



Carrying Water

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INTRODUCTION

In this lesson, students will audit their personal daily water usage, and will participate in a class discussion about water use and conservation. Through an introduction to the Kenyan village of Kapsasian, group mathematical problem solving, and class discussions, they will have a better understanding of the problems faced by those with lack of access to water.

LESSON OVERVIEW

Grade Level & Subject: Grades 5 – 8: Mathematics and Social Studies (Mathematics calculations are most appropriate for Grades 7 & 8 or advanced Grade 6. This lesson can be adjusted by skipping the **Kapsasian Calculations** section.)

Suggested Length: One class period (45 – 90 minutes)

Objectives:

After completing this lesson, students will:

- Have a better understanding of their personal daily water usage.
- Brainstorm ideas of ways to conserve water and reduce their daily usage.
- Understand the problems associated with lack of access to water in other parts of the world.
- Improve their math and problem-solving skills in a real world context.

National Standards Addressed:

This lesson addresses the following National Education Standards¹

- **Content Standard: [NSS-G.K-12.2 PLACES AND REGIONS](#)**
As a result of their activities in grades K-12, all students should
 - Understand the physical and human characteristics of places
 - Understand how people create regions to interpret Earth's complexity
 - Understand how culture and experience influence people's perceptions of places and regions
- **Content Standard: [NSS-G.K-12.5 ENVIRONMENT AND SOCIETY](#)**
As a result of their activities in grades K-12, all students should
 - Understand how human actions modify the physical environment

¹ Education World (2008) *U.S. National Education Standards*. Retrieved January 22, 2009, from <http://www.education-world.com/standards/national/index.shtml>.

- Understand how physical systems affect human systems
- Understand the changes that occur in the meaning, use, distribution and importance of resources
- **Content Standard: [NM-NUM.6-8.1](#)**
Understand numbers, ways of representing numbers, relationships among numbers, and number systems
 - Work flexibly with fractions, decimals, and percents to solve problems
 - Develop meaning for integers and represent and compare quantities with them
- **Content Standard: [NM-NUM.6-8.3](#)**
Compute fluently and make reasonable estimates
 - Select appropriate methods and tools for computing with fractions and decimals from among mental computation, estimation, calculators or computers, and paper and pencil, depending on the situation, and apply the selected methods
 - Develop and analyze algorithms for computing with fractions, decimals, and integers and develop fluency in their use
 - Develop and use strategies to estimate the results of rational-number computations and judge the reasonableness of the results
- **Content Standard: PERSONAL AND SOCIAL PERSPECTIVES**
As a result of activities in grades 5-8, all students should develop understanding
 - Personal Health
 - Populations, resources, and environments
 - Natural hazards
 - Risks and benefits
 - Science and technology in society

Materials Needed:

- Chalkboard or whiteboard
- Reproducible #1 – **Personal Water Audit**
- Reproducible #2 – **Kapsasian Calculations**
- Reproducible #3 – **Kapsasian Calculations – ANSWER KEY**

Assessment: Students will be assessed through the following activities:

- Completion of pre-assignment: **Reproducible #1 – Personal Water Audit**
- Completion of **Reproducible #2 – Kapsasian Calculations** worksheet
- Participation in and contribution to class discussion

LESSON BACKGROUND

Conversion Information:

- 1 U.S. liquid gallon is equal to 3.785411784 litres/liters
- 1 U.S liquid gallon is equal to 128 fluid ounces
- 1 kilometer is equal to 0.621371192 mile

Information:

According to World Health Organization estimates in 2006, 1.1 billion people do not have access to improved sources of drinking water, negatively impacting almost every aspect of daily life.² Nearly everywhere around the globe, collecting water falls to the task of women and children, who often have to carry water for several miles a day. In addition to the time and energy spent on water collection, there are many consequences resulting from unsafe and unsanitary conditions. Although most citizens in the United States generally have reliable access to clean water, conditions such as drought, pollution, increased population and unequal distribution of natural resources threaten our water supply. This makes it necessary for each of us to conserve water and find ways to reduce our daily water usage.

Resources:

- **The Global Water Network:** www.globalwaternetnetwork.org
- **Kenya:**
 - CIA World Factbook: www.cia.gov/library/publications/the-world-factbook/geos/ke.html
 - Official Kenya Destination Website: www.magicalkenya.com

LESSON STEPS

Warm-up: *Personal Water Audit – Pre-Assignment*

1. To be done as homework the night before the lesson, send students home with **Reproducible #1 – Personal Water Audit**. This will give students insight into their own daily water usage, and will be an indication of how much water is needed on a daily basis.

Activity One: *Daily Water Usage - Discussion*

1. Begin by listing a range of student water usage totals (as calculated in their **Personal Water Audit** pre-assignment) on the chalkboard or whiteboard. Guide students in determining the class average of daily water usage.
2. Lead a discussion of the **Personal Water Audit** results, water use, and availability. Use the following questions and answers as a guide:
 - a) Were you surprised by your daily personal water usage? Did you imagine that you used more or less water each day? How does your personal total differ from the class average?
 - b) How much of your total water was actually *used* and how much was wasted down the drain?
 - c) How would your audit look if you did it on a different day of the week or a different time of year? (*Think about summer vs. winter, weekdays vs. weekends, playing with a sprinkler or filling a pool, watering a garden or yard, laundry day, etc.*)
 - d) Do you think you actually use more water than what was calculated in your **Personal Water Audit**? Why or why not? Remember, this was an audit of your personal

² Philadelphia Global Water Initiative, retrieved from www.pgwi.net January 2009.

domestic water use. (Remind students that a large majority of water used in the US is in agriculture and industry. For example, it takes thousands of gallons of water to raise a cow to make beef, and nearly all of their food and drink required water to process. In addition, almost every product they use required water to make, transport, etc.)

- e) How do you think your water usage compares to other people in the US? (Ex: Southwest is very dry, Northwest is very wet, urban vs. rural, poverty levels, etc.)
- f) How do you think your water usage compares to people in other countries? (Consider climate, cost, availability, access, etc.)
- g) Conditions such as drought, pollution, rising population, and unequal distribution of natural resources threaten our water supply, even in the US. What might happen if we were faced with extreme water shortages? (Cost would go up, our usage would have to go down, access would be less reliable, conservation practices would become more common, etc.)

Activity Two: *Imagining Kapsasian, Kenya*

1. Show Kenya on a map (Eastern Africa, bordering the Indian Ocean, between Somalia and Tanzania). Find out what students may already know or think about Africa and Kenya - have students brainstorm what it might be like there right now. Consider season, weather, temperature, people, culture, technology, language, food, drink, schools, etc. (Example: hot, mostly arid or semi-arid, grasslands, some agriculture, ranges from drought to strong rains, desertification, pollution, safaris, villages, cities, deserts)
2. Have students close their eyes and imagine they are living in the village of Kapsasian, Kenya. Read the following passage³:

You live in the village of Kapsasian, Kenya, in eastern Africa. Although there is a rainy season, it is usually hot and dry. Piped water is unavailable in your area, and no one in your village has running water in their homes. Every time you and your family wash your hands, take a bath, have a drink, or prepare a meal, you use water. Where does it come from? There are about seven thousand other people in and around your town – how do they get water? Whose job is it to provide water for every household, building and school? In most families it is up to the women and children to find and collect water.

The nearest water source is a small plastic tank one kilometer from your home, or more than half a mile away. When this tank is empty or dirty, water must be obtained from seasonal springs which could be up to several hours walking distance from your village! Even these dry up during the dry season, and the entire population suffers from outbreaks of waterborne diseases, such as typhoid and dysentery, from sharing contaminated water.

How much of your day do you spend carrying water? How much can you carry by yourself? Do you have time to go to school? When do you play with your friends? Can you walk in the dark? How do you bathe and where do you go to the bathroom? Think about these questions and how it would affect your life to not have clean running water. How would you reduce your water use, and how would you prioritize between drinking, cooking,

³ Inspired by “Water Source for Kapsasian Community Dispensary in Kenya,” Global Water Network, retrieved from www.globalwaternetwork.org January 2009.

cleaning, bathing, or recreation?

Activity Three: Kapsasian Calculations

1. Pass out Reproducible #2 – **Kapsasian Calculations**.
2. Break students up into small groups to work on the calculations together. Encourage them to answer as many questions as they can without a calculator.

Wrap Up: Lessons Learned – Conservation Discussion

1. Ask students what they learned from the **Kapsasian Calculations**. These are real-life problems faced by billions of people around the world. Do they have a better idea of the issues associated with lack of access to water? (*This could include illness, lack of sanitation, lack of time for education, recreation, and professional activities, etc.*)
2. Have students imagine that they and their families must live off of less than 10 gallons of water a day. How would life be different? (*Consider cooking, cleaning, toilet use, bathing, drinking, appliances, etc.*)
3. Transition into a discussion of what students could do to reduce their daily water usage. (*For example, do not let water run when brushing teeth or washing dishes, take shorter showers, do full loads of laundry or dishes, use rainwater to water lawns, etc.*)
4. Empower students to share these ideas with friends and family. Remind them of the lessons learned and the importance of water conservation around the world.

Extension: Global Water Network

1. As a class or in small groups, visit the “Adopt-a-Water-Project” section at www.globalwaternetwork.org to learn more about Kapsasian, Kenya, and a water source project to benefit the area.
2. Visit the “Adopt-A-Water-Project” section at the Global Water Network (www.globalwaternetwork.org) to read about other water-related projects around the world. Compare these stories to the scenario and discussions in class. How many people around the world deal with these issues everyday?
3. You can also make donations through The Global Water Network to support these projects. Consider adopting a project, and have your class brainstorm ways to fundraise contributions.

CONCLUSION

In this lesson, students audited their personal daily water usage for a better understanding of how much water is used and wasted on a daily basis. They also discussed the implications and consequences of water shortage. By imagining themselves as a child living in Kapsasian, Kenya, they were able to empathize with the difficulties and problems associated with lack of water access. Through math calculations and problem-solving, they were exposed to the real-life situations of

billions of people around the world. Finally, through class discussions and brainstorming, they thought about ways to conserve water in their own lives.



Personal Water Audit



Name: _____ Date: _____

Answer the following questions about your household water usage today. If you do not know the exact numbers, please estimate as well as you can.

Pre-Question: Before completing the chart below, take a guess at how many gallons of water you use in 1 day ____ Compare your guess with the **Daily Total** below when you finish your water audit and calculations!

Question	Answer	Calculation - Try not to use a calculator!	Answer
1. How many times today have you flushed your toilet?		Multiply this number by 3. The average toilet uses 3 gal of water per flush.	Gal
2. Did you take a shower or bath?		Write down 40 gal if you took a bath. Write down 7 gal for every minute you were in the shower. You may adjust your number if you did not fill the tub all the way or if you have a low-flow showerhead.	Gal
3. How many times did your family run the dishwasher today?		Account for about 10 gal per load.	Gal
4. How many loads of laundry did your family do today?		Multiply this number by 40. (If you have a front-loading washer, multiply by 25 per load.)	Gal
5. How many minutes today did you run your sink faucet? Think about brushing teeth, washing hands and face, washing dishes, shaving, etc.		Factor 4 gal per minute.	Gal
6. Check the faucets in your house to see if any are leaky. Count the number of drips per minute.		For every 10 drips in a minute, multiply by 1.4. This should be done for each leaky faucet.	Gal
7. How many glasses of water did you drink today?		Multiply each glass by 0.0625. There are about 8 oz in an average glass. 128 oz = 1 gal (or about 16 glasses of water).	Gal
8. Did you use a hose today? Think about watering a garden, washing a car, or bathing a pet.		Factor 10 gal per minute.	Gal
Daily Total		Add up the numbers in the right-hand column. This is how many gallons of water you used today domestically.	Gal

Figures for calculations estimated from "Conducting a Household Water Audit," Maryland Department of the Environment.



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Pre-Question: Before completing the chart below, take a guess at how many gallons of water you use in 1 day ____ Compare your guess with the **Daily Total** below when you finish your water audit and calculations!

Question	Answer	Calculation - Try not to use a calculator!	Answer
1. How many times today have you flushed your toilet?		Multiply this number by 8. The average toilet uses 3 liters of water per flush.	L
2. Did you take a shower or bath?		Write down 80 liters if you took a bath. Write down 35 liters for every minute you were in the shower. You may adjust your number if you did not fill the tub all the way or if you have a low-flow showerhead.	L
3. How many times did your family run the dishwasher today?		Account for about 25 liters per load.	L
4. How many loads of laundry did your family do today?		Multiply this number by 65. (If you have a front-loading washer, multiply by 40 per load.)	L
5. How many minutes today did you run your sink faucet? Think about brushing teeth, washing hands and face, washing dishes, shaving, etc.		Factor 15 liters per minute.	L
7. How many glasses of water did you drink today?		Multiply each glass by .25. An average glass is about $\frac{1}{4}$ of a liter.	L
8. Did you use a hose today? Think about watering a garden, washing a car, or bathing a pet.		Factor 540 liters per activity	L
Add up the numbers in the right-hand column. This is how many liters of water you used today domestically.		Daily Usage Sub-Total	L
		About $\frac{1}{3}$ of our water is lost through leaky pipes before it even reaches our homes. Figure out a $\frac{1}{3}$ of the amount of your daily water usage and add that to your sub-total to get your grand total.	L
		Grand Total Water Usage	L

Figures for calculations estimated from "How Much Water Do You Use?" by uSwitch. Retrieved March 10, 2009 from <http://www.uswitch.com/water/how-much-water-use/>



Kapsasian Calculations

Name: _____ Date: _____

Answer the following questions about carrying water in Kapsasian, Kenya.

1. a) You can carry 2 liters of water at a time, and your sister can carry 3 liters of water at a time. If your family requires 10 liters of water each day, how many trips must you make together to collect water?

b) Your sister is sick from drinking unclean water, and will require 2 extra liters of water in addition to your family's usual 10. Because she is feeling weak, you must instead bring your little brother to help you collect water. If he can carry 1 liter at a time, how many trips for water must you make together that day?

2. On Monday, the nearest water source is a $\frac{3}{4}$ hour walk each way. By Thursday, this source has dried up, and you must now walk $1\frac{1}{2}$ hours each way to another dam. If you made 2 trips each day, how many hours did you spend walking to collect water in one week (Monday – Sunday)?

3. a) School in Kapsasian begins for you at 7:45am. Based on the information in Question #2, what time would you need to wake up on Monday to make one trip before school?

b) What time would you need to wake up on Friday to make one trip before school?





Kapsasian Calculations

ANSWER KEY

1. a) $2 \text{ liters} + 3 \text{ liters} = 5 \text{ liters per trip.}$
 $10 \text{ liters} / 5 \text{ liters} = \mathbf{2 \text{ trips per day}}$
b) $2 \text{ liters} + 1 \text{ liters} = 3 \text{ liters per trip}$
 $12 \text{ liters} / 3 \text{ liters} = \mathbf{4 \text{ trips that day}}$

2. *Monday, Tuesday, Wednesday:* $.75 \text{ hrs} \times 2 = 1.5 \text{ hrs per trip}$
 $1.5 \text{ hrs} \times 2 \text{ trips} = 3 \text{ hrs per day}$
 $3 \text{ hrs} \times 3 \text{ days} = 9 \text{ hrs}$
Thursday, Friday, Saturday, Sunday: $1.5 \text{ hrs} \times 2 = 3 \text{ hrs per trip}$
 $3 \text{ hrs} \times 2 \text{ trips} = 6 \text{ hrs per day}$
 $6 \text{ hrs} \times 4 \text{ days} = 24 \text{ hrs}$
Total: $9 \text{ hrs} + 24 \text{ hrs} = \mathbf{33 \text{ hrs that week}}$

3. a) $7:45 - 1.5 \text{ hrs} = \text{you would need to awaken no later than } \mathbf{6:15\text{am}}$
b) $7:45 - 3 \text{ hrs} = \text{you would need to awaken no later than } \mathbf{4:45\text{am}}$

