

Lesson A3–1

Understanding the Water Cycle and Its Importance to the Environment

Unit A. Natural Resources

Problem Area 3. Water

Lesson 1. Understanding the Water Cycle and Its Importance to the Environment

New Mexico Content Standard:

Pathway Strand: Natural Resources and Environmental Systems

Standard: VII: Apply scientific principles to environmental services.

Benchmark: VII-C: Explain well design and groundwater supplies to demonstrate knowledge of hydrology.

Performance Standard: 1. Explain hydrology. 2. Explain geological and meteorological principles affecting groundwater supply. 3. Conduct channel flow analysis.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Describe the water cycle.
2. Describe the physical and chemical makeup of water.
3. Identify bodies of flowing water.
4. Identify bodies of non-flowing water.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Porter, Lynn, et al. *Environmental Science and Technology*. 2nd Edition. Upper Saddle River, New Jersey: Prentice Hall Interstate, 2003. (Textbook and Activity Manual, Chapter 14)

Lee, Jasper. *Natural Resources and Environmental Technology*. Danville, Illinois: Interstate Publishers, Inc., 2000. (Textbook, Chapter 7)

Other Resources. The following resources will be useful to students and teachers:

Turk, Jonathan and Amos Turk. *Environmental Science*. 3rd Edition. New York: CBS College Publishing, 1984.

Arms, Karen. *Environmental Science*. New York: Holt, Rinehart and Winston, 1996.

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters
Copies of student lab sheets
Glasses or cups
Water
Table salt

Terms. The following terms are presented in this lesson (shown in bold italics):

Brackish water
Brook
Canal
Catchment
Channel
Creek
Current
Desalination
Distillation
Drainage divide
Estuary
Evaporation
Flood plain
Freshwater

Lakes
Marshes
Oceans
Ponds
Precipitation
Reservoirs
River
Saline water
Saltwater
Sloughs
Stream
Stream banks
Stream bed
Stream hydrology
Streamflow
Transpiration
Water cycle

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Set up three empty cups or glasses in front of the class. Add plain water to two of the three cups. Leave one plain. Pour a lot of salt into the second sample. In the third glass, mix some of the water from each of the other two samples. Ask them if they'd like to sample any of the water. Hopefully, most of them will say no to the salty samples. Ask them why they think you did this. Tell them that it represents the three categories of saline water you'll be talking about in class today. Have them think about the water samples. If they wouldn't drink the water then how could plants and animals live in the water? Tell them to keep this in mind as you continue with the lesson.

Summary of Content and Teaching Strategies

Objective 1: Describe the water cycle.

Anticipated Problem: What is the water cycle?

- I. The **water cycle** is the movement of water from the earth to the atmosphere and back to the earth. It is also known as the hydrologic cycle. This is a continuous cycle used to renew and refresh the water resources on the earth.
 - A. Water moves from the earth to the atmosphere through the processes of evaporation and transpiration. **Evaporation** is the transformation of water from its liquid form to its gaseous form as a result of coming in contact with heat or the air. The process of plants

releasing water through their leaves is called **transpiration**. Hot, windy days cause transpiration to increase. Water can also move from the earth to the atmosphere through combustion and respiration.

- B. Water moves from the atmosphere to the earth through the process of precipitation. **Precipitation** is the moisture from the atmosphere that is returned to the earth in the form of snow or rain.

Use TM: A3–1A to review the concept of the water cycle. Have students sketch the diagram in their notes or give them a copy of the transparency master with the key terms removed. Have them fill it in as you discuss each process.

Objective 2: Describe the physical and chemical makeup of water.

Anticipated Problem: What is the physical and chemical makeup of water?

- II. Water, in its purest form, is tasteless, odorless, and colorless. It is a chemical compound made up of two atoms of hydrogen and one atom of oxygen. Its chemical symbol is H_2O .
- A. Water can be found in three physical states.
1. The solid form of water is called ice. Water freezes at $32^{\circ}F$ or $0^{\circ}C$.
 2. The gaseous form of water is called water vapor or steam. When water boils it turns into water vapor or steam. Water boils at $212^{\circ}F$ or $100^{\circ}C$.
 3. In between the gaseous and solid form, water is in its liquid form.
- B. Water that contains salt is called **saline water**. Sodium chloride, potassium, and magnesium can raise the level of salts in the water. The amount of salt in the water will determine its usefulness. Water that is too high in salt cannot be used for drinking or irrigation. There are three categories of saline water, freshwater, saltwater, and brackish water.
1. Water with less than 3.0 parts per thousand (ppt) of salt is called **freshwater**. Freshwater is most commonly found in drilled wells, streams, and lakes. Only 3 percent of the water on the earth is considered freshwater, of this 3 percent only 1 percent is available for use.
 2. Water with 16.5 ppt or more of salt is called **saltwater**. Some ocean and sea water is as high as 33 to 37 ppt. Saltwater makes up about 97 percent of the earth's water.
 3. A mixture of saltwater and freshwater is called **brackish water**. Brackish water is found where freshwater flows into the ocean or other bodies of saltwater. An **estuary** is the area where a freshwater stream flows into the ocean or a saltwater lake.
- C. There are two main ways that salt water and contaminated water can be turned into usable water. These are distillation and desalination. **Distillation** is the boiling of water and collection of its vapor. The vapor then turns into liquid when cooled. The liquid is pure at this point. **Desalination** is the removal of salt from water. It involves the process of distillation but is not economical on a large scale.

Use TM: A3–1B to review the material covered in this objective. At this point you could have the students name local water resources that are freshwater, saltwater, and brackish water. If none are in your area, bring resource books showing areas where they are located and discuss them.

Objective 3: Identify bodies of flowing water.

Anticipated Problem: Which bodies of water flow?

- III. One of the most important parts of the water cycle is the stream. Streams are useful resources for irrigation, factories, and local water systems. A **stream** is a flowing body of water. Most streams are freshwater and they can flow through a natural or man-made channel.
- A. There are four types of streams. The stream type is determined by the volume and velocity of the movement of water, or **streamflow**. The rate of flow in a stream is called a **current**. The four types of streams are rivers, creeks, brooks, and canals.
 - B. A **river** is the largest stream. Rivers have high streamflows.
 - C. A **creek** is a stream that is smaller than a river. Creeks often flow into rivers, lakes, and oceans.
 - E. A **brook** is a small stream. Brooks often flow into creeks, rivers, lakes, and oceans.
 - F. A **canal** is an artificial waterway built for transportation, to relieve flooding, or to divert the flow of water.
 - G. The study of flowing water and its environment is called **stream hydrology**. In stream hydrology, the physical, chemical, and biological properties of the water and the surrounding environment are tested. The ecosystems, including food webs, are studied. Many ecosystems can be found in streams. Species within the streams survive on nutrients that are provided by the areas surrounding the stream. These nutrients move with the flow of the stream.
 - H. The structure of a stream determines how water moves within the stream and through the earth. A stream is an important part of watershed or **catchment**. The edge of a watershed is known as a **drainage divide**.
 - I. The area through which water flows in a stream is called a **channel**. A channel is usually formed with rock or soil and it is the sides and bottom of the stream. The bottom of the channel is called the **stream bed**, the sides are called the **stream banks**. When a channel is not large enough to hold the flow of water the area that overflows is called a **flood plain**.

Use TM: A3–1C to show a common food web that could be found in a stream. TM: A3–1D shows a cross section of a stream.

Objective 4: Identify bodies of non-flowing water.

Anticipated Problem: What are the bodies of water that do not flow?

- IV. Many bodies of water do not flow. These bodies may be natural or artificial. Non-flowing bodies of water influence the weather and climate of an area. Commerce, food supply, and recreational activities can also be influenced by the non-flowing bodies of water in an area. Bodies of water that do not flow still have water movement. The internal movement is caused by temperature changes and salinity.
- A. The seven types of non-flowing bodies of water are oceans, lakes, ponds, reservoirs, sloughs, marshes, and estuaries.
 - B. **Oceans** are large bodies of saltwater. Oceans cover almost 75 percent of the surface of the earth.
 - C. **Lakes** are bodies of freshwater that are surrounded by land. Lakes vary in size, some are natural and others are man-made.
 - D. **Ponds** are non-flowing bodies of water that are smaller than lakes. Ponds are commonly man-made and used as a source of recreation or for use by livestock.
 - E. **Reservoirs** are large bodies of stored water. Reservoirs are commonly used to generate electric power.
 - F. **Sloughs** are thick, muddy areas of shallow water.
 - G. **Marshes** are areas of land covered with shallow water and plants such as cattails. Marshes do not contain trees and are similar in nature to sloughs.
 - H. Estuaries are areas where freshwater streams flow into the ocean or a saltwater lake.
 - I. As in flowing streams, non-flowing bodies of water may contain a variety of ecosystems. The ecosystems at the bottom of the body of water will vary from those at the top. This is due to the varying water temperature, salinity, and other characteristics.

Use TM: A3–1E to review the seven types of non-flowing bodies of water.

Review/Summary. To review and summarize the information in this lesson, have the students define the terms and answer the anticipated questions.

Application. To apply the objectives in this lesson, refer to Chapter 14 of the *Environmental Science and Technology Activity Manual*.

Evaluation. Use the following sample test to evaluate the students' comprehension of the objectives covered in this lesson.

Answers to Sample Test:

Part One: Matching

1 = j, 2 = h, 3 = a, 4 = c, 5 = d, 6 = e, 7 = b, 8 = f, 9 = i, 10 = g

Part Two: Completion

1. freshwater, saltwater, brackish water
2. hydrologic
3. stream hydrology

Part Three: Short Answer

1. The water cycle is the movement of water from the earth to the atmosphere and back to the earth. It is also known as the hydrologic cycle. This is a continuous cycle used to renew and refresh the water resources on the earth. Water moves from the earth to the atmosphere through the processes of evaporation and transpiration. Evaporation is the transformation of water from its liquid form to its gaseous form as a result of coming in contact with heat or the air. The process of plants releasing water through their leaves is called transpiration. Hot, windy days cause transpiration to increase. Water can also move from the earth to the atmosphere through combustion and respiration. Water moves from the atmosphere to the earth through the process of precipitation. Precipitation is the moisture from the atmosphere that is returned to the earth in the form of snow or rain.
2. The seven types of non-flowing bodies of water are oceans, lakes, ponds, reservoirs, sloughs, marshes, and estuaries.

Test

Lesson A3–1: Understanding the Water Cycle and Its Importance to the Environment

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | |
|------------------|------------------|
| a. precipitation | f. transpiration |
| b. estuary | g. saline water |
| c. distillation | h. stream bed |
| d. stream banks | i. stream |
| e. ocean | j. desalination |

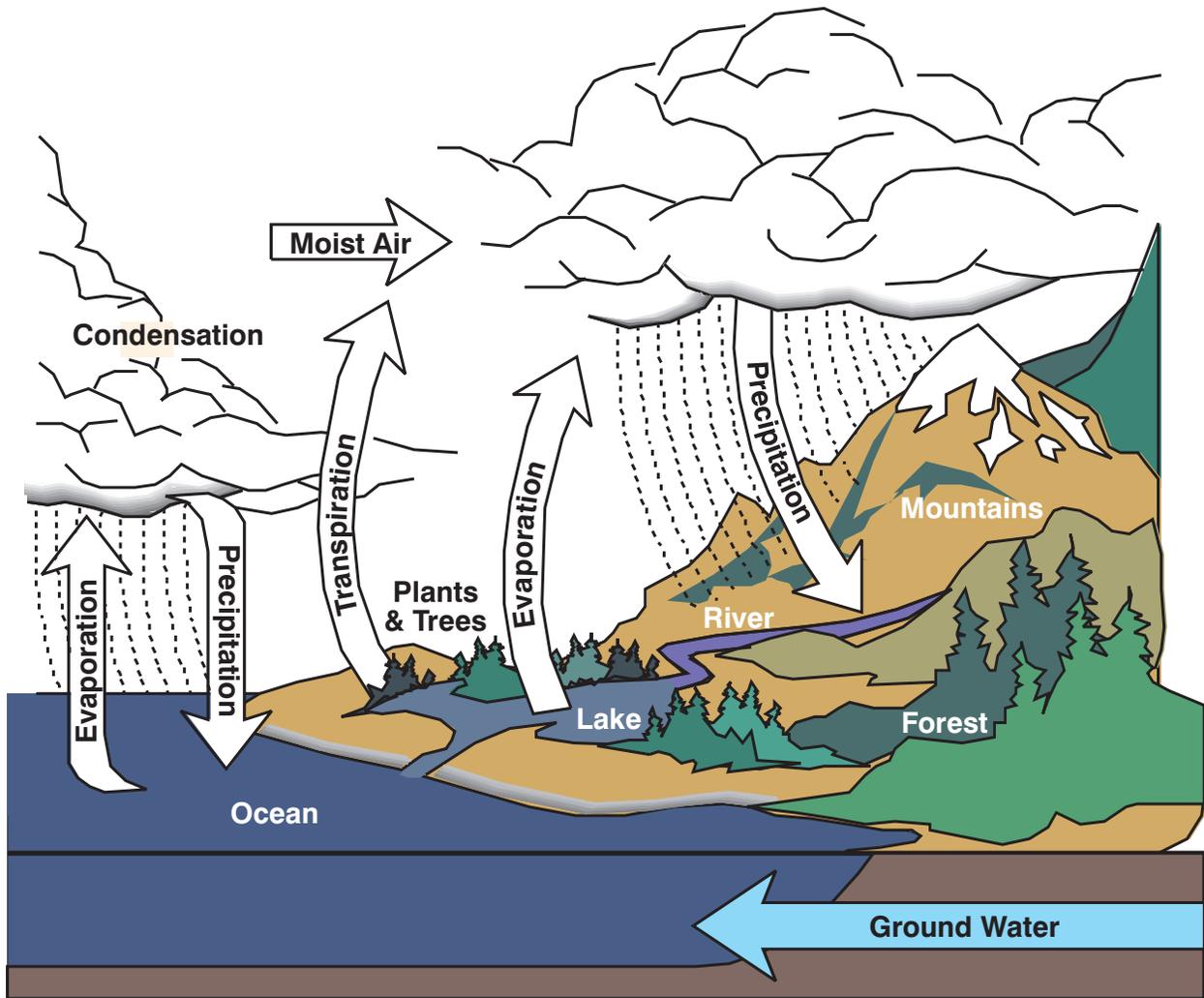
- _____ 1. Removal of salt from water.
- _____ 2. The bottom of a channel.
- _____ 3. Moisture from the atmosphere that is returned to the earth.
- _____ 4. Boiling of water and collection of its vapor.
- _____ 5. The sides of a channel.
- _____ 6. A non-flowing body of water.
- _____ 7. The area where a body of freshwater flows into a body of salt water.
- _____ 8. The process of plants releasing water through their leaves.
- _____ 9. A flowing body of water.
- _____ 10. Water that contains salt.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. The three types of saline water are _____, _____, and _____.
2. The water cycle is also known as the _____ cycle.
3. The study of flowing water and its environment is called _____.

THE HYDROLOGIC CYCLE

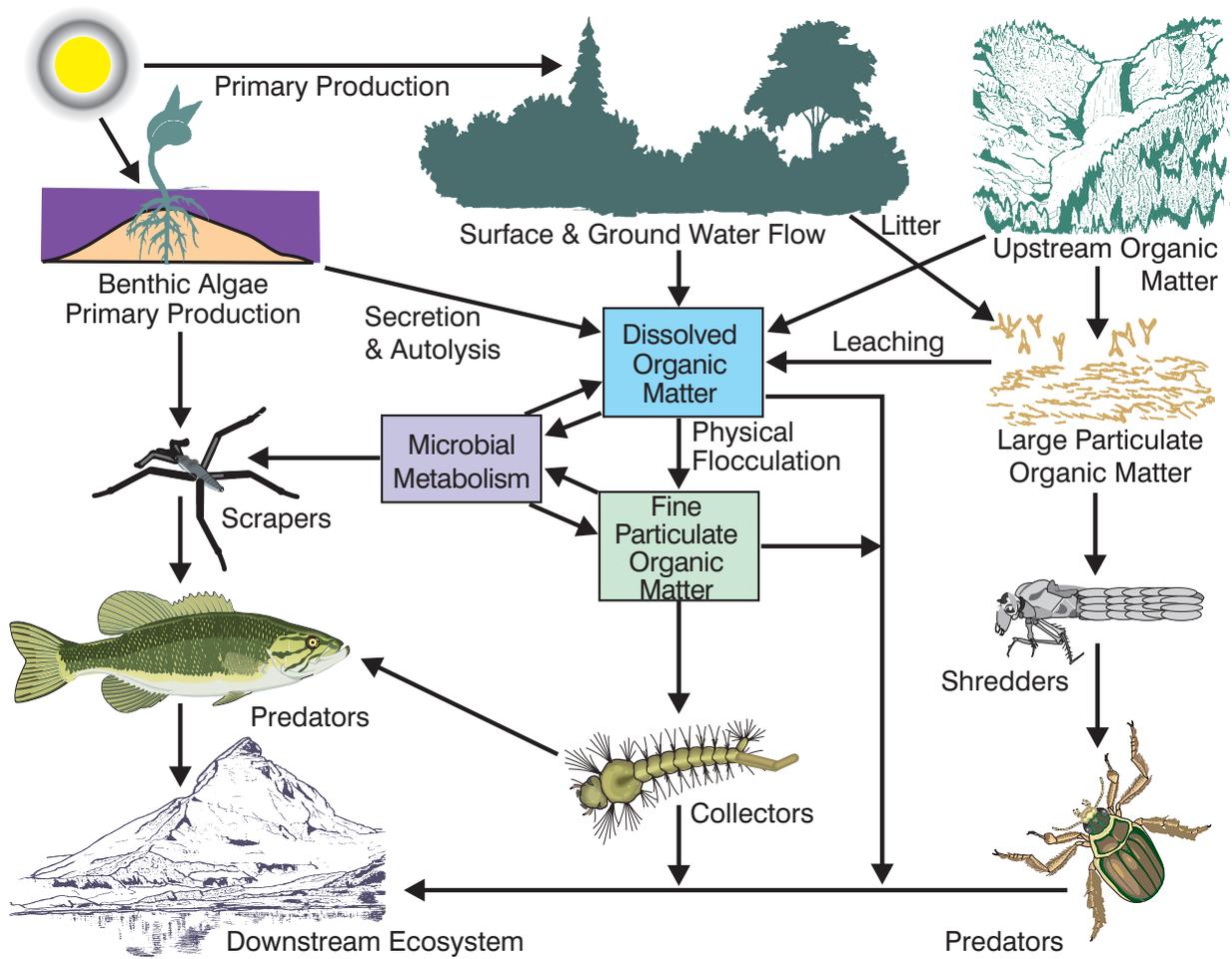


(Courtesy, Interstate Publishers, Inc.)

WATER

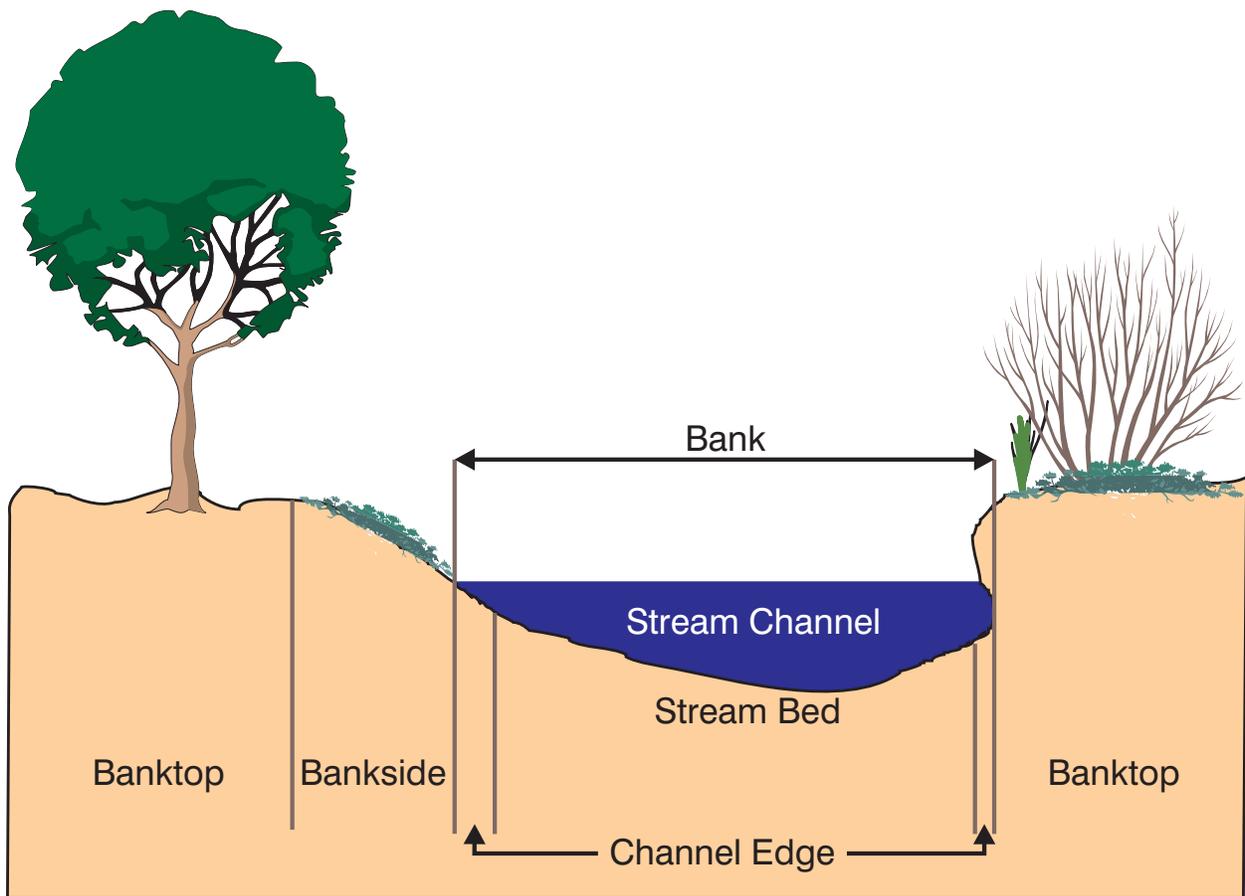
- ◆ **Chemical Formula: H₂O**
- ◆ **Three physical states**
 - Solid-ice
 - Liquid-water
 - Gas-water vapor/steam
- ◆ **Saline water**
 - Freshwater
 - Saltwater
 - Brackish water
- ◆ **Salt water →→→ usable water**
 - Distillation
- ◆ **Desalination**

FOOD WEB IN A STREAM



(Courtesy, Interstate Publishers, Inc.)

CROSS-SECTION OF A STREAM



(Courtesy, Interstate Publishers, Inc.)

NON-FLOWING BODIES OF WATER

- ◆ Oceans
- ◆ Lakes
- ◆ Ponds
- ◆ Reservoirs
- ◆ Sloughs
- ◆ Marshes
- ◆ Estuaries