

CHAPTER 6:

THE WATER WE DRINK





WHAT HAPPENS TO WATER AFTER YOU USE IT?

Activity 1:

What happens to water?

Water is an essential component. Without it, we could not exist.

Humans get the water they need by drinking and eating. In cases where a human lacks water, he is called “dehydrated” and can become seriously ill, and even die.

The following website (<http://www.scientificamerican.com/article.cfm?id=noaa-makes-2011-most-extreme-weather-year>) will help you appreciate the consequences of climate variations associated with global warming on Earth, and how this may alter the water cycle and ultimately impact human beings.

Water has many uses in addition to drinking. We use water and depend on it for many everyday activities. In this activity, try to determine how humans influence the properties of water.

Part One:

1. In the table below, record the different ways you use water **in your home**. Try to determine how much water you use for each of these purposes, and place an X in the appropriate box in the table.

Type of Use	1% of water	5% of water	10% of water	20% of water	30% of water	40% of water	50% of water

- Look at the table to the right: "Water use in my home." Use Excel to prepare a graph that represents the percentage of water used for each of the individual purposes shown in the table.
- Explore the graph to try to make at least two conclusions regarding the use of water in your home

in %	Use
14 %	laundry 
32 %	shower/ tub 
6 %	dish- washing 
5 %	drinking and cooking 
3 %	bathroom sink 
40 %	toilet water 



Activities in Excel

Part Two:

Visit the website: <http://www.answers.com/topic/water-balance-1> "Oxford Companion to the Body: Water Balance." Pay particular attention to the pattern of intake and output of water in the human body.

Answer the following questions:

- What is the balance of water?
- What are the activities through which the body brings in water?

3. What are the activities through which the human body puts out water?
4. Can you influence the water balance of your body?
5. Can the flow of water from your home to the drain influence the water balance of your body? Explain.

Food for Thought

1. What happens to the water from your house after you're finished using it?
2. Can this water be reused? Explain.
3. The water we use flows to a sanitation plant. Where does wastewater (sewage) flow?



Additional Information

The liquid flowing into the drain from household sewage is composed mostly of water (approximately 99%) and a small part (about 1%) is composed of other compounds, such as remains of human excretions, cleaning materials, medicines, paints, salt, food waste, and pesticides. In many countries, the law specifies that every city should have a system of pipes that collects wastewater (sewage) and moves it to a treatment plant. The purpose of this plant is to separate water from contaminating particles. However, not all harmful particles can be separated from water through this purification process. For example, metal particles (ions of different metals) are not separated. Many of the substances found in wastewater, such as metal ions, can affect human health, even in very small amounts. That is why even after purification, wastewater cannot be used as drinking water. However, this water may be suitable for irrigation. The price of a water purification system for a city is extremely high, and that is why some towns and cities prefer to send their wastewater to collection tanks or rivers. In the next activity, you will see what happens in a polluted river, in an area where you live.





Wastewater treatment plant



*Surfing the
Internet*

Go online and locate one or two websites that describe what happens to the water you use at home after it's been used (wastewater flow). For example, these sites may have useful information:

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

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

Pay special attention to the treatment of “domestic wastewater,” also known as “greywater” in some countries.

Prepare a poster or sheet that explains “Where does wastewater flow?” after you’ve collected information on the Internet.

Activity 2:

The water cycle in my local environment

For this activity, we will travel to a river in the neighborhood and look at what might happen to the water we use.



Study Trip

Part One: Visit several websites to find articles about pollution of rivers.

For example:

- <http://www.grinningplanet.com/2005/07-26/water-pollution-facts-article.htm>
“Water Pollution Facts for the United States”
- <http://www.grinningplanet.com/2005/09-06/water-pollution-causes-article.htm>
“Water Pollution - Point and Nonpoint Sources”

Part Two: Visit the website for the Environmental Protection Agency. (www.epa.gov)

Prepare an outline that describes the health and environmental quality of rivers in the United States.



Additional Information

Here are some facts about the development of the field trip to a river in your neighborhood, the learning style, and the equipment needed for this activity. Your teacher will provide the missing details on the following page:

General Information:

1. The study tour will take place on _____ on the date _____.
2. We will leave the school at _____.
3. We will return to school at _____, approximately.
4. Lunch will/will not be eaten during the course of the trip.
5. The itinerary will include visits to the following sites: _____, _____, _____.
6. Moving from one place to another will be done by bus or walking to the locations where you will carry out the activities. This educational event will not require significant physical effort.
7. We will be at each site for approximately _____ minutes.

Equipment Necessary for the Field Study:

1. Notebook (one per student).
2. A pen or pencil.
3. A clipboard for writing (one per student).
4. One **camera** per group (students' responsibility).
5. A large bottle of water, not to be used for drinking, but for collecting water samples.

Equipment Necessary for being Outdoors:

1. Hat.
2. Drinking water (at least 2 liters per student).
3. Sandwiches and other food.
4. Sunscreen.
5. A small backpack.
6. Bags to collect trash.





Synthesis

Summarize the field trip using photographs, words, and pictures.

1. Record your feelings and ideas as a result of visiting the river and its surroundings.
2. Categorize the photographs taken according to the divisions of the Earth System:

Parts of planet Earth (Geosphere) in the water environment.

Living things (Biosphere) in the water environment.

Evidence of the existence of water (Hydrosphere) in the environment.

Evidence of human activity in the water environment.

3. Glue the pictures you took into your report of the field trip as follows:

Biosphere
in a water environment



Here is an image that presents the biosphere in a water environment



Here is an image that presents the biosphere in a water environment



Here is an image that presents the biosphere in a water environment

The factors that appear in the image are linked to the biosphere include:

The image shows an example of mutual influence between

_____ and _____

What is the nature of the influence? _____

4. Write a story that makes connections between the photographs you took.



HOW DO WE KNOW IF THE WATER IS SUITABLE FOR DRINKING?

Activity 1:

Science and Technology: Water purification by activated carbon

In recent years, as a result of publications about the presence of different contaminants in drinking water sources, a portion of the population has lost confidence in tap water. In many houses, people have installed water purification equipment that contains activated charcoal. This activity will examine whether the movement of contaminated water through activated carbon improves its quality.

Equipment and Laboratory Materials:

A spoonful of potting soil

Two Erlenmeyer flasks

Concentrated raspberry juice

Two funnels

A teaspoon of salt

Filter paper

Two teaspoons of powdered charcoal (activated carbon)

One teaspoon

Ammeter



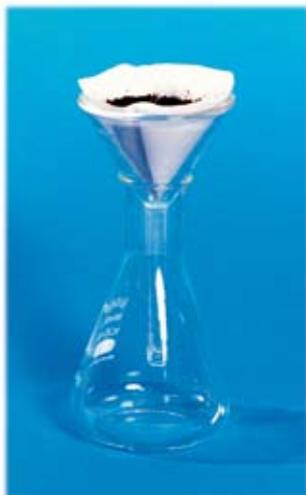
Experiment

Part One: Water Purification with Activated Carbon

Development of the experiment:

- a. Prepare a flask with mixture of potting soil in water, and a teaspoon of salt.
 1. Describe the properties of the solution: What color is it? Does it look cloudy?
 2. Examine the electrical conductivity as a measure of salinity (use a milli-ammeter).
 3. Examine the concentration of nitrate ions (NO_3^-) in solution (as in Chapter 3).

- b. Prepare a funnel with filter paper and the powdered activated carbon. Pour the prepared solution into the funnel. Describe the properties of the solution. After it's been filtered: What color is it? Is it cloudy?
1. Examine the electrical conductivity as a measure of salinity (using a milli-ammeter).
 2. Examine the concentration of nitrate ions (NO_3^-) in solution.
 3. Briefly describe the process of the experiment and its results. Use the terms observation,



conclusion, and inference.



Synthesis

Synthesis of the experiment: Copy the following statements into your notebook, and complete the statements using the **word bank**: *attractive forces, adsorbs, not adsorbed into, large particles, dissolved, water, attracted*.

The water solution contains water molecules and molecules of another substance which is _____ in the water.

Activated carbon _____ molecules dissolved in water.

It is possible that molecules of water and salt are less _____ by activated carbon.

You may not have generated _____ between the molecules of water and salt with molecules of activated carbon, and therefore, it is not adsorbed into it.

The molecules of the mixture of potting soil are _____ and therefore _____ the activated carbon.

A clear water solution contains a large number of molecules of _____ and few

molecules of other substances that are dissolved in the water.



Observations

Part Two: What is the mechanism behind activated carbon?

Development of the experiment:

- a. Pour the raspberry concentrated solution into the second funnel, and describe what happens.

What is the observation of this experiment?

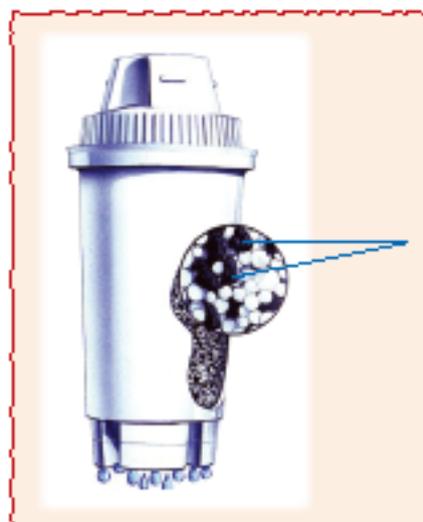
What is the hypothesis of this experiment?

What is the conclusion of this experiment?

- b. Activated carbon is made up of tiny particles, or granules. Importantly, as the pellet size gets smaller, the ratio of its outer surface area to its volume increases. What is the relationship between this and the disappearance of the color of the raspberry juice concentrate? Explain.

- c. The smaller the granule of a substance, the greater its capacity for adsorption. Can you come up with other situations in which this phenomenon occurs?

- d. In the previous activity, you learned that although water appears transparent, it may still contain substances that are harmful to your health. In this activity, the process of water filtration made the particles of raspberry vanish. Do you think that the clear water is suitable



*activated
carbon
granules*

Activity 2:

Quality of the drinking water at home



for drinking, after being filtered? Why?
It is known that good quality drinking water is vital to maintaining our health. Frequently, the public is warned by the media about possible contamination of drinking water. Some people believe that manufacturers of water purification systems, or bottled water (mineral water) contribute to the conflicting views on water. However, we can't ignore the news about the contamination of water sources in different regions of the world, which appear almost weekly on the news and in the media. Likewise, in the last few decades, various serious events related to microbiological and chemical contamination of water have occurred, such as polio epidemics, cholera, and other diseases in people and livestock

due to the ingestion of contaminated water from rivers.



Surfing the Internet

Part One: Search the Internet for one or two articles published in local or national newspapers about water quality and drinking water in the United States.

Answer the following questions:



Questions

1. Why was the article published in the newspaper?
2. Based on the articles you read, come up with three questions you have about drinking water quality.
3. Is there a real problem with the quality of water we drink, or do the articles discuss accidents and damage to the water supply as isolated cases that don't allow us to make generalizations?



Part Two: Locate an additional article on the Internet with scientific data about the quality of drinking water that you consume. Describe specifically, the quality of drinking water in the United States.

- a. Carefully read the article, and then complete the activities below:
 1. Write down the author of the article.
 2. Note whether the author is an expert on the subject.
 3. Use a highlighter to mark the concepts that you do not know or understand in the article. Copy these concepts to your notebook.
 4. Use a different color highlighter to mark the concepts that you already know. Copy these to your notebook.
 5. Use a different color highlighter to mark the most important statements in the article.
- b. Record three scientific facts that emerged from the article, and for which you had no prior knowledge.
- c. Record the factors that influence the quality of drinking water in the United States.

The influential factor	How it influences the quality of drinking water

- d. Record the agencies that are responsible for ensuring that citizens get suitable water for drinking.

Organizations	Its role in ensuring the quality of drinking water



Synthesis

Gather each article you read for the earlier tasks, and record ten key statements the authors make in the table below.

Statement	Author

Activity 3:

What do people know about the water quality in the United States?

In this activity, try to find out if friends and family (who live nearby) are aware of the issue of drinking water quality, and their opinion on this question: Is the water in the United States

suitable for drinking? To do this, you should know about the health standards in the United States with respect to drinking water.

The concept of a **“standard”** refers to the maximum concentration of substances and microorganisms that are allowed in the water for it to still be considered potable (safe for drinking). This includes certain physical characteristics, such as being tasteless, odorless, and colorless.

We will conduct the survey according to the following steps:



Step One: What is the scientific knowledge we need to conduct this survey?

1. Why is it important to know the answer to this question? Explain.
2. Make a list of questions whose answers may provide information that will help answer the question. It may help you accomplish this task by considering question words: what, why, how, how much.
3. Among the questions you recorded, mark those that you can answer, based on what you've learned so far.
4. Use a different color to mark the questions which you cannot yet answer, based on what you've learned so far.



Conclusion

5. Fill in the center column of the following table, which corresponds to the standard that defines the maximum concentration of substances allowed in drinking water in the United States, using data found here: <http://water.epa.gov/action/advisories/drinking/upload/dwstandards2011.pdf>
6. Compare the standard of the United States, with the equivalent standard in Mexico (<http://www.salud.gob.mx/unidades/cdi/nom/127ssa14.html>)*.
7. Examine the table, and answer the following questions:
 - a. What three conclusions (at least) can be drawn from an analysis of the table?
 - b. Write down three new questions (at least) about the issue of the quality of your drinking water, which emerged from the analysis of the table.
8. Do the data contained in the table influence the type of survey regarding water that you will carry out? Explain.

* You may also consider the guidelines of the World Health Organization (<http://water.epa.gov/action/advisories/drinking/upload/dwstandards2009.pdf>)

Component	Maximum Level (Standard) in the United States	Maximum Level (Standard) in Mexico
Total solids		500 mg/L
Detergents (active compounds)		0.5 mg/L
Turbidity		< 5 units
pH		6.5 – 8.5
Chloride (Cl ⁻)		250 mg/L
Nitrate (NO ₃ ⁻)		45 mg/L
Mercury ions (Hg ²⁺)		0.002 mg/L
Cadmium ions (Cd ²⁺)		0.005 mg/L
Lead ions (Pb ²⁺)		0.015 mg/L
Bacteria		Zero presence of fecal coliform bacteria
Atrazine		0.003 mg/L
Glyphosate		0.7 mg/L

Units: There are different units for the various measurements to establish the concentration of substances in water. The best known is milligrams per liter (mg/L) i.e., the amount of substances found in milligrams, in a liter of water.

Step Two: Results of the scientific information collected.

1. In order to reach reliable conclusions from the survey conducted, it is important to think carefully about the following:
 - a. What are the objectives of the survey?
 - b. What are you trying to learn from the survey?
 - c. Write at least three questions you would like answered as a result of the survey.
2. What is the population to be surveyed?
Who will participate in the survey? Residents of the building or house where you live, the entire neighborhood, people chosen at random in the street, school students, visitors of all ages in a shopping center, school teachers, family, etc.
3. What are the criteria to determine the population to be surveyed?
4. How many people will participate in the survey? Who will determine the sample size (number of people participating in the survey)?

Step Three: Deciding how to conduct the survey.

1. What type of survey did you choose? Placing a kiosk in a public area, making phone calls, sending letters by mail, survey through a website, etc.
2. How can you adapt the type of survey you chose based on the type of population you want to survey?

Step Four: Drafting the survey questionnaire.

1. Write ten questions on the topic you chose to focus on in your survey.
2. Respond to all questions, and review each one based on the answers given:
 - a. Are the questions on the survey meeting your objectives/goals?
 - b. How appropriate is the degree of difficulty of the questions for the people who will complete the survey?
 - c. Will the information you receive as responses contribute to the process of drawing conclusions?
 - d. What is the degree of difficulty for each question? Do I need extensive knowledge to answer questions?
 - e. Choose five questions, and print them out.

Step Five: Conducting the survey.

Important

1. Give your teacher the first draft, before distributing the survey.
2. To investigate whether the selected questions are clear and appropriate for the goals you've set, we recommend first conducting a survey of only five people, and only after should you address your chosen survey population (the sample).
3. Present to each subject the topic and purpose of the survey.
4. After the interview, remember to thank the respondent for their cooperation and the time they spent.

Step Six: Analysis of survey results.

1. After conducting the survey, it is important to carryout the following activities:
 - a. Summarize the answers you received, and compare them with the answers written in the drafting stage of the survey questionnaire.
 - b. Think about the criteria you will use to classify the answers of your respondents: e.g., age, scientific knowledge, awareness of the issue, level of interest.
 - c. For each answer, write down the conclusions reached by considering the responses from all respondents.
 - d. Next to each answer, write down how the information you received is aligned to the objectives of the survey.
2. How can we use the results of the survey as a basis for preparing a targeted outreach program that addresses the public about the importance of conserving the quality of drinking water?
3. To summarize, it is important to publish the results of the survey in the daily newspapers, or in the school newspaper.

Activity 4:

Who influences the quality of water we drink?

Research Laboratory of Dr. Hydrology



In the previous activities, you learned that the level of turbidity of the water solution is not necessarily an indicator of water quality. The clear water can contain compounds that are harmful to your health, but are not seen with the naked eye. Not all compounds that produce turbidity in the water are dangerous to our health.

Objective of the Activity

For this activity, we will visit the laboratory of Dr. Hydrology, and learn how to analyze the quality of water solutions, and to adjust the quality if needed, for drinking.



Laboratory investigation of water quality

Collect a sample of tap water and characterize it as you did in Chapter 3, on page 104.

Sample Number	Chemical analysis – ion concentration in mg/L		Physical analysis – milliamps
	Concentration of nitrate ions (NO_3^-) Variable to measure water pollution by toxic salts	Concentration of calcium ions (Ca^{2+}) Variable to measure the “hardness” of water	Electrical conductivity Variable to measure water salinity
1			
2			
3			



*Knowledge
Organization*

Activity 5:

Is industrial pollution inevitable? An exercise in asking questions

Following is a story that describes an initiative to create a company. Read it carefully.

In a certain city, there was an initiative to create an industry for the production of dyes. It is known that in the process of the preparation of dyes, the industry uses water-soluble substances whose residues are left behind at the end of the process.



Production zone in an industry

Near the area where they plan to build this industry is a tributary of a river on the banks of which a park has been built, and where the locals tend to go for a walk. The construction industry is rushing, as hundreds of jobs will be provided to people living in the city, who are currently unemployed.

Recently, you were appointed as director of the committee representing the inhabitants of the city. The function of this committee is to prepare a document to determine what impact this industry will have on the environment, and particularly, on the water system. The commission that you lead will ultimately decide whether to go through with the building of this industry.

“At Your Service” is a team of experts who specialize in the preparation of environmental impact surveys (a survey that determines how a project impacts the environment).

The team includes specialists in different areas, such as: environmental quality, geology (study of rocks), ecology (study of living things), hydrology (study of water), economics (money management), chemistry (study of substances), architecture (home design and landscape design).





Questions

What do you see as the important questions to ask the team of experts which you are heading, in order to collect the greatest amount of information? Remember, their responses will help you make an informed decision regarding the construction of the new industry.

Photocopy the table below on an overhead transparency, and write down at least two questions that you will use to address each of the experts. Present the table to your classmates.

Type of Expert	Questions
Environmental quality 	1. _____ 2. _____ 3. _____
Geology (research on rocks) 	1. _____ 2. _____ 3. _____
Ecology (interrelationships between living things) 	1. _____ 2. _____ 3. _____
Hydrology (research on water) 	1. _____ 2. _____ 3. _____
Economy (money management) 	1. _____ 2. _____ 3. _____
Chemistry (research on substances) 	1. _____ 2. _____ 3. _____
Architecture (houses and landscape planning) 	1. _____ 2. _____ 3. _____



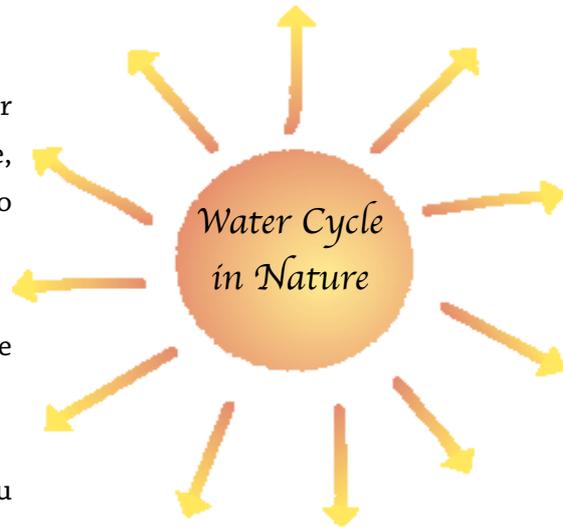
Activity 6:

Knowledge organization using a concept map

How do you build a concept map?

A concept map is a learning tool for organizing your knowledge about a given topic. In the first phase, you will try to remember all the concepts related to the main topic.

Now, we will try to organize our knowledge on the subject of the water cycle in nature.

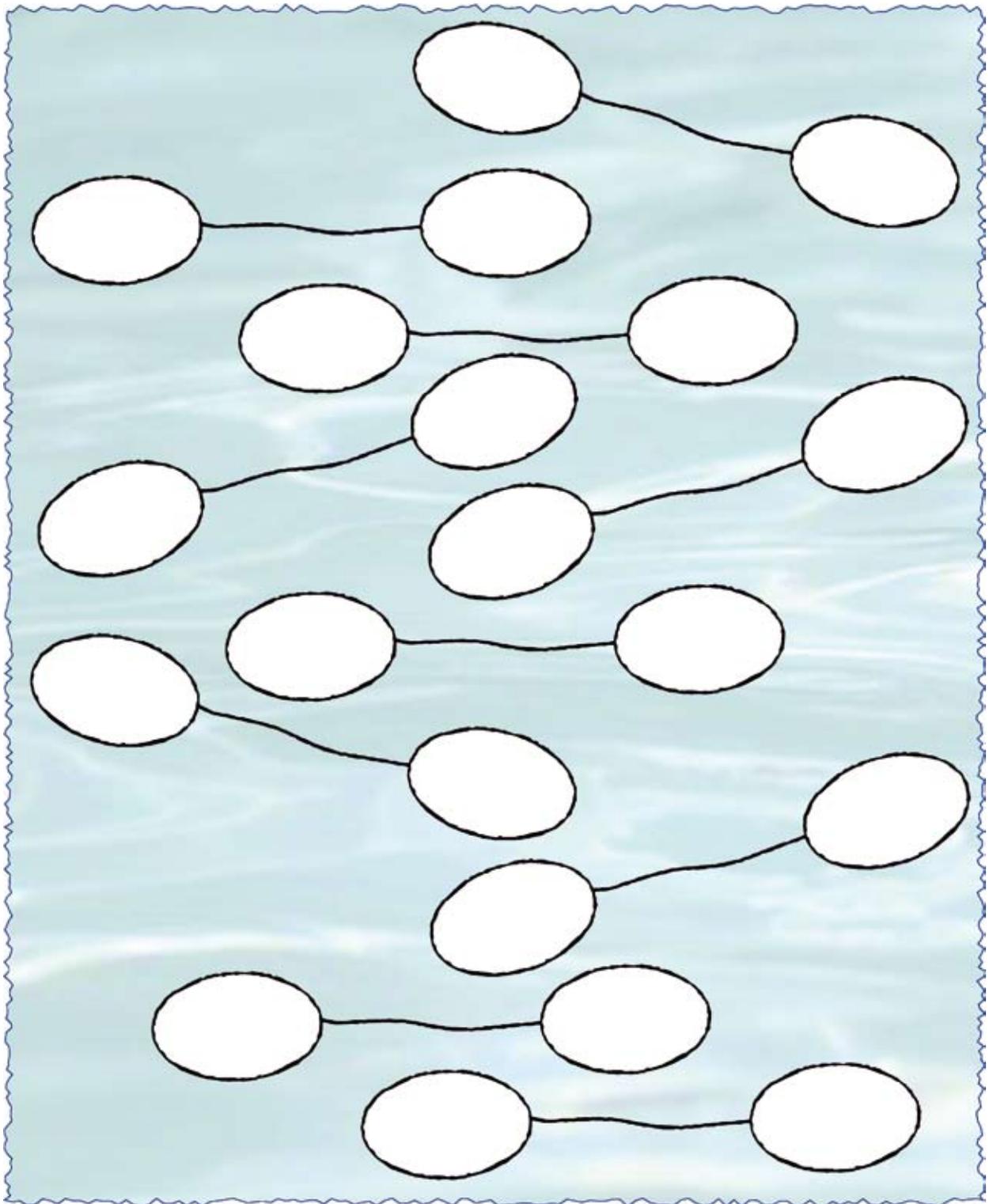


1. For each arrow, write down the concepts that you believe are related to the water cycle in nature.
2. Try to create statements that describe the relationship between two concepts that are included in your concept bank. Use the illustration on the next page. In each circle, write down the concepts, and on the line, write down a phrase or sentence to connect the two concepts. Use the following as an example:



3. Try to create a concept map that describes the various links between the concepts related to the water cycle in nature.

Remember that in a concept map, there is no particular order, and you can begin with any concept you choose. It is important to try to generate the maximum number of connections between different concepts. Creating a concept map is a task in which there is no “correct” or “incorrect” answer. Instead you can create different maps with different conceptual links between the concepts.



4. Was the development of the concept map enjoyable or difficult for you? Explain.



Synthesis

Activity 7: Synthesis of “The Blue Planet” unit

Workshop for the Resolution of the Water Problems in the United States

A workshop will be organized to analyze the Water System of our country.

For this activity, divide the class into 6 groups, representing six different groups that influence water resources and water quality in the country. These might include:

1. **Health Commission** - Responsible for analyzing the standards for drinking water quality and monitoring its quality and care.
2. **Finance Committee** - Responsible for establishing the distribution of the national budget and the allocation of financial resources for water conservation.
3. **Water Commission** – Responsible for tracking and maintaining the balance of natural water reserves in the country, and for the distribution of water to citizens. It monitors water quality in aquifers, lakes, and rivers. This body warns of future issues associated with water resources, and offers solutions such as desalination, water conservation, and importing water from abroad.
4. **Manufacturer’s Association** – Represents the industries that both consume and pollute water. The Association offers advanced technological treatments which can be applied in industry to prevent the contamination of water sources. It also organizes conferences for the development of environmental awareness.
5. **Green Organizations** – Represents the citizens of the country that warn people about the lack of attention to water problems, and discovers how this lack of attention impacts different organisms. They are also responsible for providing legal advice, and the promotion of laws for environmental conservation, and education for the conservation of natural resources.
6. **Environmental Commission** – Tracks compliance with standards to prevent pollution of water sources.

Task

You must choose one of the groups mentioned previously and collect testimony from the press and websites that represent their position. For the next class, bring in at least one testimony - a fragment of a newspaper article or a website. You will also meet with other students who chose to represent the same group as you, and you will prepare a portfolio of evidence and documents that support your position.

To summarize the activity, each group will present their position and together, will write a proposal with practical solutions to the water problems in your region.

