


5th Grade

Solar Purification Aids

Water Crisis

Eco-Energy for Schools



Unit Overview	
Unit Title	Solar Purification Aids Water Crisis
Unit Summary	This unit will bring awareness to the world's dwindling water supply. Students will learn about strategies that utilize solar energy to conserve and purify water. This unit integrates measurement, data, writing, theme, research, energy, inquiry, technology, along with comparing needs and wants. The culminating event for this unit will be the study of solar stills, and students will build a solar still to distill water. Teachers may choose to complete this unit in March to coincide with World Water Day.
Subject Area Strands	Science – Embedded Inquiry, Embedded Technology & Engineering, and Earth's Systems Math – Measurement and Data ELA – Reading: Informational Texts-Key Ideas and Details; Writing: Research to Build and Present Knowledge Social Studies – Economics
Grade Level	5 ^h Grade
Appropriate Time	5 days

Lesson Foundation

Targeted Content Standards	Common Core Standards	
	Mathematics	<ul style="list-style-type: none"> • 5 MD 1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m) and use these conversions in solving multi-step, real world problems.
	English / Language Arts	<p><u>Reading Strands for Informational Text</u></p> <ul style="list-style-type: none"> • RL.5.2 Determine a theme of a story, drama, or poem from details in the text, including how characters in a story or drama respond to challenges or how the speaker in a poem reflects upon a topic; summarize the text <p><u>Writing</u></p> <ul style="list-style-type: none"> • W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources
	TN Standards	
	Science	<ul style="list-style-type: none"> • 0507.Inq.1 Identify specific investigations that could be used to answer a particular question and identify reasons for this choice. • 0507.Inq.3 Maintain a science notebook that includes observations, data, diagrams, and explanations. • 0507.T/E.4 Evaluate an invention that solves a problem and determine ways to improve the design.
	Social Studies	<ul style="list-style-type: none"> • 5.2 spi 1 Differentiate between needs and wants on a personal and national level.
	Next Generation Science Standards	<ul style="list-style-type: none"> • 5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

Lesson Foundation – Big Ideas & Cross-Curricular Connections

Big Ideas:

- Not everyone in the world has access to clean water.
- Water can be purified using solar energy.
- Capacity is measured in cups, pints, quarts, and gallons.
- Conservation of water will help all of the world's people.

Cross-Curricular Connections:

This unit engages students in reading and writing activities centered on the growing problem of the world's diminishing water supply. Students will learn about other societies struggles to obtaining clean drinking water, how solar power is used to aid the cleaning of contaminated water, and how they can change their own water consumption habits to conserve more water. During the unit, students will learn to measure and convert liquid capacity. Students will end the unit by creating a solar still to purify contaminated water.

Lesson Foundation – Essential Questions

1. What are effects of drinking contaminated water?
2. How can you conserve water?
3. What will you do to convince others to conserve water?
4. How does the water crisis impact the world?
5. Explain when solar water distillation is an appropriate method to use in purifying water.
6. Describe how water changes states during solar distillation.

Lesson Foundation – Student Objectives

Going Beyond	<ul style="list-style-type: none">• I can accurately convert customary units of capacity into metric units.• I can evaluate the world's usage of water and create strategies to help with the world's water crisis.• I can create a personal action plan for conserving water and develop an argument for persuading others to conserve water.• I can evaluate solar distillation experiments of various liquids in containers of different materials to determine which liquid and material provides a maximum yield of fresh water.
Mastery	<ul style="list-style-type: none">• I can calculate and convert customary units of capacity.• I can compare and contrast access to water in my life to that of other countries.• I can make a personal action plan for conserving water.• I can complete a solar distillation experiment which converts dirty and salt water into freshwater.
Building the Basics	<ul style="list-style-type: none">• I can measure cups, pints, quarts, and gallons.• I can tell why I have access to water easier than people of other countries and form a personal opinion about other countries' water supply.• I can show how to conserve water• I can observe a solar distillation experiment which converts dirty and salt water into freshwater.

Lesson Foundations – Prerequisite Content & Skills

Content Knowledge

- Students need to know customary capacity units.
- Students need to be able to convert customary capacity units.

Skills

- Students need to be familiar with computers and how search the Internet.
- Students need to be familiar with one of the software programs.

Unit Anchor Text

Unit Anchor Text

- Kerley, Barbara. *A Cool Drink of Water*. Washington, D.C.: National Geographic Society, 2002. (Juvenile Nonfiction)
- Burgan, Michael. *Not a Drop to Drink: Water for a Thirsty World*. Washington, D.C.: National Geographic, 2008 (Juvenile Nonfiction)

Unit Companion Texts

Informational Text(s)

Cross-Curricular Texts:

- Drinking Water Sanitation Quiz
<http://environment.nationalgeographic.com/environment/freshwater/drinking-water-and-sanitation-quiz/#close-modal>
- Photo Gallery that goes with the National Geographic Magazine article *The Burden of Thirst* <http://ngm.nationalgeographic.com/2010/04/water-slaves/johnson-photography>
- Photo Gallery at National Geographic Magazine online titled Freshwater Conflict Photos <http://environment.nationalgeographic.com/environment/photos/freshwater-conflict/>
- Lab 1: Aquifer Model in a Tank and Lab 2: Contaminants in a Tank experiments by The University of Texas at Austin
<http://www.beg.utexas.edu/education/aquitank/tank01.htm#materials>
- Video: Bringing Water from Sol to Soul by Peace Corps
<http://www.peacecorps.gov/wvs/videos/sol-soul/>
- Rosenberg, Tina. "The Burden of Thirst." *National Geographic Magazine*. N.p., Apr. 2010. Web Accessed on 21 Mar. 2014.
<http://ngm.nationalgeographic.com/print/2010/04/water-slaves/rosenberg-text>
- Basu, Tanya. "Kenya's Giant Aquifer Highlights Groundwater's Critical Role." *National Geographic Daily News*. N.p., 2 Oct. 2013. Web Accessed on 21 Mar. 2014.
<http://news.nationalgeographic.com/news/2013/10/131002-kenya-aquifer-lotikipi-groundwater/#close-modal>
- Water Cycle Animation
http://www.epa.gov/safewater/kids/flash/flash_watercycle.html

	<p>Informational Texts:</p> <ul style="list-style-type: none"> Rosenberg, Tina. "The Burden of Thirst." <i>National Geographic Magazine</i>. N.p., Apr. 2010. Web Accessed on 21 Mar. 2014. http://ngm.nationalgeographic.com/print/2010/04/water-slaves/rosenberg-text Basu, Tanya. "Kenya's Giant Aquifer Highlights Groundwater's Critical Role." <i>National Geographic Daily News</i>. N.p., 2 Oct. 2013. Web Accessed on 21 Mar. 2014. http://news.nationalgeographic.com/news/2013/10/131002-kenya-aquifer-lotikipi-groundwater/#close-modal
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Assessments

Formative Assessments	<ul style="list-style-type: none"> Teacher observation Group work Independent work Question / Answer Science Journal
Summative Assessments	<ul style="list-style-type: none"> Water Diary calculations for the week Presentation of global water facts on the seven continents. Constructed response on the amount of water in Kenya's Aquifer Billboard Advertisement on a water issue A written action plan for conserving water Culminating Activity of Building a Solar Still
Writing Assessments	<ul style="list-style-type: none"> A paper comparing and contrasting water collection in the USA to other parts of the world. Cooperative paper on consequences of the scarcity of clean drinking water for humans in the form of a newspaper article. T-Chart on obstacles faced by the main character in an article and the student in obtaining water daily. A letter to the President of USA discussing water issues. A paper comparing a personal experience to the daily life of people in an article. A written reflection on the debate held on whether or not to access an aquifer in Kenya.

Unit Vocabulary

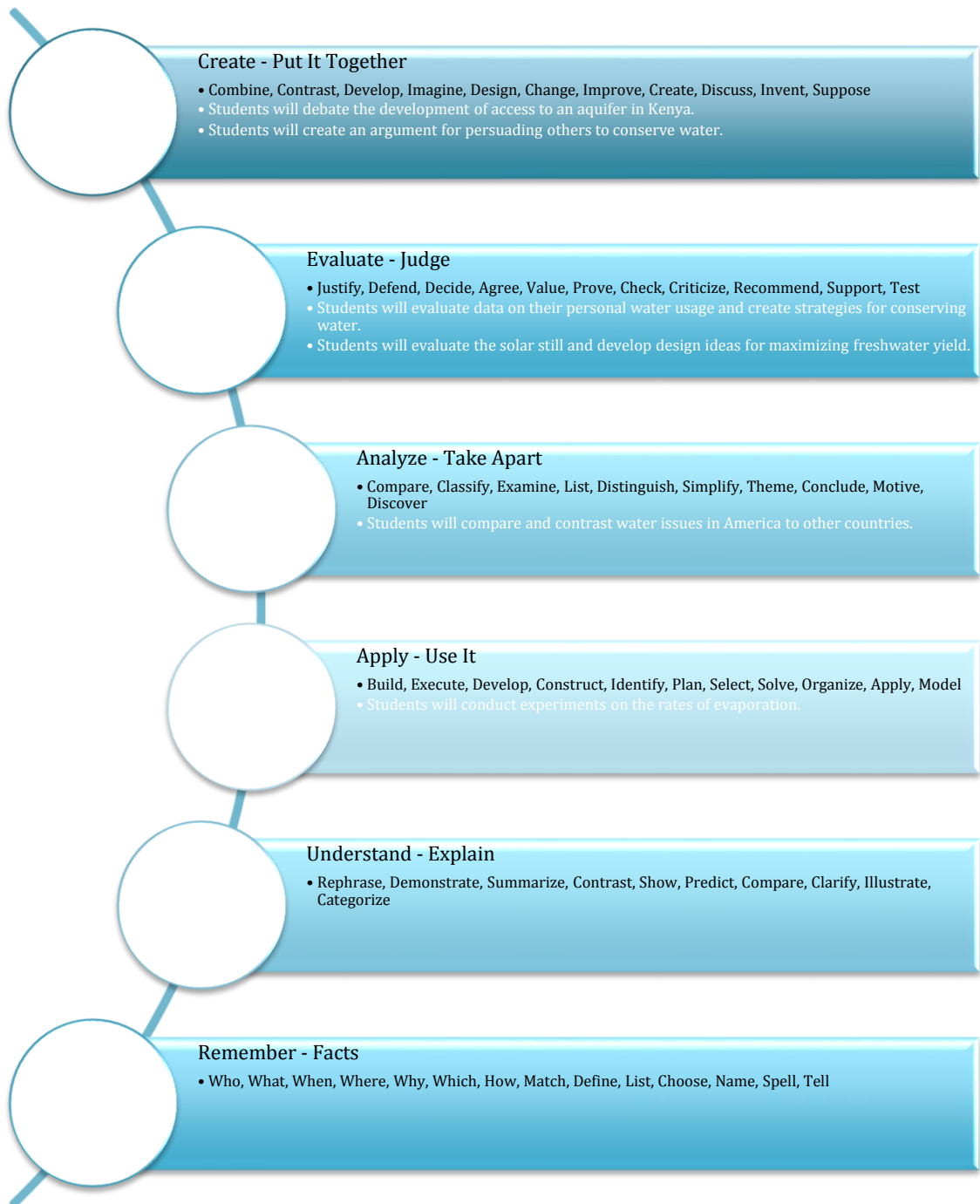
Term	Definition
Accessible	Easy to approach, reach, or use
Aquifer	Any geological formation containing or conducting ground water
Capacity	The ability to contain
Contaminate	To make unsuitable by contact or mixture with something unclean

Crisis	A difficult or dangerous situation that needs serious attention
Distill	To turn something into a gas and then back into a liquid to purify it
Pollution	The natural environment being contaminated with harmful substances
Scarce	Not plentiful or abundant
Well	A hole drilled into the earth to obtain water

Teaching the Unit

Initial Strategies	<ul style="list-style-type: none"> • Using a globe, ask students what color is covering most of the globe and what that color represents. • Discuss the different forms of water around the world, such as oceans, lakes, rivers, and ponds. • Ask students if they can drink water from these sources. • Discuss why they cannot drink much of the water. • Guide the discussion toward understanding the unsanitary conditions of much of the water on earth.
Direct Instruction	<ul style="list-style-type: none"> • The teacher will direct reading groups during ELA activities. • The teacher will complete mini lessons on capacity conversion. • The teacher will facilitate group discussions. • The teacher will perform the second evaporation experiment. • The teacher will moderate a class debate. • The teacher will instruct students how to write a formal letter.

Higher-Level Cognitive Function Strategies



**Guided
Practice &
Activities**

DAY 1

ELA:

- Students will read *A Cool Drink of Water*.
- Students will create a graphic organizer showing ways water is collected in different parts of the world.
- Students will individually write a paper comparing and contrasting water collection in the United States and other parts of the world.

Math:

- Students will estimate how many gallons of water they use in washing hands and brushing teeth.
- Next, students will test their estimates by completing the following activities.
 - Activity 1:
 - Place a 2-3 gallon bucket under the classroom sink.
 - One student will wash his/her hands over the bucket, so all the water is collected in the bucket.
 - Measure the amount of water used in cups, pints, quarts, and gallons. Record the data.
 - Activity 2:
 - Place a 2-3 gallon bucket under the classroom sink.
 - Using a straw to act as a toothbrush, a student will turn on the water and simulate brushing his/her teeth.
 - Measure the amount of water used in cups, pints, quarts, and gallons.
 - Record the data.
 - Activity 3:
 - Place a 2-3 gallon bucket under the classroom sink.
 - One student will be given five dishes to wash while holding them over the bucket, so all the water is collected in the bucket.
 - Measure the amount of water used in cups, pints, quarts, and gallons.
 - Record the data.
- After the activities are complete, discuss any factors that would change the results, such as flow rate, amount of dishes, etc.

Science:

- Using the math data, students will create a chart of daily activities that require water in a water diary.
- For one week, students will record data for all activities that use water, how long the water ran, approximate capacity used, and list ways they can reduce their use of water.

Social Studies:

- To help students understand the water crisis in much of the world, they will take the Drinking Water and Sanitation Quiz at <http://environment.nationalgeographic.com/environment/freshwater/drinking-water-and-sanitation-quiz/#close-modal> and record their responses.
- Students will create a survey about the world's drinking water, which will be administered to ten people outside of the classroom.
- Once results of the survey are collected, students will compile the results into a graph.

DAY 2

ELA:

- Students will read *Not a Drop to Drink: Water for a Thirsty World*.

- Students will work in small groups to create a list of consequences of the scarcity of clean drinking water world-wide.
- Small groups will cooperatively write a paper about the consequences of the scarcity of clean drinking water for humans in the form of a newspaper article.

Math:

- Students will use the data from the both evaporation experiments to plot a line graph and compare the data.

Science:

- Students will experiment with rates of evaporation.
- Prior to the experiments, students will write their hypothesis about the experiments in their science journals.
- After each experiment, students will record the procedures, results, and make a conclusion.
 - Experiment 1:
 - They will pour two cups of water into a foil pan, cover it with clear cellophane wrap, and set it in a sunny place.
 - During the week, measure the amount of water each day and record it in a data table
 - Experiment 2:
 - The teacher will pour 2 cups of water into a pan, place the pan on a burner, and let it come to a boil.
 - Every 5 minutes, measure the amount of water remaining and record the data. Continue until the water is all gone.

Social Studies:

- Students will research global water facts on the seven continents.
- They will discover the number of people who live without clean drinking water, the effects of drinking un-sanitized water, and the scarcity of water on each continent.
- Students will create a presentation of their data using a program such as PowerPoint, GloGster, Prezi, Wikispace, or Museum Box.

DAY 3

ELA:

- Students will read the article **The Burden of Thirst** by Tina Rosenberg, National Geographic Magazine, April 2010, <http://ngm.nationalgeographic.com/print/2010/04/water-slaves/rosenberg-text>
- Teacher needs to pre-read this article to possibly censor parts of the article before students read.
- Students will make a T chart.
 - On one side, students will list all the obstacles the main character faces in providing clean water for her family.
 - On the other side, they will list obstacles they face during their day in getting access to clean water.
- In the form of a letter to the President of the United States, students will write about how fortunate they are to have access to clean water, ways this has made their life easier, and why we need to help developing countries.

Math:

- Teams of students will experience hauling water from a well by carrying two or three

gallons of water in a bucket over a preselected route on the school grounds three different times during this school day.

- Students will be timed as they carry a full bucket of water on the route.
- At the end of the route, students will measure the amount of water left in the bucket and calculate how much water was lost.
- Totals will be converted into cups, pints, quarts, and gallons.
- Together, students will graph team results.

Science:

- Students will complete Lab 1: Aquifer Model in a Tank.
- Students will make a model of an aquifer for the purpose of inquiry into ground-water systems.
- Directions for building the model are attached or can be found at <http://www.beg.utexas.edu/education/aquitank/tank01.htm>.
- After completing the model, students will record their observations as water is added and removed from the aquifer, measure water levels at different points in the experiment, and interpret their observations in their science journals.

Social Studies:

- Before showing these pictures, the teacher should preview the photos and preselect photos that coordinate with the topic.
- The teacher will show photo gallery pictures from the article *The Burden of Thirst* at <http://ngm.nationalgeographic.com/2010/04/water-slaves/johnson-photography> and photo gallery pictures from Freshwater Conflict Photos at <http://environment.nationalgeographic.com/environment/photos/freshwater-conflict/>.
- The teacher will facilitate a class discussion about the photos and the students' experience hauling water during the math activity.
- Students will write about their personal experience and compare it to that of the people in the article.

DAY 4

ELA:

- Students will read the first two sub title sections of the article **Kenya's Giant Aquifer Highlights Groundwater's Critical Role.** <http://news.nationalgeographic.com/news/2013/10/131002-kenya-aquifer-lotikipi-groundwater/#close-modal>
- They do not need to read from subtitle An MRI of the Earth to the end of the article to complete the activity.
- Students will debate whether or not the aquifer in the article should be accessed.
- Students will choose a side to debate, write their reasons for choosing that side, and write statements they plan to use in persuading the other side to change their minds.
- Hold the debate.
- After the debate, students will write a reflection of how the debate progressed and any changes they personally had in their opinions.

Math:

- Students will use data from the article, which states the aquifer will be sustainable for 70 years, contains 250 billion cubic meters of water, and the population of Kenya is 41 billion people to calculations.
- Small groups of students will calculate the amount of water each person would be able

to use each year and convert it into cups, pints, quarts, and gallons.

- Students will complete this activity as a constructed response task.

Science:

Students will complete Lab 2: Contaminants in a Tank, Cleaning up Spills

- Students will experiment with contaminating the environment by simulating various contamination events.
- Students will observe and record events as they happen in their science journals.
- Students will write a plan for cleaning up the model, put their plan into action, and record the results and effectiveness of their clean-up plan.
- Students will write revisions to their plan to make it more productive in the real world.
- Directions for the lab can be found at:

<http://www.beg.utexas.edu/education/aquitank/tank01.htm>

Social Studies:

- In the form of a billboard advertisement, students will draw a poster about any of the water issues discussed this week.
- Student products must demonstrate the student's understanding of the issue, include an appropriate graphic, and contain a motivating message.

DAY 5

ELA:

- Students will read *One Well: The Story of Water on Earth* by Rochelle Strauss.
- Students will cite evidence from the text that shows water around the world is connected, water changes the environment, and how water is treated will affect every species around the world.
- In response to the data from water diaries and reading this text, students will write an action plan for conserving water.

Math:

- Students will combine all class data from each student's water diary.
- The class totals in each category will be calculated and converted into cups, pints, quarts, and gallons.
- Students will produce a class graph to display the data.

Science:

- Students will work on the culminating activity of construct solar stills and place them outside for the experiment.

Social Studies:

- Students will view the five minute 36 second video **Bringing Water from Sol to Soul**, which shows Peace Corps volunteers building solar stills to be used at a school in Cape Verde, Africa at <http://www.peacecorps.gov/wvs/videos/sol-soul/> .

<p>STEM Projects</p>	<ul style="list-style-type: none"> • Students will experiment with rates of evaporation. They will write a hypothesis in their science journals and record procedures, results, and a conclusion after each experiment. • Lab 1: Aquifer Model in a Tank: <ul style="list-style-type: none"> ○ The student will: <ul style="list-style-type: none"> - They will pour two cups of water into a foil pan, cover it with clear cellophane wrap, and set it in a sunny place. - During the week, measure the amount of water each day and record it in a data table. • Lab 2: Contaminants in a Tank, Cleaning up Spills <ul style="list-style-type: none"> ○ The teacher will: <ul style="list-style-type: none"> - Pour 2 cups of water into a pan, place the pan on a burner, and let it come to a boil. - Every five minutes, measure the amount of water remaining and record the data. - Continue until the water is all gone. • Students will make a model of an aquifer; record their observations as water is added and removed, measure water levels at different points in the experiment, and interpret observations in science journals. • Students will use the model of the aquifer to simulate various contamination situations and experiment with various methods at removing contaminates.
<p>STEM Culminating Event</p>	<p>For the culminating activity, each student will make a solar still.</p> <ul style="list-style-type: none"> • The students will: <ul style="list-style-type: none"> ○ Fill two plastic containers with one inch of water. ○ In one container, mix two tablespoons of dirt with the water. ○ In the other container, mix two tablespoons of salt with the water. ○ Place one empty glass upright in the middle of each plastic container. Make sure it remains empty. ○ Cover both plastic containers tightly with plastic wrap and seal them with tape. ○ Place a small rock in the middle of the plastic wrap directly over the glass but not touching it. ○ Place the stills in a sunny place for two hours. ○ Examine and measure any water that forms in the glass. ○ Students are to evaluate the solar still and determine ways to improve the design. ○ Students write a paper discussing the results and ideas for improving the design to aid low water areas around the world. <p>Solar Distillation Experiment came from The NEED (National Energy Education Development) Project http://www.need.org/Files/curriculum/sciencefair/SolarDistillation.pdf</p>
<p>Differentiated Instruction</p>	<ul style="list-style-type: none"> • Provide leveled books and articles • Alter writing assignments to accommodate different learners • Small group activities allow for peer collaboration and tutoring • Allow calculators and a customary capacity conversion chart
<p>Re-teaching Strategies</p>	<ul style="list-style-type: none"> • A re-teaching lesson will be conducted using measuring cups one cup, pint, quart, and gallon containers. Students will fill the cup with water and pour it into the pint, quart,

	<p>and gallon to learn the capacity of each in cups. Students will fill a pint with water and pour it into the quart and gallon to learn the capacity of each in pints. Students will fill a quart with water and pour it into a gallon to learn its capacity in quarts.</p> <ul style="list-style-type: none"> • Students will be allowed to use calculators to convert capacities. • To aid in comprehension of texts, students reread parts of text with peers and teacher. • Students keep a literacy journal on each text with notes on themes, supporting details, and draw pictures of events in sequence. • Students will create thinking maps and flashcards on points such as plot, set, characters, and vocabulary. • Students will create mnemonic device to remember skills, formulas, and key facts. • Students will be given visual support in understanding the process water goes through during solar distillation by viewing the animation on the water cycle at http://www.epa.gov/safewater/kids/flash/flash_watercycle.html
Enrichment Strategies	<ul style="list-style-type: none"> • Students will complete the distillation experiment using different kinds of solutions like juice, lemonade, soda, etc. and compare the results with distillation of salt water. Students will write a report explaining the procedure and results. • Students will complete the distillation experiment using bowls made of different materials, such as glass, metal, ceramic and plastic to discover if transparency or opacity affect the rate of accumulation in the solar still. Students will create a graph displaying the rate of accumulation for each type material. Students will write a summary of the results. • Students will write a creative story or comic strip about the journey a water molecule takes during the distillation process. Students must show understanding of the distillation process and where the stages of the water cycle occur during the process. • Students will draw the distillation experiment and label the stages of the water cycle. • Students can convert customary units to metric units.
Independent Practice Activities	<ul style="list-style-type: none"> • Students will read books and articles. • Students will create a graphic organizer showing ways water is collected in different parts of the world. • Students will write a paper comparing and contrasting water collection in the USA and other parts of the world. • Students will convert customary capacity units. • Students will create a chart of daily activities that require water and record amount of water used during these activities for a week in a water diary. • Students will create and administer a survey about the world's drinking water to ten people outside of the classroom. • Students will create a T-chart listing obstacles faced by themselves and the main character in an article in obtaining water daily. • Students will write a letter to the President of USA discussing water issues. • Students will write a paper comparing a personal experience to the daily life of people in an article. • Students will write a reflection on the debate held on whether or not to access an aquifer in Kenya.
Materials & Resources	<p>Two gallon buckets Timers Access to water Paper</p>

Pencil
Globe
Science Journals
Water diary(notebook)
Measuring containers in the sizes: cup, pint, quart, gallon
Chart paper
Foil pan
Clear cellophane wrap
Ruler
Sauce pan
Hot plate (electric burner)
Computer, IPad, or IPod
10-gallon fish tank
80 lbs. gravel
20 lbs. sand
Labels
Flashlight
Plastic tubing
1 to 2 gallon dishpan
Squirt bottle
Binder clips
Scoops
Several liquid soap pumps
Salt
Yellow food coloring
Green food coloring
Red food coloring
Cooking oil
Cornstarch
Elbow macaroni
Sponges
Spoons
Straws
Plug to fit the bottom of the PVC pipe
Several graduated (1- or 2-liter) pitchers to measure water
1 small plastic container (yogurt or butter tub)
PVC pipe 2.5 cm in diameter and 38 cm long

INTERNET RESOURCES:

Drinking Water Sanitation Quiz

<http://environment.nationalgeographic.com/environment/freshwater/drinking-water-and-sanitation-quiz/#close-modal>

Photo Gallery that goes with the National Geographic Magazine article *The Burden of Thirst*

<http://ngm.nationalgeographic.com/2010/04/water-slaves/johnson-photography>

Photo Gallery at National Geographic Magazine online titled Freshwater Conflict Photos

<http://environment.nationalgeographic.com/environment/photos/freshwater-conflict/>

Lab 1: Aquifer Model in a Tank and Lab 2: Contaminants in a Tank experiments by The University of Texas at Austin

<http://www.beg.utexas.edu/education/aquitank/tank01.htm#materials>

Video: Bringing Water from Sol to Soul by Peace Corps

<http://www.peacecorps.gov/www/videos/sol-soul/>

Water Cycle Animation http://www.epa.gov/safewater/kids/flash/flash_watercycle.html

Solar Distillation Project instructions:

<http://www.need.org/Files/curriculum/sciencefair/SolarDistillation.pdf>

BOOKS:

Kerley, Barbara. *A Cool Drink of Water*. Washington, D.C.: National Geographic Society, 2002.

Burgan, Michael. *Not a Drop to Drink: Water for a Thirsty World*. Washington, D.C.: National Geographic, 2008

INTERNET ARTICLES:

Rosenberg, Tina. "The Burden of Thirst." *National Geographic Magazine*. N.p., Apr. 2010. Web Accessed on 21 Mar. 2014.

<http://ngm.nationalgeographic.com/print/2010/04/water-slaves/rosenberg-text>

Basu, Tanya. "Kenya's Giant Aquifer Highlights Groundwater's Critical Role." *National Geographic Daily News*. N.p., 2 Oct. 2013. Web

Accessed on 21 Mar. 2014.

<http://news.nationalgeographic.com/news/2013/10/131002-kenya-aquifer-lotikipi-groundwater/#close-modal>

Comments

How to teach students to write an action plan:

<http://www.bottomlessclosetnyc.org/GOALSETTINGWORKSHOPpt2.pdf>

Possible action plan template:

https://docs.google.com/document/d/1zol90ua0eS370_nkxRIUI8W8sZHPZXIYMtlASPo3NC0/edit?pli=1

<http://smallbusinessbonfire.com/free-action-plan-template>

Supplemental books:

Bowden, Rob. *Earth's Water Crisis*. Milwaukee, WI: World Almanac Library, 2007.

If you have an questions you may contact:

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