H2O4U

Learning Unit Lesson Plans for Grades 6-8

Lesson 1

Mission: Access Water—Colorado River

Time: 90-minutes

Content Areas: Science, Social Studies, Language Arts, Workplace Skills

Lesson Overview/Purpose

The purpose of this lesson is to introduce you to the how Arizona accesses one of its most critical and vital natural resources—water! During the first session, you will learn about the Colorado River Basin (CRB) the disputes that took place between the 1920s and 1970s between states regarding who should get to use water from the CRB. You will learn how those disputes were resolved and how Arizona benefited. Finally, you will learn about the Central Arizona Project, a comprehensive water delivery and conservation system, which was established to transport Arizona's allocation of Colorado River Basin water throughout Maricopa, Pinal, and Pima counties via the Central Arizona Project.

Objectives

At the end of the lesson you will be able to:

- Organize information using a tree map and create a timeline highlighting key dates and events regarding the history of the Colorado River Basin.
- Analyze and categorize components of the Central Arizona Project's water delivery system.

Vocabulary

• Acre Foot	• Agricultural	• Aqueduct
• Aquifer	• Basin	• Hydrology
• Municipal	• Percolate	• Recharge

Online Resources

- CAP Videos: YouTube Channel

Supplies/Materials/Equipment

- Internet connection and computer
- Notebook for journal entries
- Handouts provided in the lesson

Procedures

Step 1:

- Review key vocabulary that will be addressed in this lesson.

Step 2:

- Read part one of ***A Brief History of the Colorado River Basin.***
- Analyze the 1920s census data on the chart provided.
- Based on the data, think about how you would divide the 15 million acre-feet and record.

Step 3:

- Read part 2 of ***A Brief History of the Colorado River Basin.***
- Use a highlighter to identify each of the areas mentioned on the ***Colorado River Map***.

Step 4:

- Using the information in the passage and the ***Tree Map*** as a guide, create a ***Timeline*** depicting key events taking place during the following years, as part of the Colorado River Compact: 1922, 1928, 1935, 1944, and1968.
- Draw a picture in the frame and use the blank line below each frame to write a brief caption identifying the event.

Step 5:

- Watch the video titled Welcome to Central Arizona Project

- Read the CAP Recharge StoryMap
- Use the map on the next page to track parts of the Central Arizona Project's water delivery system highlighted in the videos.

Step 6:

- Summarize your learning by responding to the following questions in your journal.
    - What were some reasons for the debate over the Colorado River water resource in the 1920s?
    - What factors did you consider when solving the problem?
    - How might the lack of water to the various states affect the quality of life? Water quality? Population density?
    - What might be some of the economic advantages for a state to have large quantities of water? Disadvantages?
    - Why did it take Arizona so long to sign the Compact?
    - What economic effects do you think the allocated water has had on each state, both positive and negative?
    - Based on the 2007 census data, do you think the water allocations had an effect on the population growth within each state, decades later? Explain your answer.
    - What is the main goal of the Central Arizona Project?
    - What is recharging? Why is it necessary?
    - Why do you think CAP banks almost a third of the water underground?

Lesson 1—Activity 1: Review the key vocabulary that will be addressed in this lesson.

Vocabulary List

Acre-Foot	**a • cre-foot** *n* 1. The volume of water that would cover an area of one acre to a depth of one foot, equivalent to 1,244.5 cu. M/43,560 cu. ft. 2. The equivalent of 325,851.43 gallons
Agricultural	**ag •ri·• cul • tur • al** *adj* 1. involving or relating to agriculture 2. with farming as the dominant way of life
Aqueduct	**aq • ue • duct** *n* 1. a pipe or channel for moving water to a lower level, often across a great distance 2. a structure in the form of a bridge that carries a canal across a valley or river
Aquifer	**aq • ui·• fer** *n* a layer of permeable rock, sand, or gravel through which groundwater flows, containing enough water to supply wells and springs
Basin	**ba • sin** *n* 1. a broad area of land drained by a single river and its tributaries, or draining into a lake 2. any depression in the Earth's surface that contains water 3. a bowl-shaped depression on land or on the ocean floor into which sediments may be deposited

Hydrology	**hy • drol • o•• gy** *n* the scientific study of the properties, distribution, use, and circulation of the water of the earth and the atmosphere in all of its forms
Percolate	**per•• co•• late** *v* 1. vi to pass slowly through something or spread throughout a place
Municipal	**mu•• nic•• i•• pal** *adj* 1. relating to a town, city, or region that has its own local government
Recharge *	**re • charge** *vt* 1. the addition of surface water to an aquifer. 2. natural recharge occurs when naturally occurring surface water infiltrates through the unsaturated zone (vadose zone) and is stored in an aquifer as groundwater. 3. artificial recharge is an engineered system (either natural or human designed system) designed to store surface water in an aquifer. Artificial recharge occurs in two ways: surface infiltration and direct injection.

Sources:

1. Encarta® World English Dictionary © 1999 Microsoft Corporation. Developed for Microsoft by Bloomsbury Publishing Plc.
2. CAP *

Lesson 1—Activity 2: Read the following passage.

Part 1: A Brief History of the Colorado River Basin

Located in the southwestern United States and northwestern Mexico, the Colorado River is 1,450 miles (2,330-kilometer) long with its headwaters in the Rocky Mountain National Park in north-central Colorado. The river is the primary source of water for a region that receives little annual rainfall. More than 1,000 years ago, Native Americans irrigated their crops with the waters from the river.

The Colorado River system, including the Colorado River, its **tributaries**, and the lands that these waters drain, is called the Colorado River Basin, or **watershed**. The Basin drains an area of 246,000 square miles (637,000 square kilometers), including parts of seven western U.S. states (Wyoming, Colorado, Utah, New Mexico, Nevada, Arizona, California) and Mexico. Three-fourths of the Colorado basin is federal land comprised of national forests, national parks, and Indian reservations. The drainage basin's total runoff is about 700 cubic meters (24,700 cubic feet) per second. It is the international boundary for 17 miles (27 kilometers) between Arizona and Mexico.

During the early 1900s, the states sharing the basin debated for shares of the Colorado River. In 1922, representatives from the seven states and the United States government created a compact allocating 15 million acre-feet to be shared by the states.

What would you do?

- Take a look at the 1920s census data on the table on the next page.
- Based on the data, think about you would divide the 15 million acre-feet.
- Record your allocations for each state below.

Arizona:	California:
Colorado:	Nevada:
New Mexico:	Utah:
Wyoming:	

1920s Census Data for the Seven Colorado River Basin States

State	Statehood Year	Population 1920	Population 2007	Density* 1920	Density* 2007	Urban Residents 1920	Rural Residents 1920	Value of Crops (per square acre)
Arizona	1912	334,162	6,338,755	2.9	45	35.2	64.8	$102.49
California	1850	3,426,861	36,553,215	22.0	217	68.0	32.0	$137.06
Colorado	1876	939,629	4,861,515	9.1	41	48.2	57.8	$51.48
Nevada	1864	77,407	2,565,382	0.7	18	19.7	81.3	$37.41
New Mexico	1912	360,350	1,969,915	2.9	15	18.0	82.0	$48.74
Utah	1896	449,396	2,645,330	5.5	27	48.0	52.0	$59.43
Wyoming	1890	194,402	522,830	2.0	5	29.5	70.5	$30.76
United States	--	105,710,620	304,105,724	35.5	--	51.4	49.6	--

* Number of Persons per Square Acre (population/square miles)
Source: U.S. Census Bureau

Lesson 1—Activity 3: Read the following passage. Use the *Colorado River Basin* map and the "tree map" to highlight key areas and information provided in the passage.

Part 2: A Brief History of the Colorado River Basin

In 1922, representatives from the seven states and the U.S. government created the Colorado River Compact, which divided the states into upper and lower basins with an annual allocation of 7.5 million acre-feet to be split among the states within each basin.

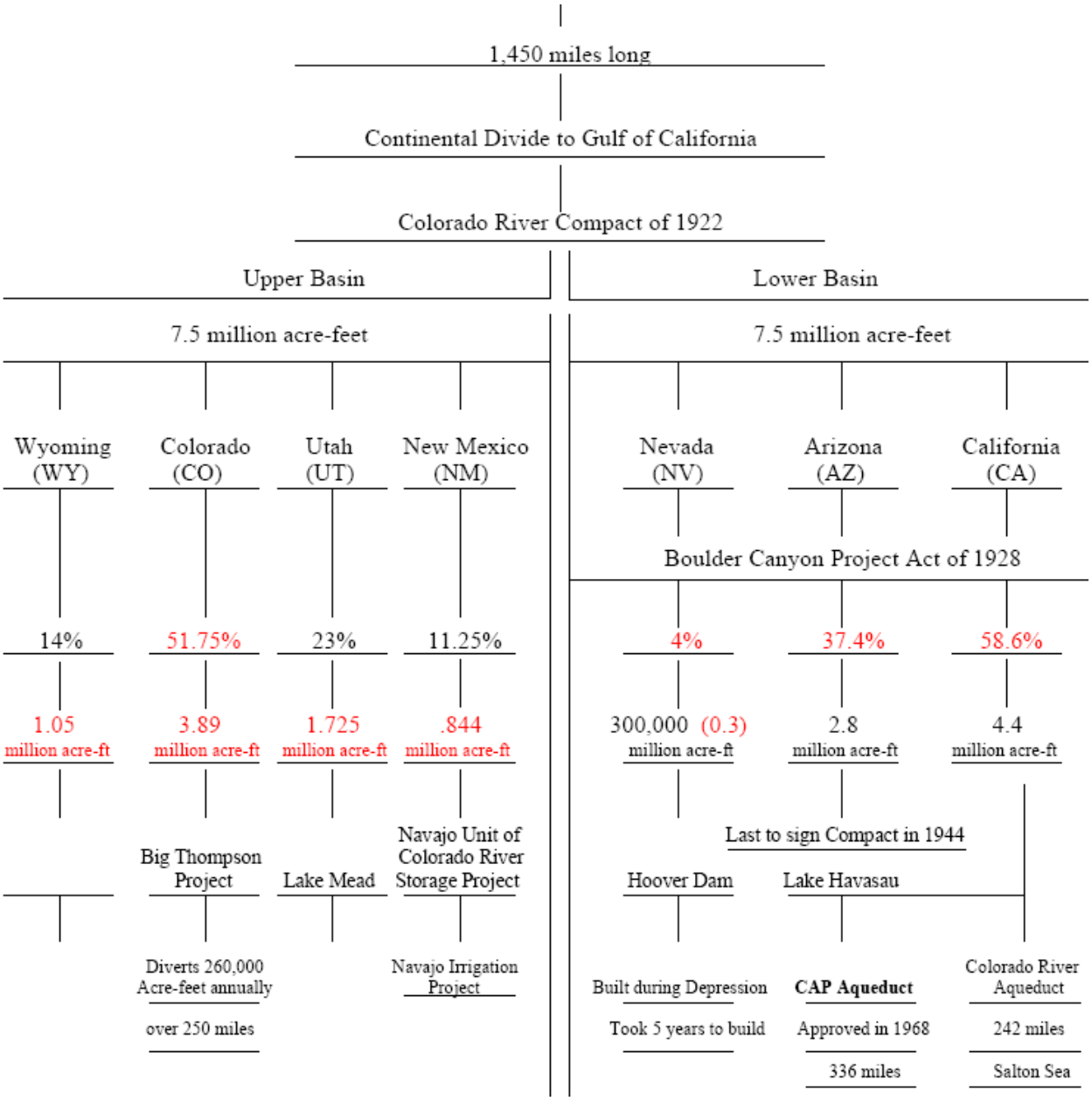
Political and legal interstate disagreements ensued over the next 22 years, with Arizona being the last to sign the compact in 1944, ensuring a yearly allotment of 2.8 million acre-feet of water for the state. As part of the Boulder Canyon Project Act of 1928, California was provided with an annual allocation of 4.4 million acre-feet and Nevada with 300, 000 acre-feet.

As a result of these Acts, various dams, lakes and aqueducts were formed with water feeding from the Colorado River Basin. Lake Mead a popular United States recreation site, located in the upper basin state of Utah, is created by the Hoover Dam, which holds Colorado River water as it exits the Grand Canyon. As the river travels south it meets the Central Arizona Project's (CAP) aqueduct and the Colorado River Aqueduct (CRA). The CAP aqueduct diverts water 336 miles east and then south from Lake Havasu to Tucson, while the CRA aqueduct diverts the river water 242 miles west across the Mojave and Colorado Deserts and south to the Salton Sea (an inland salt-water lake) in California.

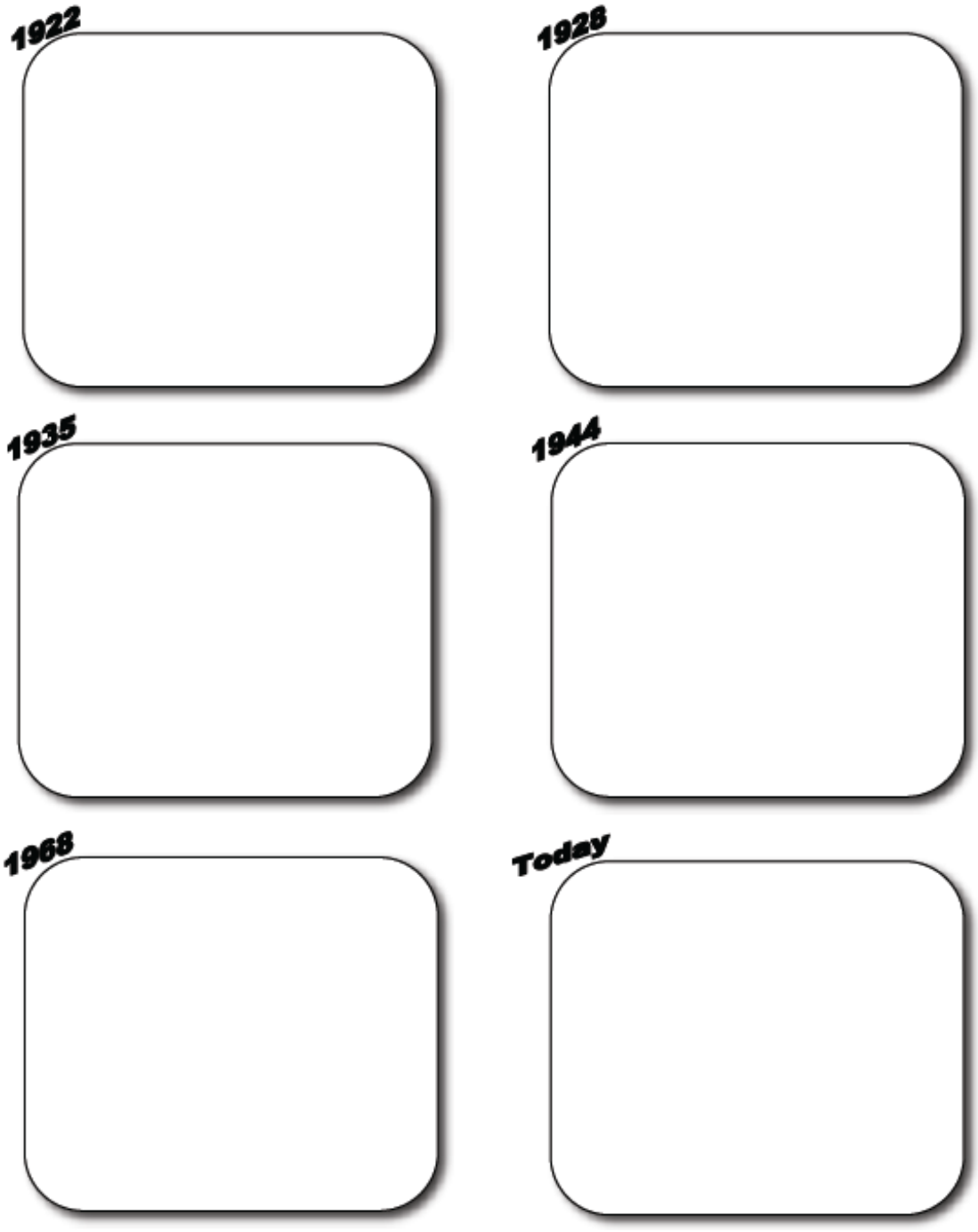
Colorado, Utah, New Mexico, and Wyoming make up the four upper basin states. Colorado has the largest share of upper basin water allocation, with Utah at 23%, Wyoming at 14%, and New Mexico with 11.25%. The Big Thompson Project, located in Colorado stores, regulates, and diverts water from the Colorado River on the western slope of the Continental Divide to the eastern slope of the Rocky Mountains. The upper basin also encompasses the Navajo Indian Irrigation Project, situated in on part of the Navajo Indian Reservation located in Northwestern New Mexico. The Project, built by the U.S. Bureau of Reclamation, is used exclusively for Navajo lands on or next to the reservation.

Colorado River Basin Map

Colorado River Basin



Lesson 1—Activity 4: Use the information in the passage and the "tree map" to create a timeline depicting and labeling key events in the history of the Colorado River Basin, using either the frames below or on a separate paper.

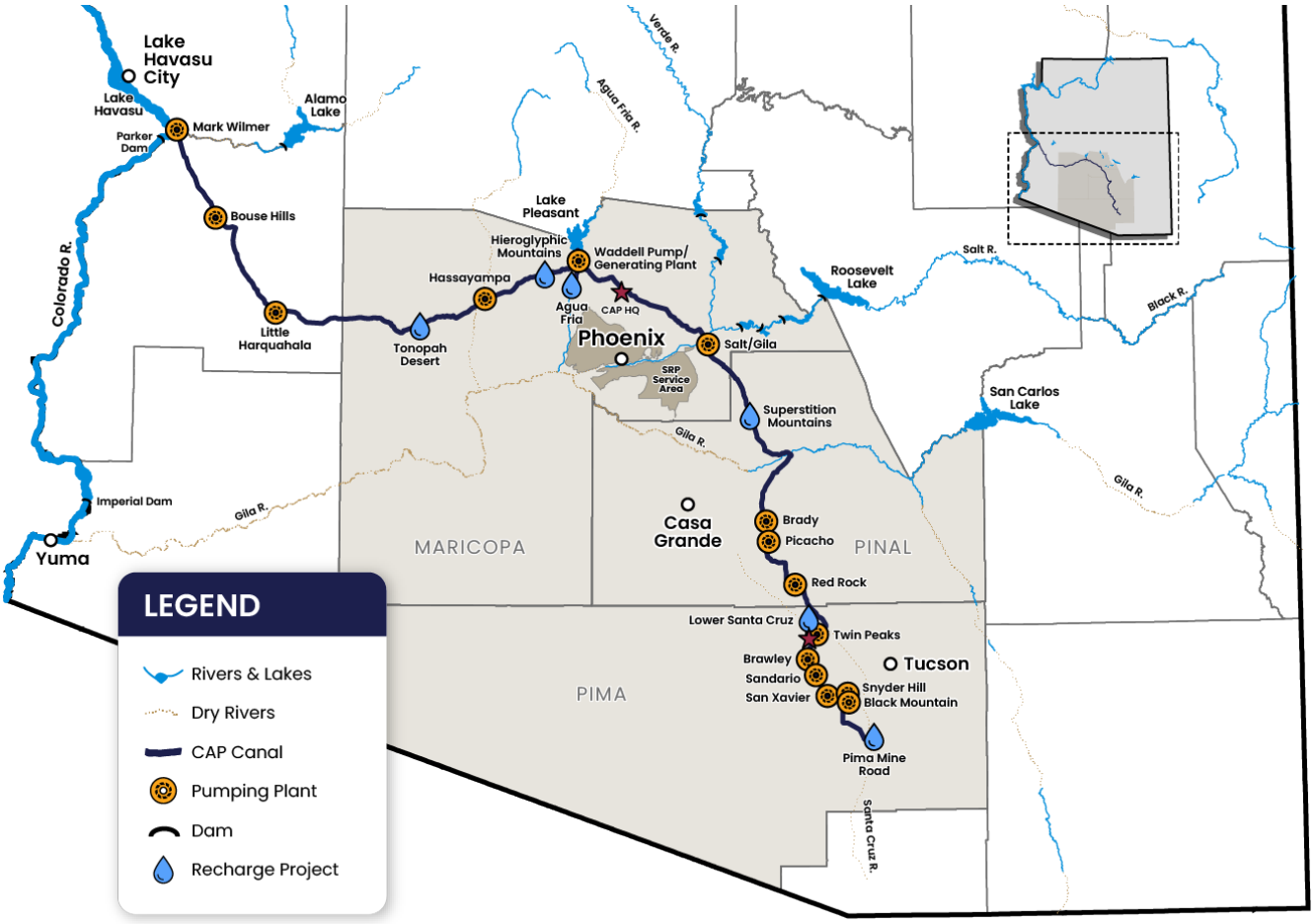


Lesson 1—Activity 5: Read/view the following resources:

- Welcome to CAP video
- CAP Recharge StoryMap
- CAP System StoryMap

Use the map on the next page to track parts of the Central Arizona Project's water delivery system highlighted in the videos.

Central Arizona Project Water Delivery System Map



Lesson 3—Activity 2: Read CAP Canal Safety Challenges. Then, a list of "things" people should and can do to safeguard the canals in the space below.

CAP Canal Safety Challenges

The Lands Department is responsible for managing all the properties owned and operated by CAP. Such properties include: remote, mountainous terrain; vast open deserts; farm and grazing lands; and suburban environments.

Originally constructed in rural areas, canals are now being surrounded by urban growth and development. This growth and development has presented the Lands Department with challenges, including:

- Trespassing
- Illegal dumping
- Off-road ATV
- Dust Control
- Target Shooting
- Graffiti
- Encroachments

Water Depth and Flow

While the canal waters appear to be calm and dauntless, most people do not realize that the average depth of the CAP canals is 18 feet; the concrete sidewalls are steep and slippery; and flow rates run about 3,000 cubic feet per second or 2 miles per hour.

Vandalism/Theft

CAP has installed security fencing around the canals to prevent entry into the hazardous area by both people and wildlife. When vandals cut the security fencing, it creates holes for small children and wildlife to enter the hazardous area.

Thieves and vandals will often cut through the security fencing to gain access to the canal. In the process they destroy or damage equipment or property. Theft often includes the removal of copper and other valuable metals.

Target shooting not only poses a safety hazard to those nearby the canal, but can also cause significant damage to equipment and other structures. Other common forms of vandalism include graffiti and stolen cars that have been dumped into the canal.

Trespassing

This can often take the form of operating ATVs and motorcycles on the property. Such activity can cause major damage to area vegetation and cause significant dust pollution.

CAP is responsible for maintaining dust pollution on the properties and can be penalized for violation, no matter what the cause.

Encroachments

Some people mistake the chain link fencing for CAP's property boundary lines. Unfortunately, this often results in encroachments by developers and new homebuilders. Typical encroachments include: block walls, fences, driveways, walkways, and landscaping.

Illegal Dumping

Often people will dump hazardous waste items, such as oil, paint, construction or landscaping debris, and industrial solvents. This creates a problem, as the chemicals can contaminate the water and are extremely costly to remove.

Trail Development

CAP boundaries are can be located up to ½ mile away from the canal security fencing and about 10-20 feet away on the south or west side. The narrower boundary has been designated for walking and bike paths, and trails to be enjoyed by people residing near the canal. While CAP can facilitate the construction of these upgraded recreational areas, they do not have the legal authority to develop, secure, or maintain them. Developers must incorporate these recreational paths into their development plans, if agreed upon by the municipality. However, it must be decided who will be responsible for the maintenance and oversight of the areas before the developer can proceed with the plans. CAP can only make these agreements with another governmental agency. Often these are homeowners' associations.

Lesson 3—Activity 3: Summarize your learning by creating a brochure to educate others about the dangers of the canal and encourage them to behave appropriately when near canals. Use the space below to plan your brochure. (Note: Ask your teacher to show you some examples of brochures to help you get started).