

### National Science Content Standards:

*B: Physical Science*

*F: Science in Personal and Social Perspectives*

### National Math Content Standards:

*Measurement*

### **OBJECTIVE:**

To develop an understanding of the different weights and measurements of liquid. To familiarize students with calculations of weight, time and distance. To convey the physical challenge of carrying water long distances, and the multiple causes and consequences of such a burdensome task.

### **DESCRIPTION:**

In many parts of the developing world, water is not easily accessible, particularly in Eastern Kenya, Aja's home. (Reference Water Stories Supplement to read more about Aja.) The task of fetching water falls mainly on women and children. In fact, it is estimated that in just one day, more than 200 million hours of women's time is consumed collecting water for domestic use.<sup>1</sup> In Sub-Saharan Africa alone, women may spend 40 billion hours a year completing that necessary but difficult task.<sup>2</sup> In this activity, students will experience the actual weight of water, physically and mathematically, and thereby gain appreciation of the freshwater challenges faced by many around the world.

Additionally, students will be introduced to the UN Millennium Development Goals, specifically the goal which aims to cut in half the proportion of the population without access to safe drinking water and basic sanitation by 2015.

### **MATERIALS:**

Carrying vessels:

- 1 large bucket filled with only 1 gallon of water
- 2 2-litre bottles filled with water (with tops on){approximately equals one gallon}
- 1 gallon water, milk or juice jug (full) with top on
- 1 large watering can filled with approximately a gallon of water
- plastic box or bin with a cover, filled with approximately a gallon of water
- (6<sup>th</sup> carrying vessel of your choice filled with one gallon of water) if needed
  
- yard stick or tape measure to set up course
- stopwatch or clock with a secondhand for each group (for younger grades, one timer for instructor)
- calculators for older students
- OPTIONAL** (for each student): lightweight raincoat/ponchos or other water protective clothing **or** change of clothes



Materials for variation:

- World Water Use Table
- Water Stories Supplement

## BACKGROUND:

Kenya is a water scarce country. That means the demand for water from people, plants and animals is greater than the amount the freshwater sources can provide. In rural areas, fewer than half the residents have access to clean, safe water and most don't have adequate sanitation – toilets or proper trash disposal. Very few communities have garbage pick-up, most dump their garbage in the open which can contaminate water sources.

Although most of Kenya's crops are rain fed, <sup>3</sup> more than seventy-five percent (75%) of the region's water is used for agriculture.<sup>4</sup> What does this mean? Because of highly inefficient irrigation systems, most of the freshwater – from groundwater, lakes and rivers - goes to watering crops (some of which, like cotton, are not edible.) As a result, water for domestic use (individual homes) is extremely limited, especially difficult in an area already lacking water.

In Ajia's village in the Ukambani region in Kenya, the climate is arid (very dry) with little to no rainfall. Although there is a local pond, the water resource is not reliable. Even during the rainy season, the pond frequently dries up and is often contaminated by livestock that graze on the waterfront. As more and more trees in the region are cut down for firewood, less rain water is absorbed by plants, which causes erosion. When it rains, water falling on stripped land either evaporates or becomes run-off, and is therefore diverted from the local water cycle.

Fetching water for domestic use in Kenya is mainly the responsibility of women and girls. Ajia and her sister are in charge of collecting water for their household. They carry heavy loads of water sometimes up to several hours a day.<sup>5</sup> Water is usually collected in jerry cans, plastic jugs that can hold from 5 to 20 liters of liquid. Ajia and her sister have a wheelbarrow but some women in the region transport the water on their backs, heads or shoulders. Some families are fortunate to have bicycles or donkeys to carry the water for them, lessening the burden. Most of these chores are done in bare feet!

All the combined hours spent retrieving water means many girls and women aren't able to go to school, or maintain jobs. Less than half of all girls in the region continue their education past primary (elementary) school, and many don't even finish their primary studies. It is not only the distance of the water source and the time it takes to retrieve it that prevent girls from consistently attending school, but illness. Since women and girls are the ones who are most often in contact with contaminated water, they are more likely to fall sick with water-borne diseases. Lack of education due to illness and countless hours spent fetching water means that women and girls are far more likely to remain poor.<sup>6</sup>

## GOING THE DISTANCE ACTIVITY:

**Teacher Instructions:** Explain that students will be "forming families" (groups of 4 or 5 students) and must provide water for their daily needs.

**Caution:** Water handling here! Wear raincoats or protective clothing if you wish to stay dry... or bring a change of dry clothes.

1. **Course:** Set up a 25-yard course in a suitably large space. Students will travel out and back for a TOTAL of 50 yards, or 150 feet. Place markers such as cones or chairs, to

indicate the start/finish and the 25 yard turn-around marker.

2. **Divide students** into groups of 4-5 individuals. There should be enough vessels for each group to carry a vessel per round.
3. **Who carries what?**
  - a. **Who in group will carry each vessel?** Groups need to decide who in group will carry which vessel, one vessel per teammate.
  - b. **Which group will carry which vessel?** Because there are only enough vessels for each team to carry one vessel per round, the teams will have to rotate through the vessels. For example: Team 1 begins with the bucket, Team 2 with the gallon of liquid, Team 3 with the two liters etc. The next round, Team 1 will use the 2 2-liter bottles; Team 2 will carry the bucket, etc. **Teacher should determine the order in which vessels are distributed per group** before activity commences. Students should take turns as carriers so that every student has a chance to carry at least one vessel per round.
4. **Timer**

Determine the timer for each round (students should rotate this role). For younger students the teacher will be the timer for the entire activity.
5. **Ready, set, GO!**

Round 1: The first student in each group will carry that group's vessel for 50 yards while being timed. Record that time on the GOING THE DISTANCE Worksheet, below.

Round 2: Groups exchange their vessels according to the teacher's list, then repeat this activity with a different student carrying a different vessel, and a new person timing. (Teacher times/records all rounds for the younger groups.)

Rounds 3, 4, etc.: Repeat above until each group has carried each vessel.

Older or more advanced students should use the second GOING THE DISTANCE worksheet, first recording their actual times in column A, per vessel. Students will then calculate how long it would take to carry the water **one mile**, and finally **five miles, per vessel**.

## ACTIVITY 2: WALKING IN AJIA'S FOOTSTEPS

Teacher may lead discussion, asking students the questions listed below, or students may remain in their "family" groupings to discuss and answer questions. Alternatively, students may complete questions individually. Complete the "**Walking in Ajia's Footsteps**" worksheet.

### ENDNOTES:

<sup>1</sup>"water facts" water.org. <http://water.org/water-crisis/water-facts/women/>

<sup>2</sup> – CSW56 – Facts and Figures on Rural Women." United Nations Entity for Gender Equality and the Empowerment of Women. <http://www.unwomen.org/how-we-work/csw/csw-56/facts-and-figures/>

<sup>3</sup>"Environmental Hotspots." UNEP Atlas, Chapter 4, p 91.  
[http://na.unep.net/atlas/kenya/downloads/chapters/Kenya\\_Screen\\_Chapter4a.pdf](http://na.unep.net/atlas/kenya/downloads/chapters/Kenya_Screen_Chapter4a.pdf)

<sup>4</sup>"Water Use." Kenya. [http://www.fao.org/nr/water/aquastat/countries\\_regions/kenya/print1.stm](http://www.fao.org/nr/water/aquastat/countries_regions/kenya/print1.stm)

<sup>5</sup>"Kenya: Water to Lighten Women's Load." <http://webworld.unesco.org/water/ihp/publications/waterway/waw/kenya.html>

<sup>6</sup>Progress for Children; A report card on water and sanitation," p 6. UNICEF  
[http://www.unicef.org/publications/files/Progress\\_for\\_Children\\_No.\\_5\\_-\\_English.pdf](http://www.unicef.org/publications/files/Progress_for_Children_No._5_-_English.pdf)

**Additional resource for Kenya:** United Nations Country Profile: <http://data.un.org/CountryProfile>

# WEIGHT OF WATER: GOING THE DISTANCE WORKSHEET

Students Names: \_\_\_\_\_

		A	B	C
<b>Vessel Carried</b>	<b>Student name</b>	<b>Seconds required to travel 50 yards</b>	<b>Minutes required to travel 1 mile (Column A x 35.2 / 60 seconds)</b>	<b>Minutes required to carry water for 5 miles (Column B x 5 miles)</b>
Bucket				
2 2-litre bottles				
Gallon jug				
Watering can				
Plastic box				
Optional additional vessel (1 gal) _____				

## INSTRUCTIONS:

*Column A.* Fill in time required to carry each vessel 50 yards.

*Column B.* Calculate how many minutes it would take to carry each vessel for a mile. (1 mile = 1,760 yards, divided by 50 yards is 35.2.) **How?** Multiply amount in Column A x 35.2 to calculate how many seconds it took to carry the vessel, then divide by 60 seconds to calculate the time in minutes it would take to travel 1 mile.

*Column C.* Complete Column C to determine the number of minutes per day you would spend collecting a gallon of water in that particular vessel if you lived 5 miles from the water source. **How?** Multiply amount in Column B by 5. [To convert this number of minutes to hours, divide Column C by 60 minutes.]

## FOLLOW UP DISCUSSION:

- Which vessel was the easiest to carry? Which was the most difficult?
- Which methods of carrying did groups use (on heads, under arms, arms wrapped around, etc)? Discuss ways in which people in other countries carry water containers. (Mostly on their heads!)

# WEIGHT OF WATER: WALKING IN AJIA'S FOOTSTEPS WORKSHEET

## STUDENT INSTRUCTIONS:

After the Going the Distance activity, you can begin to imagine the physical challenge Ajia faces every day completing her very important chore; retrieving water for her family.

- 1) **In your house:** Discuss or list chores you do around your own home (i.e.: take out the garbage, do dishes, clean up room, walk the dog). Then think about the following:
  - How much time do you estimate it takes to complete your chores?
  - Does completing chores ever prevent you from attending school?
  - Does completing those chores ever make you ill?
  - Does your family's health and wellbeing depend upon you completing your chores?
  - If you were Ajia, how would you answer these questions differently?
- 2) **In Ajia's home:** Imagine that, in addition to your list of chores above, you are now also responsible for collecting and transporting water for your family. Instead of attending school your job is to transport water to your home. It is an important job that your family depends on to stay alive.
  - How might you feel with that responsibility?
  - How is Ajia's daily life different from yours and your friends'?
  - Imagine your family has moved to a village in Kenya, and you dictate how your family uses water. Now imagine you only have 8 gallons a day for use, (the average amount of freshwater used per person in Kenya) per person in your home. Imagine all of you (4-5 family members) want to: brush teeth, use toilet, shower, wash hands/face, flush toilet, fill fish tank, clean floor, water indoor flowers, play in the sprinkler? Since all those activities collectively require more than 32-40 gallons of water (8 gallons times 4 or 5 people), which uses would you keep? Which would you eliminate?
  - Can you think of some changes related to water that might make Ajia's life and that of her sister and other girls and women in the region easier? Discuss what those changes might be and how they would impact lives.

## EXTENSION ACTIVITIES for Older Students:

- 3) **World Water Use Table**
  - Using the World Water Use Table below, identify the US daily domestic average water use. \_\_\_\_\_ (gallons)
  - How many pounds would that weigh? \_\_\_\_\_ pounds (1 gallon = 8.34 pounds)
  - Using your **Going the Distance** chart, calculate how long it would take you to carry that amount **one mile**, using the **bucket**, if you could carry 5 gallons at a time (the same distance and rate you could carry one gallon, as in Column B on your chart.) **How?** US daily water use ÷ 5, multiplied by the number in Column B.
  - How many gallons of water does the average Kenyan use per day? \_\_\_\_\_ gallons
  - How much does that weigh? \_\_\_\_\_ pounds

- 4) The **Millennium Development Goals (MDGs)** are eight international development objectives that all 193 United Nations States and many international organizations have agreed to achieve by the year 2015. The goals declared in 2000 are ambitious and address the world's most urgent and extreme problems, from poverty, child mortality and gender inequality to AIDS and malaria. The 7th goal seeks to ensure environmental sustainability, through a number of specific ways. The 7<sup>th</sup> goal also aims to decrease by half the number of people in the world without access to safe drinking water and basic sanitation. Although defined in the 7<sup>th</sup> goal, access to clean freshwater is necessary for the achievement of **all** of the MDGs. In the **Educator's Guide**, there are numerous references to "developing" countries. The term "developing" can be defined in a number of ways and developing nations may differ from one another; but a universal characteristic of a developing nation is that a substantial portion of the population lacks access to clean water and sanitation. It is not hard to make a link therefore between societal advancement and water, sanitation, and hygiene projects.

Review the MDG's: <http://web.undp.org/mdg/basics.shtml>. Write how you believe water relates to each of the goals. If Ajia's village had free and equitable access to fresh water, describe how the Millennium Development goals might be addressed specifically in that region? Review the following [website](#) to help you make the connection between clean water and a "developed" society.

- 5) **Your Water Story:** Complete **YOUR water story** on the back of the [Water Stories Supplement \(CLICK HERE for an editable PDF version\)](#). Share the significance water has in your life, or your family's, and join the online dialogue with students around the world. [SHARE YOUR STORY HERE](#) (NOTE: Suggested instructions are on the site. Not all stories will be posted; your last name will not be used but you may use a pseudonym. We encourage you to include a photo or a drawing of yourself and/or your group): [info@celfeducation.org](mailto:info@celfeducation.org).

## Weight of Water: World Water Use Table

<b>Continent / Country:</b>	<b>Domestic Water Use (Gallons per person per day):</b>
<b>Africa</b> Ethiopia Kenya South Africa	 3 8 56
<b>Europe</b> Germany Sweden United Kingdom	 41 77 30
<b>North America</b> Canada Mexico United States	 188 73 140
<b>Central America</b> Haiti Dominican Republic Guatemala	 3 76 7
<b>South America</b> Brazil Columbia Venezuela	 60 84 12
<b>Asia</b> China India Japan	 38 33 99

Source: "The World's Water; Volume 7. 2010." <http://www.worldwater.org/data.html>