CHAPTER 4:

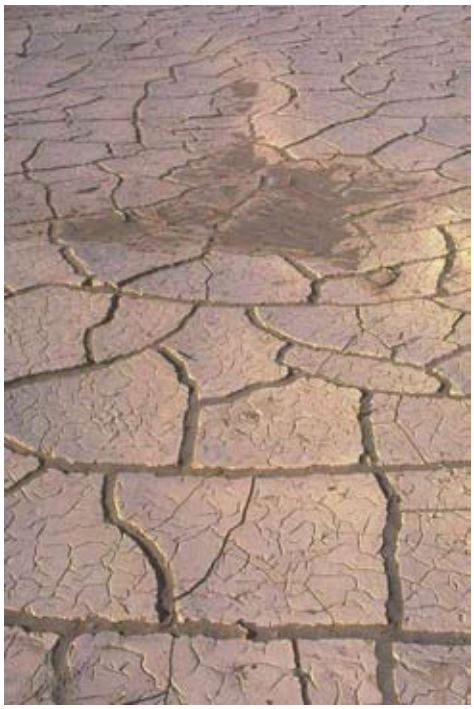
IS THERE ENOUGH WATER FOR EVERYONE?

A: AVAILABILITY OF WATER ON EARTH

Activity 1:

Distribution of water on Earth
Points to consider...

In the first chapter, we learned that most of the Earth's surface is covered by water. In your notebook, complete the following sentence:
"If two-thirds of the Earth's surface are covered by water, then..."
Next, write at least three questions related to this statement.



To answer these questions, we will study the distribution of water on Earth.

Hypothesis

Development of the Activity

1. Formulating a hypothesis.
   a. Look at the photographs on the cover of this chapter. The pictures represent different forms of water in nature. Match each form of water in nature with a hypothesis about the proportion (percentage) of the total water on Earth.
   b. In your notebook, synthesize your hypotheses in the center column of the table. After the classroom discussion, complete the right column of the table.

   Use the percentages from Figures 1 and 2 to organize your ideas in the table below.

Water Bodies in Nature	My hypothesis of proportion (in percent)	Scientific knowledge of proportion (in percent)
Oceans		
Glaciers		
Groundwater		
Precipitation (Atmospheric)		
Lakes		
Rivers		
Living things (Humans, Animals, Plants)		

Graph Analysis

On the next page, you will find two charts showing the distribution of water on Earth. Figure #1 shows the distribution of all water ("fresh" and "salt"). Figure #2 only shows the distribution of fresh water.

a. Try to make three conclusions (at least) from your exploration of the figures.
b. Mark whether each statement below is correct or incorrect.

1. 97.2% of the water on Earth is salt water, and only 2.8% is fresh water.

☐ **correct** ☐ **incorrect**

2. The amount of water in the atmosphere (such as rain, snow, hail, and water vapor) is less than that found in all rivers on Earth.

☐ **correct** ☐ **incorrect**

3. The smallest percentage of fresh water on planet Earth is locked up in glaciers.

☐ **correct** ☐ **incorrect**

4. Most of the water on planet Earth is in the oceans, and is salt water.

☐ **correct** ☐ **incorrect**

c. On the previous page, fill in the right column of the table with the data about the water distribution, based on scientific knowledge. Do the data from the graph agree with the hypotheses you made in the table?
d. In your opinion, why is there a need to provide two different graphs to show the distribution of water on planet Earth?
e. In your opinion, why is the data about living things not shown on Figure 2?

f. Try to determine the relative proportion of each place water is found in nature. Record these forms below the number that represents the proportion of these forms relative to the total amount of water in nature.

1	2	3	4	5	6	7

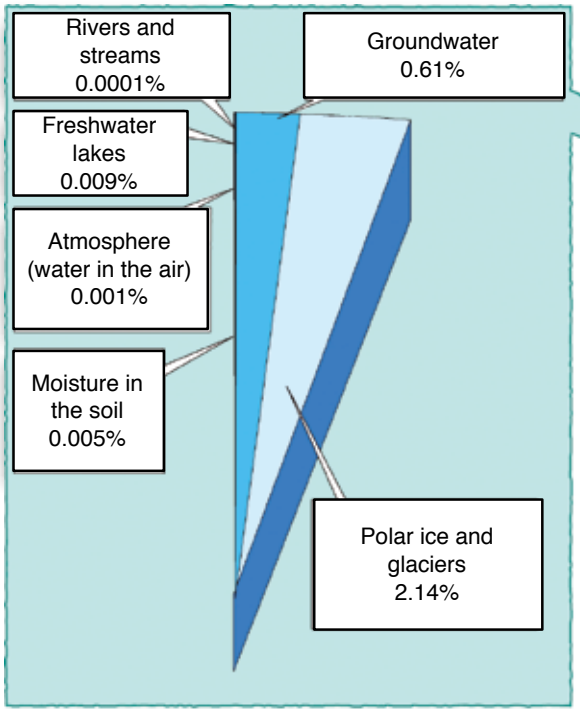


Figure 2: Distribution of fresh water on Earth*

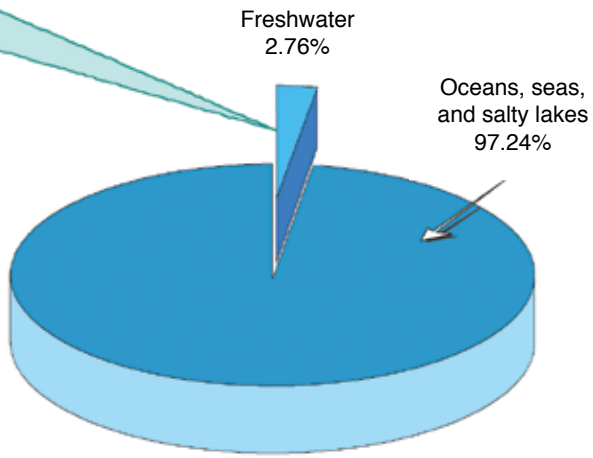


Figure 1: Distribution of all water on Earth*

* Data from the American Geosciences Institute

Activity 2:

What water is available?

We consider the existence of water in our life as stable, and generally, we do not reflect on its importance. Looking at the history of planet Earth and humanity, we notice that water has played an important role in the development of life on Earth. In the following section, we will examine the percentage of the total water on Earth, and also for the United States, and how much of that water is available for use by humans.

1. Next to each body of water in the table below, record a reason why you can use the water source, and a reason why you cannot use this water source.

Source	**Yes: Reason that the water is available for use** **No: Reason that the water is <u>not</u> available for use**
Polar ice and glaciers	Yes: No:
Groundwater	Yes: No:
Streams and rivers	Yes: No:
Fresh water lakes	Yes: No:
Atmosphere (water in the air)	Yes: No:
Soil moisture	Yes: No:
Oceans, seas, and salty lakes	Yes: No:

2. After this activity, answer the question: What sources of water are available for human

use?

3. Below is a table that describes the amount of water found in each of the bodies of water (and the different forms in which water is present) on Earth.
   Mark whether each source of water on Earth is fresh or salt water, and whether it is or is not available for humans (see the example).

Source	Percentage (%) of total	"Fresh water"	"Salt water"	Water is available to humans	Water is not available to humans
Atmosphere (water in the air)	0.001	✔			✔
Polar ice and glaciers	2.140				
Groundwater	0.610				
Streams and rivers	0.0001				
Fresh water lakes	0.009				
Soil moisture	0.005				
Seas and salty lakes	0.008				
Oceans	97.240				

Summary of the distribution of water on Earth	Percentage (%)
a. Add up the "salt water"	
b. Add up the "fresh water"	
c. Add up the amount of water available for human beings	

Conclusion

List at least three conclusions that can be derived from the data in the table.

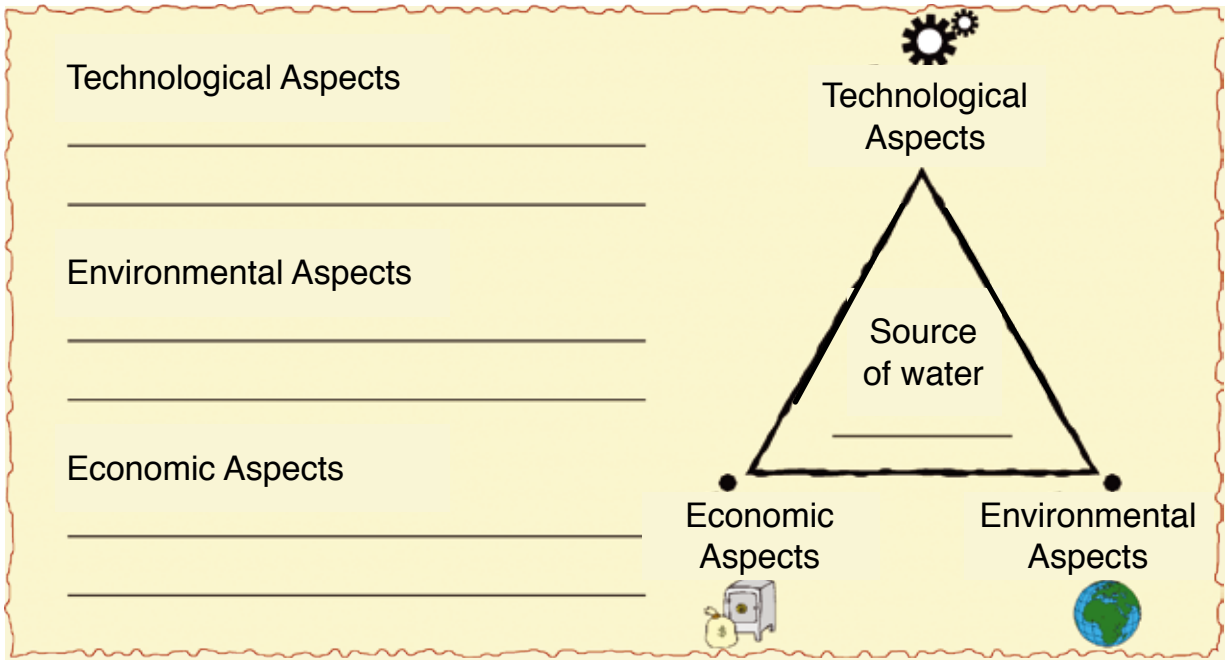
Additional Information

The phrase "water availability for humans" refers to the ability to use fresh water that is safe, without using extremely expensive technology and great effort. It is no coincidence that this definition may sound ambiguous - as water that is available for drinking in India may not be considered available for drinking in Spain. Many tourists are meticulous, and only drink bottled water when visiting some countries. The availability of water is a social issue, which has technological, economic, and environmental meanings.

Mission: Choose a source of water and explore whether this water is available or not, for humans.

Each group will receive a transparency and will write down their chosen water source, and then present the economic, technological, and environmental aspects of using this water source. The presentation can also be made in Power Point® or on a poster.

For example: The water from glaciers is not available to humans due to the high cost of transporting the water over long distances. The exploitation of this source of water brings up environmental concerns, as the transoprtation of this source requries a large amount of gasoline. The use of gas as an energy source generates air pollution, and involves the exploitation of nonrenewable resources on Earth. Therefore, the use of this source of water is damaging to the environment in two different ways.



Presentation: Availability of water on Earth

Surfing the Internet

Visit the following websites:

http://ga.water.usgs.gov/edu/followadrip.html
Explore this website and read the section about "**Following a Drop Through the Water Cycle**." Pay special attention to the movement of drops of water through different parts of the water cycle.
What happens if no one interferes with the water cycle?

http://en.wikipedia.org/wiki/Water_cycle
Read through the section of this website about **"Residence times,"** which specifically refers to estimates of the amount of time a water molecule spends in each part of the water cycle.
Where do water molecules spend significant amounts of time? Where do they spend the least amount of time?

http://news.bbc.co.uk/hi/english/static/in_depth/world/2000/world_water_crisis/default.stm
Read an overview of the **"World Water Crisis"** (at the bottom of the page), and then explore some areas of the world in which people do not have access to safe drinking water.

http://www.scientificamerican.com/article.cfm?id=freshwater-crisis-current-situation
Read the article **"Freshwater Crisis: Current Situation."** Examine the map at the bottom of the article that shows where water supplies are abundant or scarce around the world.
What does it mean when a country faces a scarcity of fresh water?
Which regions of the world are facing the most significant water scarcity?
What is the difference between physical and economic water scarcity?

http://www.worldwater.org/data.html
This website catalogs large amounts of data about the world's fresh water supply, and the availability of fresh water to people in different countries of the world. Use the data from this site, and in particular, **Table 3: Access to Safe Drinking Water, by Country, 1970 to 2004**) to answer the questions that follow.

Excel Activities

1. Explore the data about countries and their respective water availability.
2. Rank the countries according to the availability of fresh water.
3. Make a chart that shows the ranking of countries with respect to the availability of fresh water.
4. How does the United States' water availability compare with other countries in the region?
5. Assuming that the trend of water availability continues to be the same, forecast the water availability of several countries of interest, by 2025.

Activity 3:

Who is taking care of our fresh water sources?

Analysis of Information

Earth's rivers play a significant role in water runoff. In a large number of countries, including Kazakhstan, the rivers carry water to remote areas, for use in irrigation and drinking. In this activity, you will study the histroy of the Aral Sea, which is a tragic example of the exploitation of water resources.

Surfing the Internet

http://www.nationalgeographic.com/familyx/14/aral.html
http://en.wikipedia.org/wiki/Aral_sea
http://geography.usgs.gov/feature/description.php?id=173

Visit the websites from the previous page, and read the articles about the Aral Sea and the Ecological Catastrophe in that region. Be sure you look at the photos and satellite images on those sites to see how the Aral Sea has changed.

Questions

Questions about the Aral Sea articles.

Satellite view of the Aral Sea

a. Which article was most useful?
b. What is the main issue presented in the articles?
c. What is the central message of the articles?
d. What influenced the availability of fresh water in Kazakhstan, and how?
e. How did this article influence your understanding of human's influence on the availability of fresh water? Explain.

The story of the Aral Sea shows how countries that are rich in water resources, such as Kazakhstan may lose their water sources if they are not used properly.

Surfing the Internet

Now, visit the following website, and click on the links to learn more about water quality: http://ga.water.usgs.gov/edu/waterquality.html

a. Highlight the most relevant parts of this article.
b. What is the central message of the article?
c. What impact does human activity have in the degradation of water quality in lakes?
d. What ideas could you propose to restore the degraded environment?
e. Does this article make you more interested in studying how human activity affects the pollution of our water? If so, how?

HUMAN ACTIVITIES AFFECTING THE QUALITY OF FRESH WATER	DAMAGE TO THE QUALITY OF FRESH WATER DUE TO THESE ACTIVITIES

Synthesis

Activity 4:

Activity to synthesize the theme of water availability in the United States

This work will be done in groups of 3-4 students. Consider the following tasks:

Surfing the Internet

Task 1: Population growth and water availability in the United States.

1. Search the Internet for data about how the population of the U.S. has grown since 1900. Sketch or record your findings in your notebook (Note: if you prefer to focus on the data for a specific state, try to find the requested information in these tasks for that location).

2. Next, search for data about the way freshwater resources are used in the U.S. or in the state you have chosen. Ex: agriculture, recreation, industrial, domestic, etc. Record your data in your notebook.

3. Search for data about the breakdown of the population of the state you've chosen to study. What percentage of people live in urban, suburban, and rural areas?

Living situation of the population in _____ (state)	**Percentage of people**
Urban	
Suburban	
Rural	

4. Merge with another group of students in your class who studied a different state and compare your findings.

Analysis of Data

1. Write down three new facts that emerged from the data and information you gathered, which you did not previously know.
2. As a result of your analysis of the information, write down at least four conclusions regarding the availability of water in the United States, a specific state, and/or the world.

Task 2: Water problems in the United States

Synthesis

In this activity, discuss with your classmates which places in the U.S. have water problems. Search the Internet for information on these places. Be sure to include the sources of your information in your notebook. Use the following questions to guide your search:

a) How much water is available for human use?
b) What is the source of water in this location?
c) What are the reasons for the water problems in this location?
d) What actions are being taken to solve these problems?

1. Worldwide, industrial development and the rising living standards enhance the consumption of water, resulting in an increase in the exploitation of water sources.
2. Summarize in a few statements how the people of the United States (or your chosen location) might affect water availability.
3. How should the findings from your research influence the planning of the water system in the future?
4. How will developing industries increase the quality of life, and water availability for humans?

The use of water for agriculture.

Task 3: Humans and water.

Surfing the Internet

Find an article about human's influence on water in the United States, or in the location you've been studying. Use your list from Task 1, Question 2 to get you started.

1. Highlight the most relevant parts of this article.
2. What is the central message of the article?
3. Does this article make you more interested in studying how human activity affects the pollution of our water? If so, how?

Analysis of Information

Task 4: Summary of Information

Water in the United States – analysis of information sources.

1. Try to locate in the daily newspapers, fragments of information or articles related to water availability problems in the United States.
2. Synthesize the information found in these sources by referring to the following points:
   a. What are the factors that influence the availability of water in the United States in the 21st century?
   b. In your opinion, what could endanger the water resources available to the US population in the 21st century? Refer to the findings and emphasize the points you need more information about or better information in order to answer this question more convincingly.
   c. If the authors proposed possible solutions to prevent the decline of water resources in the United States, describe them in the table below.
   d. Explain the views of the authors on the proposed solutions. Are they feasible? Suggest additional solutions.

FACTORS AFFECTING THE AVAILABILITY OF WATER	POSSIBLE SOLUTIONS TO THE DIMINISHING AVAILABILITY OF WATER