.

Water Poverty (Water Poor)

Noun, adjective; The condition of not having access to sufficient water, or water of an adequate quality, to meet one's basic needs.

Links to definitions

1. Webster's: <http://www.merriam-webster.com>
2. Oxford Dictionaries: <http://www.oxforddictionaries.com>

YouTube Links

- » Lesson I: Amazing Water (The Chemistry of Water)
1. <http://youtu.be?DAilCOsjvy0>
- » Lesson II: Water Problems (Dehydration Info for Kids)
www.youtube.com/watch?v=ppFqnVHg0_E
- » Lesson III: Water Solutions (GE and WaterStep at IdeaFestival 2012)
www.youtube.com/watch?v=kvXv9BbyEOQ
- » Lesson IV: We Can Help! (Goodwall 2014)
<https://www.youtube.com/watch?v=mt6qrfvGiNU>



Sources

- » WaterStep.org/Quench/Original version
- » Center for Disease Control www.cdc.gov
- » Kenmar Foundation: Solar Water Disinfection www.solarwaterdisinfection.ca
- » Lenntech: Water Treatment and Purification www.lenntech.com
- » Louisville Water Company www.louisvillewater.com
- » UNICEF www.unicef.org
- » United Nations www.un.org
- » The University of Waikato: Science Learning Hub www.sciencelearn.org/nz
- » World Bank www.worldbank.org
- » World Health Organization www.who.int

Peer Reviewers

Dr. Maria Martinez-Blanco; Phd

K-5 Bilingual Instructor; JCPS

Dr. Antonio Blanco; Phd

K-12 Bilingual Instructor, JCPS

Ms. Tiffany Johnson; M Ed

5th grade teacher; San Bernardino City USD, CA.

Flora Martinez

Science Teacher 4th grade dual language teacher,
Hawthorne Elementary

Educational Standards

Lesson I: Amazing Water

- » (5-PS1-1): Lessons are based on real life observations of matter and its properties.
- » (3-5-ETS1.1.2): Lessons include analyzing changes, graphing quantities, and measurements of substances.
- » MP.4 (3-L5 2-1) The roles of water in earth's surface processes are explored.

Lesson II: Water Problems

- » Using Models: Make observations (firsthand or from media) to collect data, which can be used to make comparisons.
- » (2-LS2-1) LS4.D: Biodiversity and Humans There are many different kinds of living things in any area, and they exist in different places on land and in water.
- » (2-LS4-1): 3-5 Cross Cutting Concept of Cause and Effect: 4-ESS3-2 Cause and effect relationships are routinely identified, tested, and used to explain change. CCSS/ELA/Literacy: W.2.8, SL.2.5; Math: MP.2.4.5.

Lesson III: Water Solutions

- » RI.3.3 Describe the relationship between a series of historical events, scientific ideas, or concepts, and steps of technical procedures in a text, using language that pertains to time, sequence, and cause/effect.
- » (3-LS2-1) ETS1-2: Generate and compare multiple solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- » CCSS connections: ELA/Literacy-RI.5.1: Quote accurately from a text (3-5-ETS1-2). Draw on information from multiple print or digital sources, demonstrating ability to locate an answer to a question or to solve a problem efficiently. (3-5-ETS1-2)

Lesson IV: We Can Help!

- » (5-ESS2.C) Communities are doing things to help protect Earth's resources and environments.
- » (4-Ess3-2) Students who demonstrate understanding can generate and compare multiple solutions to reduce impact of natural Earth processes on humans.
- » W.3.1 Write an opinion piece on topics or texts suggesting a point of view with reasons.

Credits

Original Author:

Bethany Hertick

High School Curriculum by:

Jamie Beach

Ba Biology, Theology, Cert:7-13, Masters Science Ed.

Megan Shaughnessy

M.A.T. Secondary Science: Notre Dame University of Maryland

B.S. Biological Sciences: University of Notre Dame

Gary Householder

B.A. Liberal Arts: University of Tennessee at Martin

M.A. Management: Webster University

M.A.T. Education: Spalding University

U.S. Army Command and General Staff School Graduate

Amy Wadsworth

B.A. History

M.A. Education

Nationally Board Certified

Special Thanks to:

Mr. Bob King: M.Ed; ECE Specialist; JCPS

Mrs. Carol King: M.A.T, World Language, ESL specialist, JCPS

Dr. Maria Martinez-Blanco

Dr. Antonio Perez Fernandez

Ms. Tiffany Johnson

Ms. Fora Martinez

Graphic Design, Layout, and Illustration by:

Danny Lee Schellenberger Jr.

Presented By:



625 Myrtle Street, Louisville KY 40208 USA

(502) 568-6342

WaterStep.org



625 Myrtle Street, Louisville KY 40208 USA
(502) 568-6342
WaterStep.org