

# FRESHWATER

## Webquest

### **TEACHER PAGE**

**Global Studies Issue** – The global decline of freshwater that is available to human civilizations.

**a. Target Learners** – High school students (15-18 years) taking Biology, Environmental Science or Marine Science.

#### **b. Learning Objectives**

The Student will be able to:

1. Make a concept map that shows the relationships between humans and freshwater. (SC.D.2.4.1, SC.G.1.4.1, SS.B.2.4.4)
2. Associate human population growth with water scarcity. (SC.G.2.4.4, SC.G.2.4.5, SC.G.2.4.6)
3. Develop a plan to use freshwater more efficiently in the home and community. (SC.G.2.4.2)

**c. Notes to the Teacher** – Before starting this activity spend about 10 minutes discussing the water cycle with students (see USGS link below). However, don't spend too much time on the details of the water cycle; instead, use the water cycle as a reference point for generating a whole class discussion about potential relationships between components of the water cycle and humans. For example, you might ask students to discuss potential relationships between humans and evaporation (humans contribute to global warming – which warms the climate – which increases evaporation), or, potential relationships between humans and precipitation (human civilizations release chemicals into the atmosphere – which is absorbed by water – which returns to earth as acid rain). Other components of the water cycle you might discuss include: surface runoff, infiltration, and ground water storage.

#### **d. Background Information**

All living things on our planet require a constant supply of water not only to continue living, but also to carry out the full range of life's biological processes. The human body for example is about 66 percent water by weight, and so to maintain sufficient fluidity humans must consume about eight glasses of water a day. Of course this all makes sense considering that life evolved in water about 2.5 billion years ago. Even when plants and animals made the transition to land they brought the water environment with them – inside themselves. So, with roughly 75 percent of the Earth covered in water, why are we concerned with fresh water scarcity? The problem is that 97.5 percent of the Earth's water is held in the oceans as salt water and for most organisms, especially terrestrial organisms, the salinity levels are too high to consume in even the smallest quantities. Fortunately, through a process called the water cycle, the oceans' salt water evaporates and then falls back to Earth as freshwater. Still, perhaps as little as 2.5 percent of the Earth's water is freshwater at any given time and of this

amount as much as 75 percent is trapped in glaciers and other forms of ice. This means that at any point in time only 0.5 percent of the available freshwater on Earth is in a form that can be accessed by terrestrial organisms and most of that water is stored underground.

This problem is further magnified by the fact that humans alone seek, claim, and waste more than 50 percent of Earth's accessible supply of freshwater and most of that is used for agriculture. In addition to the obvious problems associated with the excessive and wasteful consumption of freshwater by humans, is the fact that the Earth's freshwater is unevenly distributed across the globe. For example, about 26 percent of the world's precipitation falls in South America where only 6 percent of the world's population lives and about 60 percent of the world's population lives in Asia where only 36 percent of the world's precipitation falls. As a result, human civilizations must fight for governance of this scarce commodity, and yet 1 billion people around the world still do not have access to sanitary water.

e. Answers to discussion questions

1. Freshwater is a product of the water cycle that starts with the oceans. Only about 2.5 percent of the Earth's water is freshwater.
2. Agriculture, sewage, car washing, and many others.
3. Freshwater supplies are being replenished in new places around the world, but human civilizations are extracting freshwater from the same places around the world. For example, enough freshwater flows through the Amazon River to meet the needs of every person on the planet, but most of that water flows straight off the continent into the Atlantic Ocean.
4. Ecosystem health for example may gain more attention in the future as new studies release more information about the importance of certain ecosystems to water filtration and species diversity.
5. Consider which commodity has greater worth, water or oil.
6. The problem is access. Some countries have access to water from glaciers, but most do not. And the water flowing through the Amazon is only accessible to people living in South America.
7. There are many organisms living in freshwater such as the sporozoan that causes malaria. So, one might say that these microorganisms are also contaminating our waters. But, a closer investigation would reveal that it's the shifts in natural patterns brought about by human interventions that have allowed certain parasitic organisms to flourish beyond their normal means. Another example is the eutrophication of lakes that promotes pervasive algal blooms that make those waters hypoxic to organisms living within and toxic to organisms that come to drink the water.

**f. Recommended Reading List**

Bryson, B. 2005. *A Short History of Nearly Everything: Special Illustrated Edition*. Broadway Books, a division of Random House, Inc., New York. Chapter 18 - The Bounding Main.

Robert Kunzig. "Drying of the West" National Geographic Magazine February 2008: 90-113.

Brook Larmer. "Bitter Waters" National Geographic Magazine May 2008: 147-169.

Sharon Nappier, Robert Lawrence, and Kellogg Schwab. "A Special Report on the World's Freshwater: Dangerous Waters" Natural History November 2007: 46-49.

Eleanor Sterling. "A Special Report on the World's Freshwater: Blue Planet Blues" Natural History November 2007: 29-31.

Eleanor Sterling and Merry Camhi. "A Special Report on the World's Freshwater: Sold Down the River" Natural History November 2007: 40-45.

**g. Sample of Student Work – not available**

**h. References**

Environmental Protection Agency (EPA) - <http://www.epa.gov/safewater/index.html>

U.S. Geological Survey (USGS) - <http://ga.water.usgs.gov/edu/earthwherewater.html>  
There is also a link to detailed page on the [water cycle](#) that is very useful

American Water & Energy Savers - <http://www.americanwater.com/>

Lake Eutrophication

<http://www.umanitoba.ca/institutes/fisheries/eutro.html>

<http://www.scienceclarified.com/EI-Ex/Eutrophication.html>

## **INTRODUCTION/GUIDING QUESTION**

Each of us requires about eight glasses of water each day in order to provide for even the most basic functions of our bodies and yet for at least 1 billion people around the world, sanitary freshwater is a scarce commodity. Over the next few days you will explore and document relationships between humans and freshwater so that you can intelligently support an opinion about whether or not freshwater is a scarce commodity. In addition to exploring the relationships between humans and freshwater, you will also develop a “Personal Plan” for using freshwater more efficiently in your home and community. Finally, with your newly acquired knowledge on water conservation strategies, you will present a proposal to the school principle outlining ways in which the school could be using its freshwater facilities more efficiently.

## **TASKS**

**Task-1:** The purpose of this first task is to brainstorm about ways in which humans are potentially contributing to their own problem of water scarcity. The first thing you need to do for this task is use the *Webquest Exploration Guide* to explore specific internet websites for information on direct and indirect relationships between humans and freshwater. You will complete this alone. Then, once you have completed this part you need to form a group with two other students and complete Part A+B listed below. Each group will need one box of colored pencils and one large sheet of white poster board. Write the names of your group members in the top right hand corner of the poster board.

**Part-A.** On the side opposite where you wrote the names of the group members create two columns with the headers “Direct Relationships” and “Indirect Relationships.” In each column you will list relationships between humans and freshwater. In the first column list 15 direct relationships and in the second column list 15 indirect relationships. Number each relationship (1-15) and next to each relationship write the name of the group member that thought of it (see example below). Each group member must identify at least four relationships, two in each category and each group needs at least 30 total relationships.

For this activity, I am defining direct and indirect relationships as follows: A “direct” relationship is one in which humans have made contact directly with the water, as in, pouring motor oil into a river (Ex. Polluting). This is a direct relationship because the motor oil went from the persons hand directly into the water making that water undrinkable. I’m defining an “indirect relationship” as one in which other events in addition to the initial human intervention have contributed to the relationship. For example, coal burning contributes to global climate change, which may result in higher temperatures and greater rates of evaporation of surface freshwater, thus reducing the amount available for consumption.

### **Example:**

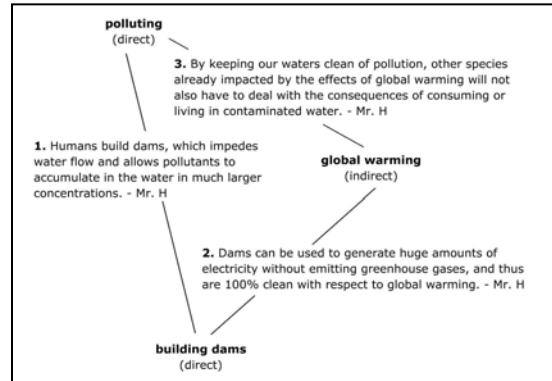
#### Direct Relationships

- 1) Polluting (Mr. H)
- 2) Building dams (Mr. H)

#### Indirect Relationships

- 1) Global warming (Mr. H)

**Part B:** On the other side of the poster you will create a concept map that displays interconnections between any numbers of “direct” or “indirect” relationships you choose. Identify each relationship as “direct” or “indirect” and write 10 interconnections between them, but no more than one interconnection per pair of relationships. Each interconnection should be numbered and written as a short description in at least one complete sentence (see example on right). You should discuss possible interconnections as a group; however, each of you must personally write at least two interconnections on the poster. Sign your name next to the interconnections you write. Points will be awarded for creativity, so BE CREATIVE with the colors.



**Completion:** When you have finished this task, give the poster to the teacher, return to a computer station, and start Task-2. Be sure your poster includes everything that is required (refer the *Evaluation of Tasks* section).

**Task-2:** For this task you will use the information you gathered in the Task-2 section of the *Webquest Exploration Guide* to construct a “Personal Plan” for using freshwater more efficiently in your **home** and **community**. Complete parts A-E and refer to the *Evaluation of Tasks* section for other specific requirements.

**Part A.** Without any assistance from anyone else I will be able to increase the efficiency of water use and/or decrease the amount of water wasted **inside** my house by doing the following:

**Part B.** Without any assistance from anyone else I will be able to increase the efficiency of water use and/or decrease the amount of water wasted **outside** my house by doing the following:

**Part C.** I know of other things that can be done at my house to save money on our water bill while maximizing water use efficiency, but they require assistance and/or monetary contributions from my parents. With some assistance from my parents here’s what we could do.

**Part D.** I recognize that the water I use at my house originates from groundwater and surface waters in my community. If I was given a chance to speak with my local congressman about what I think should be done to remove or reduce the

impact of contamination on the sources of water in my community, here's what I would say.

**Part E.** I understand that countries around the world differ in the amount of water they withdraw for agriculture, industry, and domestic use, and countries that rely heavily on agricultural practices withdraw by far the most water per capita. If I were to attend a United Nations Summit Meeting on the topic of freshwater conservation I would make the following suggestions:

**Completion:** When you have finished this task check the *Evaluation of Tasks* section to be sure you've met all the requirements and then start on Task-3.

**Task-3:** Write a letter to the school principle proposing at least **three** ways in which the school could be using its freshwater facilities more efficiently. After I've collected all the proposals, I will select the five "best" and present them to the principle for review. Use the letter template shown below to type your letter. Print and sign the letter. Check the *Evaluation of Tasks* section to be sure you've met all the requirements

Dear Mr. Principle,

YOUR PROPOSAL FOR MANAGING FRESHWATER USE AT YOUR SCHOOL GOES  
HERE. REMEMBER, YOU'RE WRITING TO THE PRINCIPLE, SO SPELLING AND  
GRAMMAR MATTERS. YOUR PROPOSAL MUST CONTAIN AT LEAST 200 WORDS, BE  
WRITTEN USING AN EXPOSITORY WRITING STYLE, AND INCLUDE AT LEAST  
THREE SPECIFIC WAYS IN WHICH THE SCHOOL COULD BE USING THEIR  
FRESHWATER FACILITIES MORE EFFICIENTLY.

Sincerely,

Logical Student

## EVALUATION OF TASKS

Your grade on this assignment will be based on how well you and your group meet the requirements outlined in the following grading rubrics.

### Task-1

<b>Part A. List of Relationships</b>	
Completes the Task-1 section of the <i>Webquest Exploration Guide</i> . [1 point for each link]	___ / 2 pts
List of 15 “direct” and 15 “indirect” relationships between humans and freshwater. [1 point for each list]	___ / 2 pts
At least 4 “direct” and “indirect” relationships were provided by you. Each one must be signed.	___ / 1 pt
<b>Total:</b>	___ out of <b>5 points</b>

<b>Part B. Concept map of interconnections between relationships</b>	
Concept map that contains any possible number of “direct” and “indirect” relationships, but at least 10 interconnections between them. Each interconnection must be written in a least one complete sentence. [½ point for each interconnection]	___ / 5 pts
Concept map displays creativity	___ / 1 pt
At least 3 interconnections written and signed by you.	___ / 1 pt
<b>Total:</b>	___ out of <b>7 points</b>

### Task-2

Responds appropriately to the questions in the Task-2 section of the <i>Webquest Exploration Guide</i> .	___ / 15 pts
Provides detailed responses (3-5 sentences) for parts A-E of the “Personal Plan” that draw from information gathered during the Webquest exploration.	___ / 5 pts
Responses to parts A-E of the “Personal Plan” are written in complete sentences and follow proper grammar and punctuation.	___ / 5 pts
<b>Total:</b>	___ out of <b>25 points</b>

### Task-3

Letter to the principal is written using an expository writing style, does not contain spelling errors, and exhibits proper use of grammar.	___ / 1 pt
Letter to the principal is double-spaced and contains at least 200 words.	___ / 1 pt
Letter to the principal contains <b>at least three</b> ways to improve water use in the school.	___ / 1 pt
<b>Total:</b>	___ out of <b>3 points</b>

### Grade

Your grade will be determined by the total points you receive on Tasks 1-3.

Grades will be distributed as follows:

- A = 35-40 points
- B = 29-34 points
- C = 23-28 points
- D = 17-22 points
- F < 17 points

## WEBQUEST EXPLORATION GUIDE

**Task-1:** To complete this task you will need explore the internet independently and find relationships between humans and freshwater. Once you've gathered all the necessary information find two other students that have also finished this task, acquire one sheet of poster board, one box of colored pencils for the group, and complete Task 1: Part A and B in the *TASKS* section.

**LINK # 1** - Visit <http://www.prb.org/>

- In the search field located at the top-right corner of the page type “**freshwater**” and click the “GO” button.
- Look under the heading, “Search Results” and click the article link titled “**Global Policies Must Address Freshwater Scarcity**” dated 08/15/2002.
- Read the short article and for each of the critical aspects of freshwater availability discussed in the article list one “direct” and one “indirect” relationship between freshwater and humans. Refer to my definitions of “direct” and “indirect” written in the *TASKS* section.

**Critical aspect #1:** Population growth and water dynamics

Direct:

Indirect:

**Critical aspect #2:** Human health and sanitation

Direct:

Indirect:

**Critical aspect #3:** International conflict and security

Direct:

Indirect:

**Critical aspect #4:** Ecosystem health

Direct:

Indirect:

**LINK # 2** - Visit <http://www.nature.org/popups/freshwater/watershed.html>

- Explore all the threats to watersheds modeled on the map. For each threat list one “direct” and one “indirect” relationship between freshwater and humans. Refer to my explicit definitions of “direct” and “indirect” written in the *TASKS* section.

	Direct	Indirect
1. Deforestation		
2. Dams		
3. Agriculture		
4. Climate Change		
5. Invasives		
6. Water Consumption		
7. Floodplain/wetland conversion		

**Task-2:** To complete this task you need to explore the internet independently for information related to using freshwater efficiently in your **home** and **community**. Use this information to complete your “Personal Plan” outlined in the *TASKS* section.

**Link # 1** - Visit <http://ga.water.usgs.gov/edu/sacos.html>

- Click the survey link “Water Shortage! - How would you handle this water crisis?” complete the survey, and then press the “Submit your answers” button.
  - 1) According to this table how many people have responded to this survey?
  - 2) Are there any states that think any of those methods for handling the water crisis is a “Great idea?”
  - 3) Which method seems to be considered the “best” among the states?
  - 4) Which method does the U.S. and the World **both** consider the “best”?
  - 5) Search the table data and determine which continent/area or U.S. state comes closest to considering at least one of the methods “Not a good idea” (Hint! Use the search feature (ctrl+f) to search for “1.x” with x being a number 1-9).
    - a. Search Value: \_\_\_\_\_
    - b. Continent/area or U.S. state: \_\_\_\_\_
    - c. Method: \_\_\_\_\_
    - d. Does this make sense? Explain why or why not in 2-3 sentences.

**Link # 2** - Visit <http://www.savewater.com.au/>

- On the right-hand side of the page look for the header “save water in...” click the button labeled “**home**”
- Choose **two** of the following categories of freshwater use in the home to explore: Kitchen, Laundry, Bathroom, Leaks, Pools and Spas, Garage and driveway, or Greywater. Click on the corresponding button titled “learn more.”
- In the spaces provided, write the category and answer the questions.
  - 6) Category 1: \_\_\_\_\_
    - a. How much of the total household water consumption could potentially be saved in this category?
    - b. Based on what you read in this article, describe **two** things that you could personally do at your own house to conserve water in this category (1-2 sentence each):
  - 7) Category 2: \_\_\_\_\_
    - a. How much of the total household water consumption could potentially be saved in this category?
    - b. Based on what you read in this article, describe **two** things that you could personally do at your own house to conserve water in this category (1-2 sentence each):



- c. What logical inferences can be made about regions around the world and the amount of water they withdraw for agriculture, industry, and domestic use?

## **RESOURCES**

In addition to the links you were required to visit in the *Webquest Exploration Guide* section you might also find the following resources useful in developing your “Personal Plan”:

Freshwater Conservation: What you can do.

<http://www.nature.org/initiatives/freshwater/work/art24150.html>

Clear Water Project

<http://www.clearwaterproject.com/dyabout.html>

USGS – Water Basics

<http://ga.water.usgs.gov/edu/mwater.html>

USGS – Urbanization

<http://ga.water.usgs.gov/edu/urbaneffects.html>

UNEP – Key Facts About Water

<http://www.unep.org/wed/2003/keyfacts.htm#resource>

FAO Newsroom

<http://www.fao.org/newsroom/en/focus/2007/1000521/index.html>

HarvestH<sub>2</sub>O

<http://www.harvesth2o.com/resources.shtml>

## CONCLUSION

At this point you should have some opinion about whether or not you think freshwater is a scarce commodity and whether humans should be concerned with the fact that they claim and waste 50 percent of the available freshwater. You might even propose as a solution a reduction in the global human population growth rate. But, would that be sufficient? Even in a zero-population growth situation, societies will pollute groundwater, destroy key ecological systems, and engage in conflicts over the limited resources, such as, freshwater. Or, perhaps it's better to focus efforts on educating people to better manage their individual water needs. Some might even suggest that global warming will help with this issue by melting the glaciers, which are storing most of our freshwater. Of course, then we would have other issue to worry about. Whatever you decide is the best course of action, remember this, water is the most precious compound in our galaxy and without we could not exist.

Now, as a class let's discuss the following questions:

### Discussion Questions

1. What is the relationship between the amount of freshwater and total amount of water on Earth?
2. The scarcity of freshwater can be traced in large part to the inefficient ways in which humans use it. What are some ways in which humans use water inefficiently?
3. Water is not disappearing from the surface of the Earth, so why aren't our freshwater supplies being replenished?
4. What are some critical aspects of freshwater availability and how do you see them being dealt with in the near future?
5. Considering that the U.S. has a relatively large abundance of ground water and the knowledge and technology to extract that water, should the U.S. consider exporting water to water scarce countries like those in the Middle East?
6. Considering that there's enough freshwater flowing through the Amazon river each year to meet the needs of every human civilizations, do you believe that freshwater is really a scarce commodity?
7. Finally, are humans the only organisms contaminating our freshwater reserves?