

**The Santa
Cruz River,
Its People and
Environment**

**A Fourth through Eighth Grade
Teacher's Guide**

P.A.R.K.S.

Parks as Resources for Knowledge in Science

The Santa Cruz River, Its People and Environment

A Fourth through Eighth Grade Teachers' Guide

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SANTA CRUZ VALLEY
UNIFIED SCHOOL
DISTRICT # 35



Friends of the Santa
Cruz River



U.S. Fish and Wildlife Service

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The meeting of the Indians and the missionaries brought profound changes. Through listening to a story and matching activities, students will classify, compare and contrast introduced and native goods and discuss how they both helped and hurt the Indians and the environment.

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2 FERNANDO'S BIG ADVENTURE

Students will follow a storyline while participating in a science experiment that defines water pollution and demonstrates how human activities affect water quality. We will also discuss Santa Cruz River issues, how current human practices affect water quality and potential solutions.

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3 AN APACHE WAY OF LEARNING

Through participation in one or more activities, students will gain a personal relationship to their environment while learning about how the historical Apache people related to their natural environment.

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4 RAILROADS, CATTLE, COTTON FIELDS AND THE ENVIRONMENT

Students will gain an understanding of the local environment through time by participating in a game that demonstrates how historical events affected the natural environment in the Santa Cruz Valley.

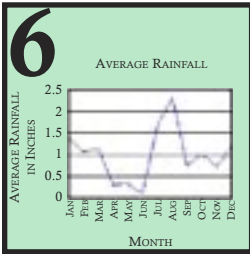
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SANTA CRUZ RIVER CARDS

Students will participate in activities that enable them to identify and review general characteristics of various animals (amphibians, arachnids, birds, insects, mammals and reptiles) found along the Santa Cruz River.

Page 5.1



WHY THE SANTA CRUZ?

By graphing rainfall and temperature patterns and comparing data in two specific sites, students will learn how environmental conditions affected human settlement along the Santa Cruz River.

Page 6.1



PEOPLE AND THEIR ENVIRONMENT

Students will hear accounts of the river environment during different time periods, visualize and depict, through drawing, each time period and record and discuss the potential impact people had on the environment of the Santa Cruz Valley.

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RIVER ISSUES AND YOU

Students will learn about specific issues relating to the Santa Cruz River, assert their opinion about each and participate in a debate using knowledge gained.

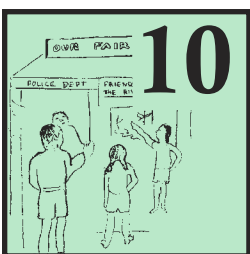
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OWLS AND CROWS

Through playing a physically active quiz game, students will demonstrate their knowledge gained of the river, the environment and local, present-day cultures.

Page 9.1



SANTA CRUZ COUNTY - 2050!

Students will become members of a hypothetical local agency in the year 2050. Based on knowledge gained, they will design and construct an informative display regarding their agency's concerns and the future for the area.

Page 10.1

Foreword

For many years, the Friends of the Santa Cruz River organization has been involved in environmental education efforts and has sponsored many events such as river day camp, tours, school presentations and clean up days. With further involvement and support from the staff at Tumacácori National Historical Park, more effort has been given to providing education regarding the river, resulting in on-going school programs. This partnership led to a generous grant from the Exxon-Mobil Corporation and the National Park Foundation, essentially forming a “marriage” between the park with its cultural resources, the Friends of the Santa Cruz River organization and the river.

The resulting program is designed to teach students about the river’s ecosystem, the local historical cultures and their reliance on the river as well as how they affected its environment. It is also designed to encourage respect and stewardship for the river and its resources. Two teachers’ guides are now available that compliment this one: *Life Along the Santa Cruz River* (primary grades) and *Birds, People and the Santa Cruz River* (middle school grades). In addition, classroom slide presentations, field trips and monitoring programs about the river are available to local schools, K-12.

The teachers’ guide offers activities specifically focused on the Santa Cruz River and its local cultures. The guide has information, resources and activities that will inform and allow teachers to focus on the local environment and historically related cultures, and will enhance the study of science and history. Because the guide is locally based, it introduces students to the beautiful environs in our own back yard and, hopefully, will be able to instill pride and appreciation for the place we call our home. The ultimate goal of the curriculum is to create informed future citizens that love and care for the place in which they live, for generations to come.

Although the activities are based on the environment and the history of the Santa Cruz, the lessons may be modified to encompass other areas, particular southwest river environments.

The lessons in this guide are sequentially ordered to cover aspects of the river and culture appropriate to fourth through eighth grades. The thematic skills included are: social studies, environmental science, multicultural education, art, and critical thinking. The lessons can stand alone, but, if used sequentially, they will give the teacher and students a solid background on the river, its environment and its related cultures.

Note about this Guide

This teachers’ guide is available free to all teachers in all Santa Cruz County schools. It is also available for loan as part of the Encounters Teachers’ Resource Box located in area schools and Pima-Tucson Public Libraries. Educators outside of this area may borrow the book at any time and photocopy all or part for non-commercial educational purposes. Copies will also be distributed by Tumacácori National Historical Park for the cost of reprinting.


For more information contact:

Tumacácori National Historical Park
P.O. Box 67, Tumacácori, AZ 85640
(520) 398-2341, extension 0
tuma_interpretation@nps.gov

or

www.nps.gov/tuma

HOW TO USE THIS GUIDE

LESSON # 	LESSON OVERVIEW A brief outline of the general theme and concepts -- what and how the lesson will be accomplished. Very useful if you wish to scan the different lessons.
Subjects Whereas most of the lessons will be in science, other disciplines such as art, English, etc. may be covered. Standards National Standards will be listed here, while Arizona State Standards will be listed on Pages iii and iv .	LESSON TITLE TEACHER BACKGROUND INFORMATION Useful background information to be read by the teacher and/or students prior to, or as part of, the lesson.
Objectives Measurable actions to be accomplished. Preparation Includes a list of materials and what steps need to be taken to prepare for the lesson.	1. Step by step instructions. 2. Numbered and clearly written. 3. Augmented by graphics and other useful information.
Time The amount of time it will take to complete the lesson. Vocabulary A list of key or foreign words.	Enrichment Suggestions or other activities appropriate to further study lesson concepts or themes. Located at the end of the activity instructions.

LESSON # - MASTER PAGE #	
Master Pages contain activities that are essential to complete the lesson.	
In most cases they are student worksheets and will need to be photocopied.	
Sometimes only a teacher copy will be needed.	

STATE OF ARIZONA - SCIENCE STANDARDS

ACTIVITY	AZ State # 1 N.S.T.A. A SCIENCE AS INQUIRY	AZ State # 2 N.S.T.A. G HISTORY AND NATURE OF SCIENCE	AZ State # 3 N.S.T.A. F SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES	AZ State # 4 N.S.T.A. C LIFE SCIENCE	AZ State # 6 N.S.T.A. C EARTH SCIENCE
1. Spanish Gifts		2SC - F1, PO1	3SC - F3, PO1	4SC - F1, PO1/2	
2. Fernando's Big Adventure	1SC - F2, PO1/2 1SC - E1, PO1/2 1SC - E2, PO1/2	2SC - F3, PO1/2 2SC - E4, PO1	3SC - E3, PO1 3SC - E3, PO1/2/3		
3. An Apache Way of Learning		2SC - F2, PO1	3SC - F3, PO1/2		
4. Railroads, Cattle, Cottonfields and the Environment		3SC - F3, PO1/2 3SC - E3. PO1/2/3	4SC - F1, PO1/2 4SC - F7, PO3 4SC - E7, PO2/3		
5. Santa Cruz River Cards			3SC - F3, PO1/2	4SC - F3, PO1/2 4SC - F4, PO2 4SC - E1, PO1/2	
6. Why the Santa Cruz?	1SC - F3, PO1 1SC - E1, PO4 1SC - E3, PO1/2/3	2SC - E4, PO1	3SC - F3, PO2		6SC - F7, PO3 6SC - E7, PO1

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7. People and Their Environ- ment	1SC - F3, PO2	2SC - F1, PO1 2SC - E2, PO1/2	3SC - F3, PO1/2 3SC - F4, PO1/2 3SC - F1, PO1 3SC - F2, PO1/2/3 3SC - F3, PO1/2 3SC - F4, PO1/2 3SC - E1, PO1 3SC - E3, PO1/3	4SC - F1, PO1/2 4SC - F7, PO3 4SC - E7, PO3	6SC - F5, PO1/2/3 6SC - F6, PO2
8. River Issues and You				4SC - F1, PO1 4SC - F7, PO1/3 4SC - E7, PO1/2	
9. Owls and Crows					
10. Santa Cruz County - 2050!	1SC - E6, PO1	2SC - F3, PO1	3SC - F2, PO1 3SC - F2, PO1/2/3/4 3SC - F3, PO2 3SC - E1, PO1 3SC - E3, PO1/2/3		
River Field Trip to Tumacacori National His- torical Park	1SC - E1, PO4	2SC - E1, PO1 2SC - F3, PO1	3SC - E1, PO1 3SC - E3, PO3 3SC - F1, PO1 3SC - F2, PO1/2	4SC - E1, PO1 4SC - E7, PO1-4 4SC - F1, PO1/2 4SC - F4, PO1/2 4SC - F7, PO1/3	AZ #5 N.S.T.A. B PHYSICAL SCIENCE 5SC - E1, PO1/26 6SC - E7, PO1-4 6SC - E4, PO1/2 6SC - F1, PO1/2 6SC - F5, PO1 6SC - F6, PO1/2

RESOURCES AND REFERENCES

LESSON 1: Spanish Gifts

Seeds of Change: The Story of Cultural Exchange after 1492, Sharryl Davis Hawke and James E. Davis, Addison Wesley Publishers, 1992.

Chilies to Chocolates, Nelson Foster and Linda S. Cordell, eds., Univ. of AZ Press, 1992.

LESSON 2: Fernando's Big Adventure

A Sanitary Code, Rules and Regulations, Solid Waste, Chapter VII, pp. 140-143, Santa Cruz County Health Department, Nogales, AZ 85621, Contact Person: Ben Stepleton, Director, phone: 761-7800.

Friends of the Santa Cruz River, P.O. Box 4275, Tubac, AZ 85646, (520) 398-9093.

Household Hazardous Waste Program, Office of Public Works, Santa Cruz County, Nogales, AZ 85621, Contact Person: Norma Northcross, HHW Coordinator, phone: 761-7800.

Nogales Wastewater Treatment Project, 777 N. Grand Ave., Nogales, AZ 85621, (520) 287-6571.

LESSON 3: An Apache Way of Learning

Sharing Nature with Children (1979), *Listening to Nature (1987)*, *Sharing the Joy of Nature (1989)*, and *Journey to the Heart of Nature (1994)*, Joseph Cornell, Dawn Publications, Nevada City, CA.

What's a Chiricahua and Chiricahua: Much More Than You Think, Roy Simpson, Chiricahua National Monument;

Project Learning Tree, American Forest Council, Wash. D.C.

Ranger Rick's Nature Scope, National Wildlife Federation, Washington, D.C.

LESSON 4: Railroads, Cattle, Cotton Fields and the Environment

Adventures in Arizona, Kate Ruland-Thorne and Linda Lawrence, Thorne Enterprises Publications, Inc., Sedona, AZ, (520) 282-7508.

Arizona: A History, Thomas E. Sheridan, U of A Press, 1995.

Cochise, Edwin R. Sweeney, Univ. of Oklahoma Press, 1991.

Geronimo, Angie Debo, Univ. of Oklahoma Press, 1976.

Hispanic Arizona: 1536-1856, James E. Officer, U of A Press, 1987.

Tubac, Richard Wormser, The Tubac Historical Society, 1981.

LESSON 5: Santa Cruz River Cards

A Natural History of the Sonoran Desert, Arizona-Sonora Desert Museum, University of California Press, 2000.

Birds: A Guide to Field Identification of North America, Chandler S. Robbins, Bertel Bruun and Herbert S. Zim, Golden Books, New York, 1966.

Easy Field Guide to Common Desert Birds, Richard and Sharon Nelson, Primer Publishers, 5738 N. Central Avenue, Phoenix, AZ, 1996.

Field Guide to the Birds of North America, National Geographic Society, 1987.

Mammals of the Southwest Deserts, George Olin and Dale Thompson, Southwest Parks and Monuments Association, 1988.

Watchable Birds of the Southwest, Mary Taylor Gray, Mountain Press Publishing Company, Missoula, MT, 1995.

LESSON 6: Why the Santa Cruz?

Project WET, (Contact Kerry Schwartz at the University of Arizona), 792-9591

Project Learning Tree, 1111 19th Street, Washington, D.C., 20036 or contact Arizona Association for Environmental Education (AAEE), 520/319-1741.

“Kino’s Unforeseen Legacy,” Dr. Thomas Sheridan, *Smoke Signal*, Issue #49, 1988.

LESSON 7: People and Their Environment

A Kino Keepsake, Kieren McCarthy, editor, Friends of the AZ Library, Tucson, 1991;

Arizona, Thomas Sheridan, U of AZ Press, 1995.

The Changing Landscape, James Hastings and Raymond Turner, U of AZ Press, 1965.

“The History of Tubac -- 1752-1948,” Doris Bent, from Tubac Presidio State Park’s archives.

Sonora, Ignaz Pfefferkorn, U of AZ Press, 1989.

Treasure Land: A Story, John George Hilzinger, Arizona Advancement Co., Tucson, 1897.

Tubac through the Centuries, Henry Dobyns, AZ State Museum, Tucson, AZ, 1958, 1959.

They Lived in Tubac, Elizabeth R. Brownell, Westernlore Press, Tucson, 1986.

LESSON 8: River Issues and You

Sonora: Its Geographical Personality, Robert C. West, Univ. of Texas Press, Austin, 1993.

They Lived in Tubac, Elizabeth R. Brownell, Westernlore Press, Tucson, 1986.

Tubac, Richard Wormser, Tubac Historical Society, 1975.

Water in the Hispanic Southwest, Michael C. Meyer, Univ. of AZ Press, Tucson, 1996.

Anza Trail Coalition, P.O. Box 396, Tumacácori, AZ 85640.

Friends of the Santa Cruz River, P.O. Box 4275, Tubac, AZ 85646, (520) 398-9093.

Nogales Wastewater Treatment Project, Nogales, AZ 85621, (520) 287-6571.

LESSON 9: Owls and Crows

Adventures in Arizona, Kate Ruland-Thorne and Linda Lawrence, Thorne Enterprises Publications, Inc., Sedona, AZ, (520) 282-7508.

Arizona: A History, Thomas E. Sheridan, Univ. of AZ Press, 1995.

Hispanic Arizona: 1536-1856, James E. Officer, Univ. of AZ Press, 1987.

Sharing Nature with Children, Joseph Cornell, Dawn Publications, Nevada City, CA, 1979.

Tubac, Richard Wormser, The Tubac Historical Society, 1981.

LESSON 10: Santa Cruz County - 2050!

“Community Profiles” from Tubac, Nogales and Santa Cruz River Valley (see Encounters Box, Green Section, or contact the Chambers of Commerce).

AZ State Government Water Resources
(520) 761-1814.

AZ Department of Agriculture, (520) 287-7887.

AZ Department of Environmental Quality
(800) 234-5677.

AZ Department of Health Services
(800) 221-9968.

AZ State Parks (520) 398-2252.

Nogales Chamber of Commerce, (520) 287-6570.

“Santa Cruz County Study,” a study paper by students of Dr. Don Wilkin, U of A, spring 1996.

Tubac Chamber of Commerce, (520) 398-2704.

U.S. Fish and Wildlife Service, (520) 823-4251;

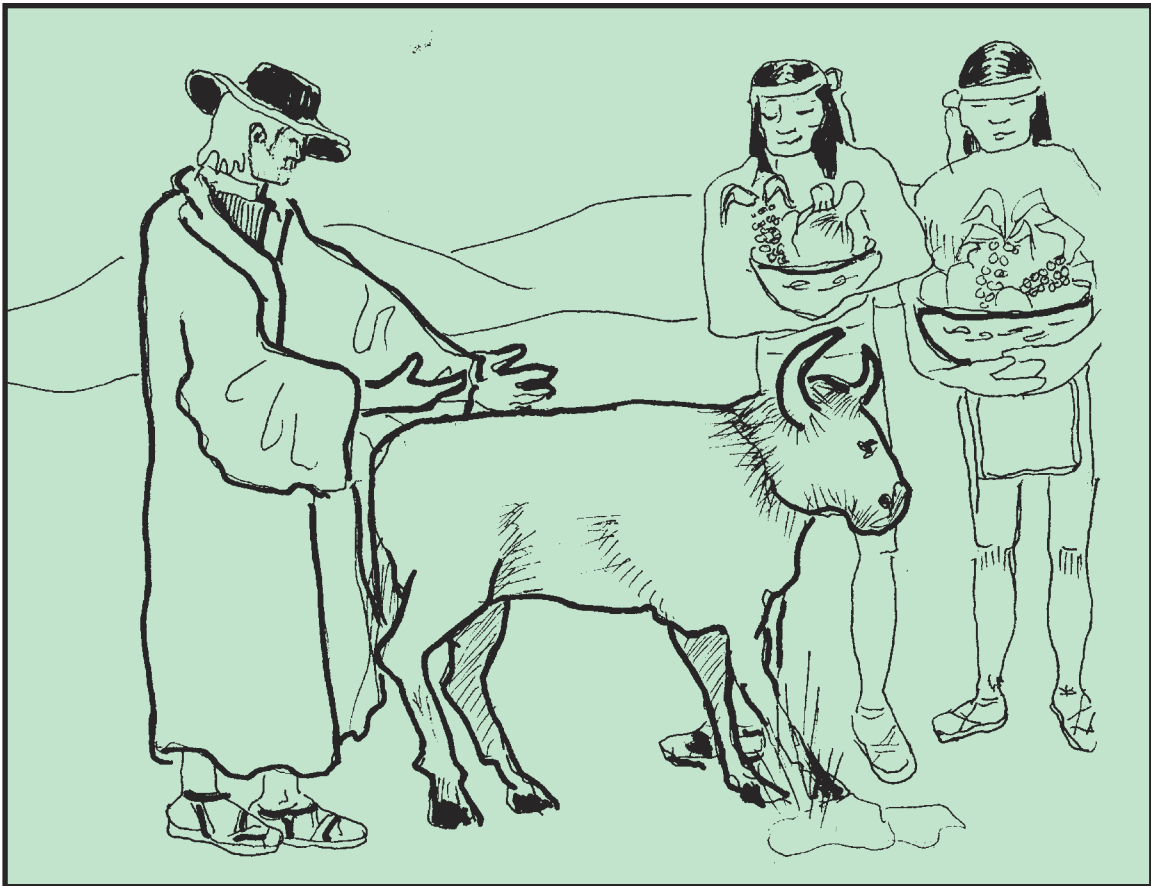
U.S. Forest Service (520) 281-2297.

U.S. Office of Mineral Resources,
(520) 670-5504.

National Park Service, Tumacácori National Historical Park (520) 398-2341.

LESSON 1

SPANISH GIFTS



The meeting of the Indians and the missionaries brought profound changes. Through listening to a story and matching activities, students will classify, compare and contrast introduced and native goods and discuss how they both helped and hurt the Indians and the environment.



LESSON OVERVIEW

The meeting of the Indians and the missionaries brought profound changes. Through listening to a story and matching activities, students will classify, compare and contrast introduced and native goods and discuss how they both helped and hurt the Indians and the environment.

Subjects

Language Arts, Science and Social Studies

Standards

History and Nature of Science
Personal and Social Perspectives in Science
Life Science

Objectives

Students will:

1. Compare and contrast historical with present-day items.
2. Classify introduced versus native food items.
3. Discuss positive and negative implications of introduced goods.

Preparation

Review and make two copies of "Spanish Gifts - Blessing or Curse?" on *Master Pages 1.3 and 1.4*. Copy *Master Page 1.5* for each student.

Time

50 minutes

Vocabulary

crops, drought, European, frosts, immunity, imported, irrigate, livestock, O'odham and ramada.

SPANISH GIFTS

TEACHER BACKGROUND INFORMATION

Food gathering is one of the primary concerns of traditional cultures, whether it be by hunting-gathering or farming. The Spanish brought a new concept of agriculture that would affect the Indians' way of life forever. The question is, was it beneficial, detrimental, or had no effect?

Before historical contact in 1691, the people of the area now known as the Pimeria Alta grew a variety of summer crops along the Santa Cruz River and its tributaries and augmented their diet with hunting and gathering.

With the arrival of Father Kino and his successors, the introduction of cattle, horses and other domesticated animals, as well as year-round wheat and other crops, brought profound change to the people and the environment. It provided the native culture with a more varied and reliable supply of food, augmenting traditional sources.

The concept of ranching provided a meat source while the introduction of metal tools and other technologies made chores easier and faster to accomplish.

In exchange, the Spanish brought back to Europe foods from the new world such as chocolate and chili.

As with many cases of intercultural exchange, there were downsides. The introduction of ranching and technologies led to environmental degradation, and newly introduced plants competed with and displaced native species. Populations increased. The most difficult, however, was the introduction of diseases never before encountered. Epidemics such as smallpox and measles spread havoc and dread to Indians and Spanish. Unfortunately, it was the Indians who were more intimate with the Spanish who suffered most.

FOOD FOR THOUGHT

Ingredients for Curry from India,
Tomatoes for marinara sauce from Italy,
and Potatoes from Ireland

Part 1 - Jigsaw Reading

1. Review the Teacher Background information and “Spanish Gifts - A Blessing and a Curse” on *Master Pages 1.3 and 1.4*. Precut the six Jigsaw readings.
2. Divide the class up into six groups and assign each group one paragraph from “Spanish Gifts - A Blessing or Curse” on *Master Pages 1.3 and 1.4*. Each group's task is to read the paragraph and summarize its content to make a presentation to the rest of the class. (Have those who finish early outline or draw aids to help them in their presentation.)
3. When all groups have finished, have each group summarize their readings to the rest of the class.
4. Summarize the reading and discuss the implications, both negative and positive, of goods introduced by the Spanish.

Part 2 - Who Brought What?

1. Brainstorm and list on the board “Native” versus “Introduced” foods.
2. Hand out and have students complete “Who Brought What?” on *Master Page 1.5*.
3. Review and discuss answers.
4. Introduce and discuss the concept of a “blessing or curse” in relation to introduced products. How did they positively and negatively affect both culture and the environment?
5. Complete the activity by expanding the discussion to include the implications of past and present-day introductions by North Americans.

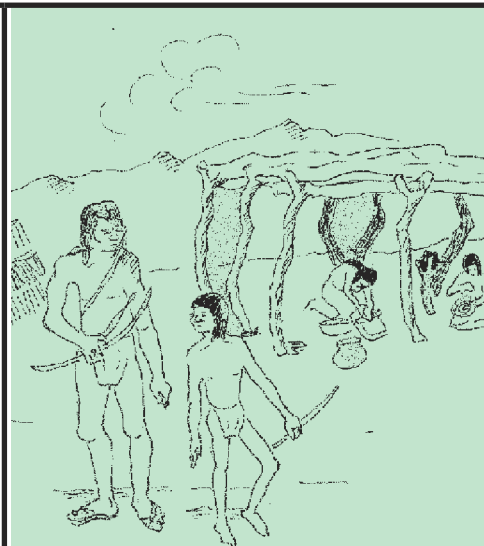
For advanced and upper grade students, consider giving each student or group the entire writing, “Spanish Gifts - A Blessing or Curse” on *Master Pages 1.3 and 1.4*. Modify part one as appropriate.

Enrichment

- Many of the things we eat today are combinations of native and introduced foods. Ask students to create a menu with at least three dishes, each using one or more native or introduced ingredients. For example:
(Wheat (introduced) + Cocoa (native) = Chocolate Cake.)

SPANISH GIFTS - A BLESSING AND A CURSE

The Sobaipuri or O'odham (Pima or River People) lived along the Santa Cruz River. They were farmers who used water from the river to irrigate summer crops of corn, squash, beans and cotton. They harvested local plants such as mesquite, devil's claw, and cactus. They also hunted rodents, birds, deer, pronghorn antelope and mountain sheep.



They depended on the river to live. A bad year might bring flooding, which destroyed crops, and in a dry or drought year the crops died from lack of water. Although the climate was usually mild, it got cold enough for frosts and the plants froze. The cold weather prevented year round planting of corn and other crops. They had no winter crop, so they were forced to travel to other areas in winter to hunt and harvest native plants.



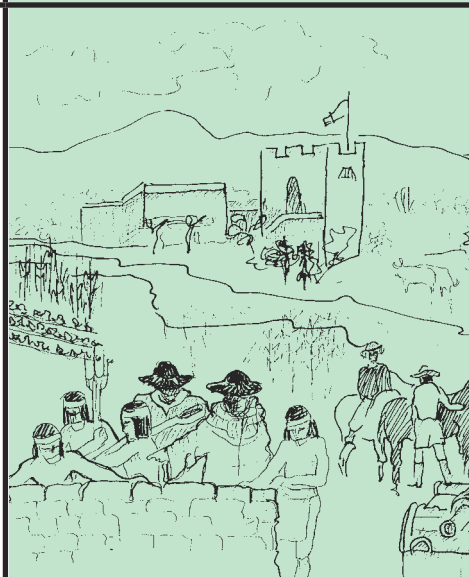
The O'odham heard from other tribes that Father Kino was kind, generous and very smart. He spoke of a new God to whom he wanted to introduce them. He gave them gifts such as colorful beads, horses, sheep, cattle and a plant called "wheat" that grew in the winter. He also brought lots of other good things to eat. These foods may have included sugar, chicken, oats, olives, grapes, pork, cabbage, barley and beets.



Goods brought by Father Kino, other priests, and the early settlers changed the way the O'odham lived. Introduced wheat and livestock meant that the people no longer needed to move around as much to find or hunt food. These new crops and animals provided year-round food. Other new foods--beets, grapes, and sugar--made their lives richer. Cattle, goats, sheep and pigs gave them lots of meat and oxen pulled the plows. European inventions such as metal knives and digging tools made their work easier.



Even though many of the changes were good, over time other things imported by the Europeans either hurt the people or their environment. More people settled in larger villages and needed to be fed. Instead of hunting during the winter they planted crops all year and floods sometimes ruined their crops. Other years, there wasn't enough water and the plants died. The livestock ate certain kinds of grass and left others. Eventually the best grassland was gone, replaced by grasses that even the livestock wouldn't eat.



The worst change came from disease. Without knowing it, the Europeans brought sickness to the Indians. Smallpox, measles and many more diseases had already spread through Europe. By the time the missionaries came, they had resistance, or immunity, to the diseases. We get sick and then we have medicine to help us get better. When the Indians got sick, they often died, sometimes whole villages.



WHO BROUGHT WHAT?

Below are lots of goods that were exchanged between the Indians and the missionaries. Can you decide who brought what? Circle all of the things which came from the missionaries. Underline those that were used by the Indians throughout the Americas before the Europeans came.

Example: Rice = Spanish Avocados = Indian

Agave	Cocoa	Onions	Squash
<u>Avocados</u>	Corn	Peanuts	Sheep
Bananas	Devil's Claw	Pigs	Sweet Potatoes
Barley	Grapes	Pineapple	Sugar
Beans	Horses	Potatoes	Tomatoes
Beets	Mesquite	Prickly Pear	Turkey
Cabbage	Oats	Pumpkins	Vanilla
Cattle	Olives	<u>Rice</u>	

HELPFUL AND/OR HARMFUL?

The European settlers introduced many new ideas and items. Some impacted the lives of the Indians in both helpful and harmful ways. Can you tell which ones might have been helpful or harmful? Draw a line between each thing they brought and the descriptions of how they might have helped or hurt.

(Hint: there may be more than one answer.)

Disease	Makes good wine.
Vegetables	Tastes great but not too good for you.
Cattle	Unwanted plants came with this fruit.
Grapes	A permanent source of food.
Sugar	Lots of people died from this.
Horses	Better than walking!
Wheat	Ate too much grass.
	Provided variety to their diet.

NOTES

LESSON 2

FERNANDO'S BIG ADVENTURE



Students will follow a storyline while participating in a science experiment that defines water pollution and demonstrates how human activities affect water quality. We will also discuss Santa Cruz River issues, how current human practices affect water quality and potential solutions.

2



LESSON OVERVIEW

Students will follow a storyline while participating in a science experiment that defines water pollution and demonstrates how human activities affect water quality. We will also discuss Santa Cruz River issues, how current human practices affect water quality and potential solutions.

Subjects

Science and Reading

Science Standards

Science as Inquiry
History and Nature of Science
Personal and Social Perspectives in Science

Objectives

Students will:

1. Define water pollution and describe ways that water becomes polluted.
2. List ways in which human activities contribute to water quality.
3. Describe ways to prevent water pollution.

Preparation

Make a fish shaped out of a sponge. Attach a 12" string with a metal washer (1" diameter) on one end and a pencil or stick on the other; a gallon of water; script for Fernando the Fish's Big Adventure (Photocopy and see *Master Pages 2.5 and 2.6*); (*Page 2.2, steps 1 & 2*).

Time

50 minutes

Vocabulary

bacteria, pesticides, factory waste, refuse, toxic waste

FERNANDO'S BIG ADVENTURE

TEACHER BACKGROUND INFORMATION

One of the most significant problems facing the Santa Cruz River watershed is pollution. The river runs through both Mexico and the United States, making it a concern of international significance.

While litter is the most visible form of pollution, giardia, chemical leakage and spills are a reality. High occurrences of health hazards and diseases such as lupus are presently being studied.

Every year hundreds of bags of trash are cleaned out only to be replenished by summer rains. For the most part, the litter comes down from the Nogales Wash, when, during the monsoon rains, tons of trash are transported north from both sides of the border.

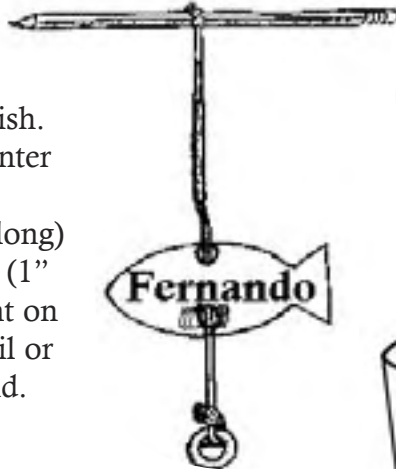
In addition to the fact that litter is ugly, we need to help our youth realize the impact it has on our present-day and future lives.

Habitat is destroyed or compromised, and string, plastic six-pack holders and sharp objects pose hazards to wildlife. Looking through the trash one can find oil cans, cleaning supplies, batteries and an assortment of other containers, many that hold harmful chemicals, which can and do leak into the water table. Our landfills are also reaching maximum capacity while we continue to increase the use of disposable products, many of which will never decompose.

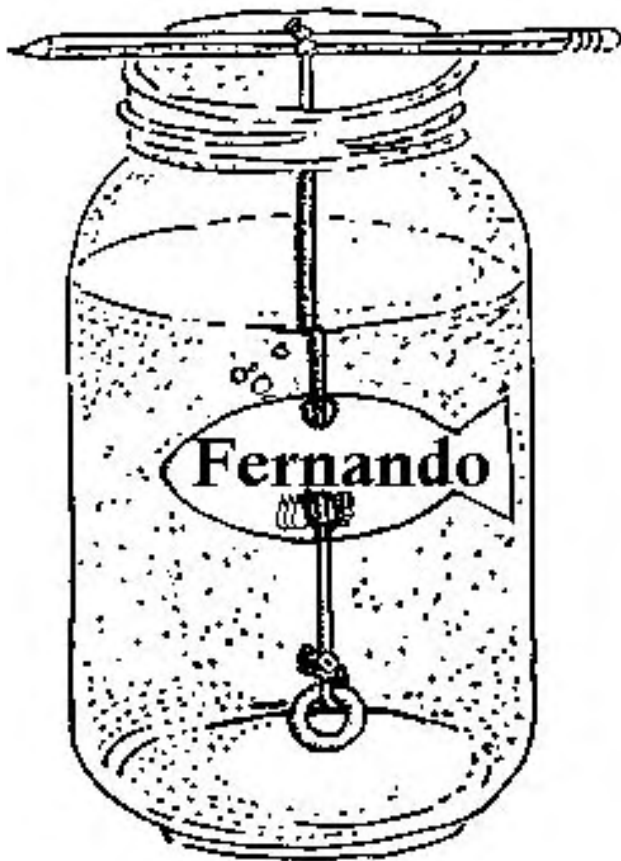
Through participating in these activities, students will become aware of the problems such as unsightliness of trash, the environmental impacts littering causes and the implications of using disposable products.

LESSON 2 - FERNANDO'S BIG ADVENTURE

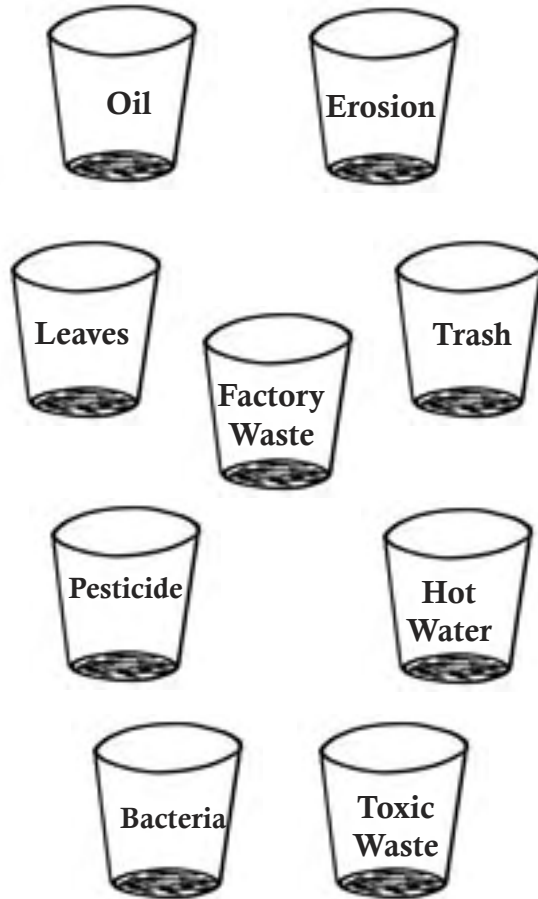
1. Cut a normal kitchen sponge into the shape of a fish. Attach this to the center of a piece of string (approximately 12" long) with a metal washer (1" diameter) as a weight on one end, and a pencil or stick on the other end.



2. Place the sponge in a gallon jar of water suspending it with the string attached to the stick or pencil on top. (See diagram below)



3. Fill and mark eight cups as follows:



Erosion - 1/2 cup soil

Oil - 1/8 cup cooking oil

Leaves - filled with leaves or other vegetation

Pesticides - 1 Tbsp sugar

Trash - 1/4 cup paper collected from a hole punch

Factory Waste - 1/8 cup soapy water

Bacteria - 1/8 cup cold water.

Toxic Waste - a pinch of salt.

Hot Water - 1/2 cup hot water

LESSON 2 - FERNANDO'S BIG ADVENTURE

4. Make photocopies of *Master Pages 2.5-2.6* and either: 1) cut out the separate parts for specific students to use or 2) make copies for all students to read along.

5. Using the prepared jar, introduce Fernando the Fish into the water. Explain that Fernando knows a lot about water quality and that he will be telling us how humans affect the quality of the water we use.

6. Discuss the meaning of the word “quality,” eventually leading to a definition of water quality. Explain that good water quality (water that is pure, clean and safe) is essential to the health of all living things. Even if we have all the water we need, if the quality is not good, we cannot survive.

7. Tell the students that Fernando is going to take us on an adventure in order to show us things we do that make water unsafe for living things. Everyone in the class will participate. Select nine students to read about Fernando’s Big Adventure. Pass out scripts (see *Master Pages 2.5-2.6*) and assign parts. You may also want to assign one student to write on the board listing Fernando’s adventures in order.

8. Ask all students to have a pencil and paper ready and each time someone says “How’s Fernando,” they should write down a word (an adjective) that describes Fernando’s condition.

9. Have selected readers read their roles, in order, while adding ingredients from the appropriately marked cup to Fernando’s jar. (For example, *Soil* add the cup marked soil, etc.) After each addition, and after each reader has read “How’s Fernando,” remind students to write down at least one descriptive adjective.

10. After Fernando has gone through all of his adventures, lift him out of the jar and discuss his condition. Ask students to share with the rest of the class some of their adjectives. Discuss whether the things that happened to Fernando are realistic (i.e., do people really do these things to water?) Using several of Fernando’s encounters with pollutants as examples, review how different human activities affect water quality.

11. Ask students to think of other human activities (which Fernando did not experience) that affect water quality.

JUST TRASH?

Aluminum Cans - not biodegradable; sharp edges may injure wildlife or people; small animals or insects may get trapped inside.

Paper - inks and bleaching chemicals contaminate soil and water.

Plastic six-pack rings - not biodegradable; may strangle wildlife.

Trash in water - may injure aquatic animals that get stuck or try to eat it; chemicals leak into water.

Household cleaners, chemicals & batteries - harmful chemicals may leak into the soil, water and air; potentially dangerous if touched by humans.

Glass - broken glass may injure people or wildlife; small creatures can get trapped inside jars or bottles.

Styrofoam and plastic - not biodegradable; may injure animals that mistake bits of plastic for food.

Old tires - may release harmful chemicals into the soil, water or air.

Candy and gum wrappers - many wrappings do not easily biodegrade.

LESSON 2 - FERNANDO'S BIG ADVENTURE

Some people think that water pollution occurs because of the activities of big industries. What about the things that many people pour down the drain like paint, cleaners and other chemicals? How would these harsh chemicals affect water quality? How does it affect people who use the water?

12. Using what students have learned, hold a discussion about problems affecting the Santa Cruz River.

Where does our drain water go?

To our septic tank or else a wastewater treatment plant in Rio Rico, Green Valley, etc.

What happens to it when it gets there?

It all eventually gets to a sewage treatment plant, is processed, cleaned and returned to the river.

Do you think the water quality in the river is good? Why or why not?

For the most part, the water is cleaned, although many people question whether there are undetected chemicals or pollutants. In 1999 water monitoring studies found high quantities of ammonia that are affecting the fish. Steps are being taken to improve the treatment process.

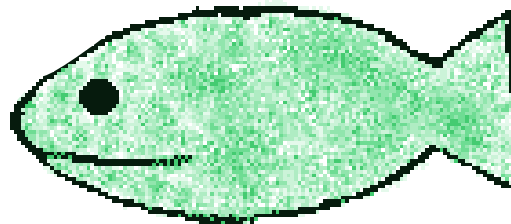
Do you think people and animals can get sick from the water? Why or why not?

Fish have died as a result of high ammonia content. Certain areas of Nogales are known to have a high rate of lupus believed to be caused, at least in part, by polluted water.

Are there any types of pollutants that you can see along the river?

Trash is a major problem along the Santa Cruz. Most of it is thrown in the Nogales wash, on both sides of the border, and then transported north with summer and winter rains. Trash found can consist of chemical bottles, oil cans, plastic, old toys, medical supplies and you-name-it. Students visiting the river at Tumacácori haul out hundreds of bags of trash annually which are redeposited every summer and winter.

13. Wrap up the activity by asking if there are ways to clean up polluted water such as Fernando's or the Santa Cruz River. What can your students do to help?



Enrichment

- Attempt to clean Fernando's water using sand, gravel and coffee filters.
- Pick up trash around your school, the Santa Cruz River or neighboring area.
- Ask students to survey what kinds of household cleaners and chemicals are used in their homes or school and how they are disposed of.

Fernando the Fish's Big Adventure

(Script)

NARRATOR: Fernando is a happy, healthy fish living in the clear, clean water of a stream on the mountain. It is a wilderness area - clean, unpolluted, and far from the effects of human activities. Fernando has lived here all of his life. One day, a big rain fell and Fernando decided to go with the flow and have an adventure.

HOW'S FERNANDO?

SOIL: Fernando swam past a big field that was recently cleared for a housing development. All the vegetation was removed from the field and, after the big rain, there was nothing to keep the soil in place. It washed away, eventually reaching Fernando's stream. **Add "Soil" and ask**

HOW'S FERNANDO?

LEAVES: Further down the stream, the vegetation that had been cleared from the fields was dumped. The same rain that washed the soil away also washed the uprooted vegetation into Fernando's stream. **Add "Leaves" and ask**

HOW'S FERNANDO?

PESTICIDES: The stream in which Fernando is swimming next flowed through an area where people were growing crops. There were cotton fields, grapes and alfalfa. The insects loved the crops and were doing quite a bit of damage. The farmer hired a plane to fly over and spray pesticides on the crops to kill the bugs. The pesticides killed the bugs but were then washed off the crops in the next rain. The poison flowed with the rainwater off the field and down to Fernando's stream. **Add "Pesticides" and ask**

HOW'S FERNANDO?

TRASH: A road leading to the edge of Fernando's stream goes to a pretty place with big cottonwood trees. Some people having a picnic near the stream did not bother to pick up their trash when they were through. The next wind blew the trash into the stream. **Add "Trash" and ask**

HOW'S FERNANDO?

FACTORY WASTES: Fernando next swam through water that was polluted when a factory located near the stream dumped some of its waste right in the stream. Add “Factory Wastes” and ask

HOW’S FERNANDO?

BACTERIA: Fernando could hear it and smell it before he reached it. The cows were packed in, mooing loudly. The local dairy farm was poorly managed and all those cows in that small space created quite a stink of refuse. The refuse drained right toward Fernando’s stream and before he knew it, he swam right into the runoff from the farm. Add “Bacteria” and ask

HOW’S FERNANDO?

OIL SPILL: When people change the oil from their car, it must be disposed of correctly. Also, sometimes people don’t properly maintain their cars and oil leaks out. Fernando was unfortunate enough to swim right into some oil that had washed into the stream from the gutters. Add “Oil” and ask

HOW’S FERNANDO?

HOT WATER: Sometimes water from streams and rivers is used to cool moving parts in big factories and energy generating stations. Unfortunately, some companies do not re-cool the water before returning it to the stream where they got it. Add “Hot Water” and ask

HOW’S FERNANDO?

NARRATOR: You call this an adventure? It’s amazing what people do to water! But maybe, just maybe, people like us can help save Fernando the Fish!

SAVE FERNANDO!
SAVE FERNANDO!
SAVE FERNANDO!



LESSON 3

AN APACHE WAY OF LEARNING



Through participation in one or more activities, students will gain a personal relationship to their environment while learning about how the historical Apache people related to their natural environment.



LESSON OVERVIEW

Through participation in one or more activities, students will gain a personal relationship to their environment while learning about how the historical Apache people related to their natural environment.

Subjects

Science and
Social Studies

Science Standards

History and Nature of
Science
Personal and Social
Perspectives in Science

Objectives

Students will:

1. Discover how an intimate relationship with nature influenced the Apache culture.
2. Summarize thoughts and feelings about a personal experience.

Preparation

Read individual activities on *Pages 3.2-3.3* and select appropriate sites for chosen activities.

Time

One or more 50-minute sessions.

AN APACHE WAY OF LEARNING

TEACHER BACKGROUND INFORMATION

The Apaches' relationship with their environment was intimate. As nomadic hunters and gatherers, they relied on nature for their food, clothing and shelter. An in-depth knowledge of their environment, therefore, was essential. From a very young age, Apache boys and girls started learning the different plants and animals and their uses as they worked alongside their mothers gathering and preparing food and doing daily camp chores. At about age seven or eight the boys were separated from the girls to learn different things.

The girls continued to work with and learn from their mothers and other women. The identification and uses of plants were particularly important in order to survive. Edible and non-edible plants needed to be distinguished and they had to learn to prepare each plant for consumption and storage.

Basket weaving required that they become knowledgeable in the different reeds and grasses, as well as plants used for dyes and paints. Plants were of utmost importance for medicinal uses. Many young women would become herbalists and healers.

Boys started learning how to hunt and become warriors at age eight. Their training was based on survival in nature. They needed to be able to identify plants, learn the habits and characteristics of animals, and study the cycles of nature. Often they needed to observe nature or stalk animals for hours. Becoming a warrior also meant that they become masters of hiding and escape, for which an intimate knowledge of the local geography was needed — so much so that they learned the location and names for specific trees, rocks, caves and geographical features of the landscape.

LESSON 3 - AN APACHE WAY OF LEARNING

The following environmental education activities emphasize and encourage intimacy with nature. They are intended to give students an adventure similar to what a young Apache growing up in the 1800s may have experienced. They are not historical Apache activities, however, similar activities may have been used.

1. Using the background information, discuss the Apache lifestyle and the importance of developing an intimate relationship with nature. Explain that the students will have the opportunity to develop the same skills that the Apaches did when they were growing up.
2. Do one or more of the described activities with your students.
3. Ask students to describe their experience through either writing or drawing .
4. Discuss how their experience helps to understand the Apaches' relationship with their environment.



MAGIC SPOT

Setting: Magic Spot can be done just about anywhere there is nature. A lawn or ornamental shrubs or trees around the school work fine. If you have a large class with limited space, send only a few students at a time, extending the activity.

1. Take your students out to a natural area. It may be a nearby park or forest, or it might be on the school grounds. Select and assign a place where each student can sit and observe nature, far enough away from other students so that each can remain alone and quiet. Have students sit for at least five minutes, observing the area. After a specific period of time, recall students.
2. Have students draw a picture or write a poem about their magic spot.
3. Discuss and share individual experiences.

SOUNDS / COLORS

Setting: A place where you and your students can sit quietly, free from artificial sounds.

1. Either individually or as a group, sit quietly in a place where natural sounds can be heard, as free from man-made sounds as possible. Ask students to close their eyes and listen for natural sounds, counting each new sound on their fingers. How many different sounds were heard?
2. Repeat this process with eyes open (mouths shut) and count colors. How many true colors can they find? How many shades of green? Blue?

STILL HUNTING

Setting: A natural area (similar to, or the same as, Magic Spot) where each student can sit alone.

1. If you happen to be in or near an area where you can observe animals, expand on the Magic Spot activity by asking students to observe an animal as closely as possible (spider, ant, bird, squirrel, rabbit, etc.) without it running away. Domestic animals could also be used, such as dogs or cats.

As a homework assignment,
ask students to observe their pets'
habits and characteristics.

SOLO WALKING

Setting: A natural area where students can walk alone for a short period of time. This could be a quiet natural area with a path or road, or else along the fence-line around your school or playground. Two adults are needed with a larger group. (Consider doing this activity with smaller groups.)

1. Take your students to a natural area and have them line up single file. At a designated point of your choice, stop the group and send the other adult to a second point up to a quarter mile up the trail or road to wait for, and gather the students.

Adult # 1: Explain to your students that they will be walking alone for a short period of time and try to eliminate all fear, assuring them that the trail is clear and that the other adult is waiting for them. The students should walk as quietly as possible while observing the environment around them.

2. Start the students on their solo walk, one at a time, with a sufficient amount of distance between each student. Ideally, they should not be able to see the next student in front as they are walking. (Depending on the number of students, consider telling a story or discussing something to the waiting group as individual students are sent on their way).

Adult # 2: At the designated stopping place, try to sit close to the path or trail, partially hidden so that students could walk by without seeing you. As students get close to you, use a voiced call such as that of an owl to get their attention. Ask them to sit next to you quietly or in silence until the next student arrives. Repeat until all of the students are quietly sitting together. Adult # 1 will be the last person to join the group.

3. Discuss and share experiences.



MAPPING

Setting: Any natural area

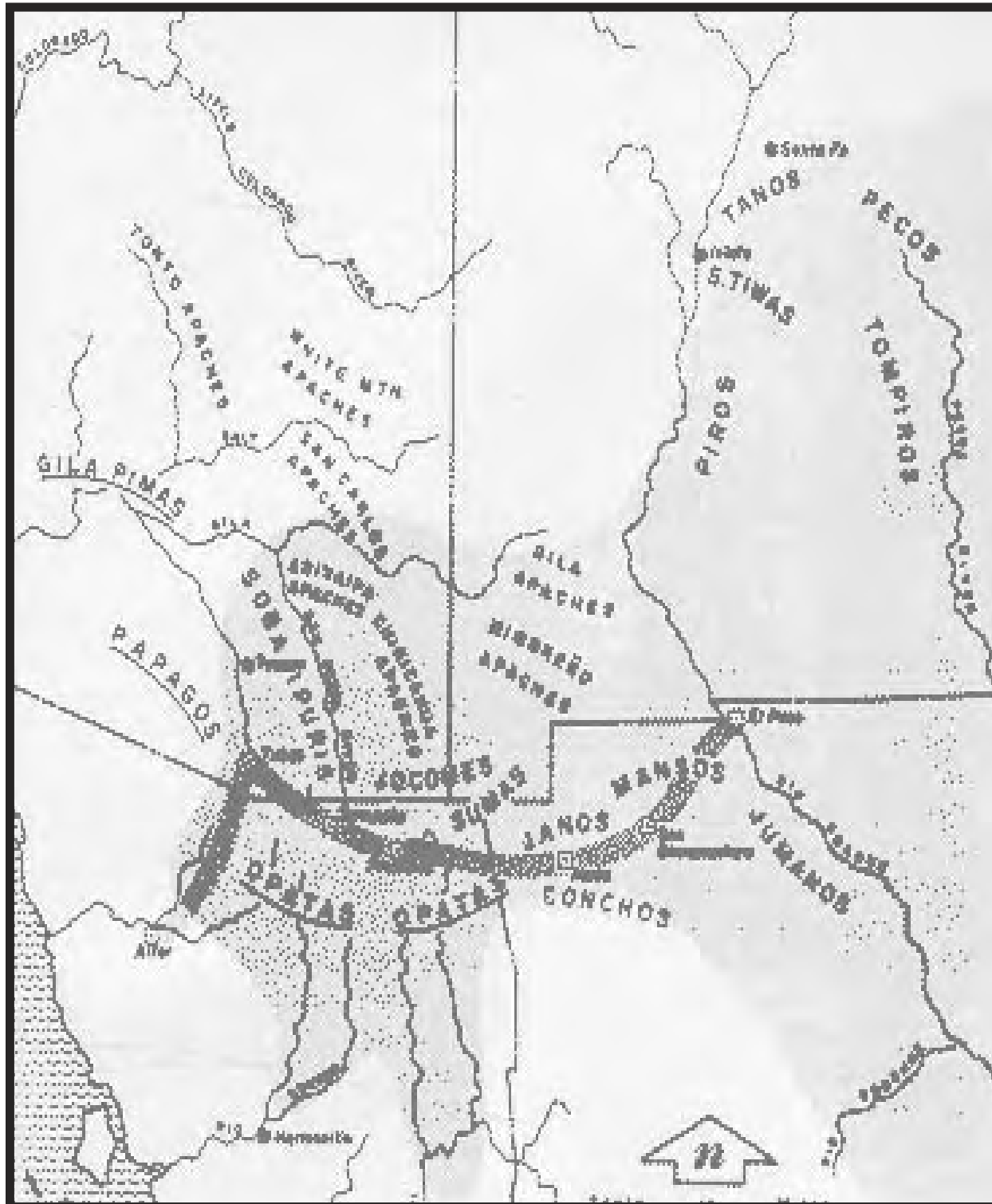
1. Assign each student, or group of students, to study and map a specific area. Have them locate and name all key features within their designated area. Can they memorize the landmarks?

2. When all maps are completed, experiment by having an individual or a group direct another to a specific spot within their assigned area.

Enrichment

- The selected activities are primarily from the work of Joseph Cornell, author of Sharing Nature With Children and other books. However, the activities are also found in a variety of other published teachers' guides, just a few of the myriad games and activities dealing with learning about, observing and appreciating nature. See References and Resources for a list of some of the many excellent guides available.

APACHE COUNTRY 1700-1900



LESSON 4

RAILROADS, CATTLE, COTTON FIELDS AND THE ENVIRONMENT



Students will gain an understanding of the local environment through time by participating in a game that demonstrates how historical events affected the natural environment in the Santa Cruz Valley.

4



LESSON OVERVIEW

Students will gain an understanding of the local environment through time by participating in a game that demonstrates how historical events affected the natural environment in the Santa Cruz Valley.

Subjects

Social Studies and Science

Standards

History and Nature of Science

Personal and Social Perspectives in Science
Life Science

Objectives

Students will:

1. Define endangered, extinct, extirpated, riparian and threatened.
2. Discern historical events that affect the environment.
3. Discuss wildlife management strategies.

Preparation

Cut-out and pre-sort animal cards on *Master Page 4.5* by species and place in an envelope. Make a reference copy of *Master Page 4.4*.

Time

One 60-minute session.

Vocabulary

endangered, extinct, extirpated, riparian, species, threatened

RAINROADS, CATTLE, COTTONFIELD AND THE ENVIRONMENT

TEACHER BACKGROUND INFORMATION

With water flowing year-round, the Santa Cruz River is the life-blood for myriad animals, insects, trees, plants and grasses. Populations of white-tailed and mule deer; javelina; mountain lion; bobcat; jackrabbit; desert cottontail; rock squirrel; valley pocket gopher; opossum; coyote; gray fox; raccoon; badger; spotted, striped, hooded and hog-nosed skunk; porcupine; white-throated woodrat and gray shrew all rely on the river. Native trees such as netleaf hackberry, honey mesquite, Arizona ash, Fremont cottonwood, walnut, Gooding willow, Mexican elder (elderberry) and catclaw acacia are common to the valley. Hundreds of insects, grasses and plants coexist in the mesquite-Bosque (mesquite woodland) and riparian environment.

During prehistoric and Spanish settlement periods, the natural environment was, for the most part, fairly stable and had abundant plants and animals mainly because the population was low. In addition what are today endangered, extirpated, or threatened species were common. This list includes monkey springs pupfish, river otter, jaguar, Mexican (gray) wolf, ferruginous pygmy owl, barking frog, Sanborn's long-nosed bat, willow fly-catcher, Gila topminnow, large flowered blue star, Wigger's milkweed vine, yellow-billed cuckoo and Santa Cruz star leaf.

The environment of the Santa Cruz Valley was not dramatically affected until the late 1800s. Prior to this time, human population remained relatively small (at least partially due to Apache attacks), and technologies did not have a great impact.

RAILROADS, CATTLE, COTTONFIELDS AND THE ENVIRONMENT

With the arrival of the railroads and immigrating Americans, the Industrial Revolution and the surrender of Geronimo, the environment took a turn for the worse.

In the mid to late 1800s, cattle operations, railroads and cotton farms took their toll on the environment. Large herds of cattle were brought into the area and some ranchers attempted to raise as many animals as possible without effectively managing the rangeland. The cattle ate and trampled native plant species and, because the herds were so large, many native plants were unable to reseed. Other introduced or “exotic” species competed for space. Wildlife was for the most part thought of as something to be used. Wolves, coyotes, large cats, raptors and other animals were considered threats and were often shot when seen. People sometimes hired hunters to track and kill predators.

New technologies came to the area with the railroad and the citizens of the Arizona Territory mostly saw a higher standard of living. Travel and movement of commerce improved and supplies were more readily available. However, technology also brought money and greed. Large companies and land owners often took from the land everything they could, destroying habitat and killing wildlife as they did so.

The technologies and inventions encouraged large-scale agriculture and cotton farming. Habitat was destroyed and the river was tapped to irrigate huge fields of cotton that depleted the soil.

So it was that the large cattle operations, railroads and agriculture negatively impacted the environment along the Santa Cruz. Most important, however, is not as much how this occurred, but why.

What was the motivation behind the new inventions and technologies?

Were they essentially good?

How does human character come into play here?

By exploring these ideas, students will gain understanding and insight into how future generations might better manage our environment.

VOCABULARY

Endangered species - A species that is in imminent danger of extinction. Example: grey wolf and jaguar.

Exotic - A species that was introduced from a different area or habitat. For example, Johnson Grass.

Extinct - A species that has ceased to exist. Example: dinosaurs.

Extirpated - a species that has been removed from a specific area but continues to exist elsewhere. Example: wolf, beaver and otter.

Riparian - referring to the ecological zone adjacent to a body of water.

Threatened - a designation given to species that are having a hard time maintaining their populations and may eventually become endangered or extinct.

RAILROADS, CATTLE, COTTONFIELDS AND THE ENVIRONMENT

1. Cut-out and pre-sort individual “species cards” on *Master Page 4.5*. Place all cards of the same species in a titled envelope. Example, place all the Mountain Lion cards in the same envelope, etc.

MOUNTAIN LION

2. Discuss and define vocabulary words. See Teacher Background information on Page 4.2.
3. Use all cards and give each student at least one. (In smaller classes give students two or more of the same species cards.)
4. Ask all students with the same species card to form groups. (All deer get together, all coyotes, etc.) Explain that the number of cards each student has represents the population of each given species (there are six deer, four bear, etc.)
5. Tell students that you are going to read some statements that describe various historical events. One by one, read each bold print statement on *Master Page 4.4*. Do not read the answer in parentheses to the students. They are teachers notes only. After reading each statement, discuss whether the event affected the environment and how. Was the effect positive, negative or neutral? Discuss all possibilities. If it neutrally or positively affected the environment, do nothing and read the next statement.

If it adversely affected it, ask each species group to give up one card, representing a percentage of their population.

6. As you read events, students will find that species populations are diminished or removed. These represent species that are extirpated, threatened and endangered. Those remaining with healthy populations represent survivors such as coyotes, raccoons, deer and javelina. Discuss why these animals survived and others did not. What happened to the other animals? What conclusions can be made about how historical events affect wildlife? Are there any other events that did, or will, affect or shape environmental history? Discuss the concepts of extinct, endangered, threatened and extirpated.

7. Play one or more rounds using the statements under **FUTURE EVENTS** on the bottom of *Master Page 4.4*. Predict and discuss the results.



Enrichment

- Study individual species to determine why some animals survive better than others.
- Activity: “How many trees in a forest,” Project Learning Tree.
- Take a field trip to the Santa Cruz River and its environs. (Call Tumacácori National Historical Park or Tubac Presidio State Historic Park for information.)

HISTORICAL EVENTS AND THE ENVIRONMENT

The Civil War - *(The devastations of war ravaged the east and south but not here in Arizona with the exception of Picacho Peak.)*

Railroads - *(Railroads bring people, commerce and new technologies to Arizona. People are able to import and export crops, wildlife [fur and meat] and livestock.)*

Yellowstone is Declared a National Park - *(In 1872, Yellowstone became the first National Park. Today there are more than 370 parks and monuments.)*

Big Cattle Operations - *(With the railroad and the push west came operations that moved thousands of cattle and other livestock across Arizona.)*

Tumacácori National Monument is Dedicated in 1908 - *(Tumacácori is one of fifteen parks or monuments established during Theodore Roosevelt's administration.)*

Land is Cleared to Grow Cotton and Raise Cattle - *(Farms expanded to large scale operations.)*

Governor Safford Starts a State-Wide Public School System - *(Possible long-term positive impact in that educated people help to bring about positive change.)*

Modern Technology Allows People to Utilize Underground Water - *(Water pumps, swimming pools, golf resorts, lawns, automatic washers, etc. allow people to pump water out of the Santa Cruz River aquifer at unprecedented rates.)*

FUTURE EVENTS

Rio Rico is the Place - 2,000 New Houses are Built

**The Area Along the Anza Trail, Between Tumacácori and Tubac, is
Managed as a Nature Preserve**

Two Million People Now Live in the Santa Cruz Valley

RAILROADS, CATTLE, COTTONFIELDS & ENVIRONMENT - MASTER PAGE 4.5

RACCOON	RACCOON	RACCOON	RACCOON	RACCOON
RACCOON	RACCOON	MOUNTAIN LION	MOUNTIAN LION	MOUNTAIN LION
MOUNTAIN LION	MOUNTAIN LION	JAGUAR	JAGUAR	JAGUAR
COYOTE	COYOTE	COYOTE	COYOTE	COYOTE
COYOTE	BEAR	BEAR	BEAR	BEAR
DEER	DEER	DEER	DEER	DEER
DEER	BEAVER	BEAVER	BEAVER	BEAVER
OTTER	WOLF	WOLF	JAVELINA	JAVELINA
JAVELINA	JAVELINA	JAVELINA	JAVELINA	JAVELINA

NOTES

LESSON 5

SANTA CRUZ RIVER CARDS



Students will participate in activities that enable them to identify and review general characteristics of various animals (amphibians, arachnids, birds, insects, mammals and reptiles) found along the Santa Cruz River.

BEAVER*Castor canadensis***5****LESSON OVERVIEW**

Students will participate in activities that enable them to identify and review general characteristics of various animals (amphibians, arachnids, birds, insects, mammals and reptiles) found along the Santa Cruz River.

Subjects

Science

StandardsScience as Inquiry,
Life Science**Objectives**

Students will:

1. Discern physical and behavioral features of local animal species.
2. Formulate questions to identify animal species.
3. Compare, contrast, & classify animal species.
4. Write and spell aloud the names of animal species found along the Santa Cruz River.

Preparation

For activities 1, 2 and 4, make copies of *Master Pages 5.5-5.16* as needed. For Activity 3, "Bingo," make copies of *Master Pages 5.17 and 5.18* for yourself and each student. Have glue, scissors and beans for markers.

Time

Vary activities for 15-50 minute sessions or use for quick questioning.

Vocabulary

amphibian, arachnid, bird, habitat, insect, mammal, predator, prey, reptile

SANTA CRUZ RIVER CARDS

TEACHER BACKGROUND INFORMATION

The Santa Cruz River is a haven for local critters. Ninety-five percent of the wildlife utilizes the river's water that provides habitat for myriad animals. Populations of white-tailed and mule deer; javelina; mountain lion; bobcat; jackrabbit; desert cottontail; rock squirrel; valley pocket gopher; opossum; coyote; gray fox; raccoon; badger; spotted, striped, hooded and hog-nosed skunk; porcupine; white-throated woodrat and gray shrew all rely on the river.

Try to picture what it was like when Father Kino first arrived in 1691. After tromping through the desert for days he probably felt as if he were in heaven in the lush cottonwood and willow riparian area. In addition to the aforementioned trees, what is today threatened or endangered was common. This list includes monkey springs pupfish, river otter, jaguar, Mexican (gray) wolf, ferruginous pygmy owl, barking

frog, Sanborns long-nosed bat, Gila topminnow, willow fly-catcher and yellow-billed cuckoo.

The railroad and industrialization brought new technology and an increase in population to the area. Travel and movement of commerce improved and supplies were more readily available. Large companies and land owners often took everything they could from the land, destroying habitat and killing wildlife as they did so.

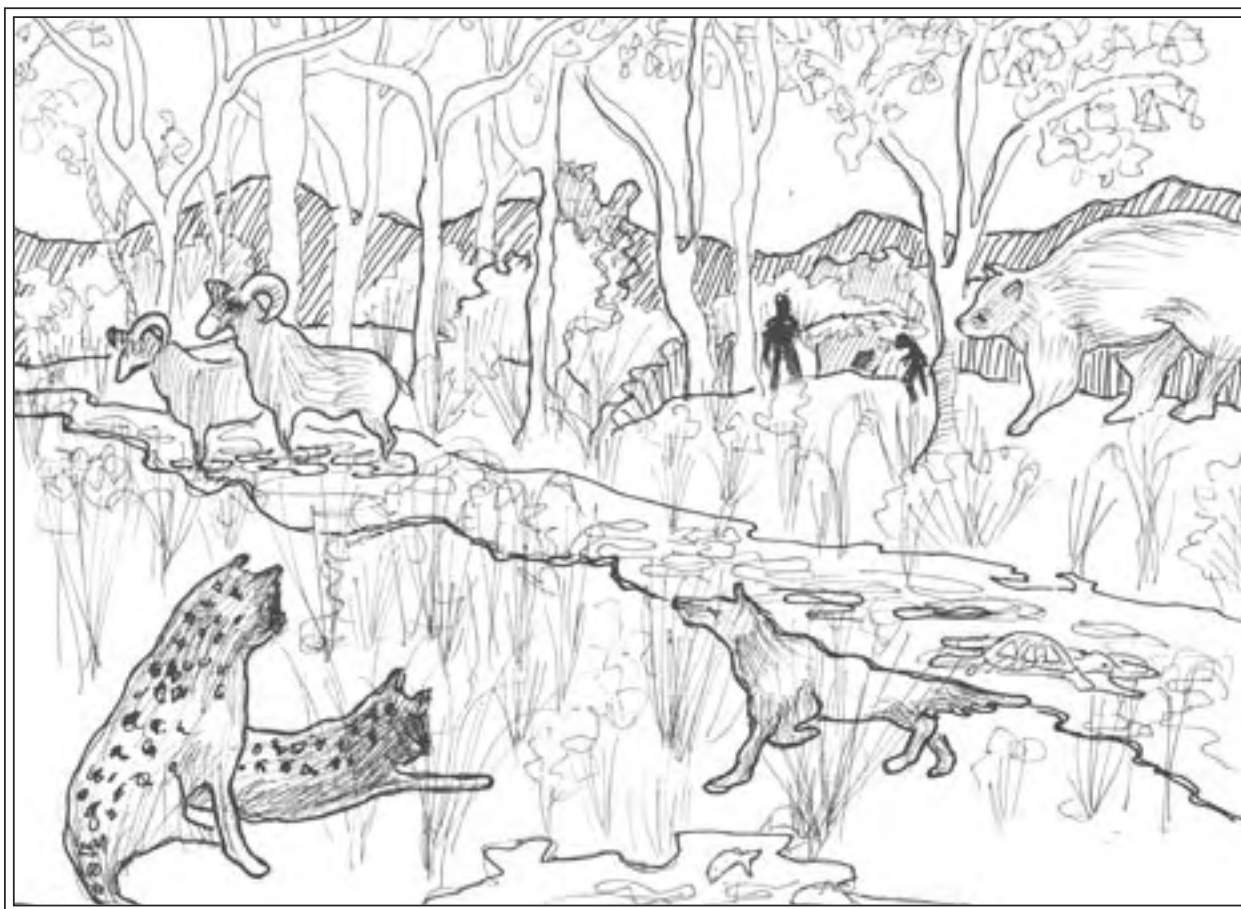
By 1970 the effect of misuse had taken its toll and the Santa Cruz River as surface water dried up except during the rains. Then in 1972, the environment between Rio Rico and Amado improved with the building of the Nogales International Wastewater Treatment Plant in Rio Rico, which, over time, has restored the surface water beyond historical records.

LESSON 5 - SANTA CRUZ RIVER CARDS

Today we might imagine that the Santa Cruz River looks, at least in places, similar to what it did in the time of Kino. Although chemically treated, the water from the treatment plant has restored habitat between Rio Rico and Tubac that was once doomed. This corridor is now home for myriad animals as well as a haven for nature enthusiasts. The creation of the Juan Bautista de Anza National Historic Trail now runs from Rio Rico to Tubac and offers great opportunities for hikers and history buffs. Arizona State Parks recently established Sonoita Creek Natural Area with plans of including the riparian corridor from Rio Rico (where Sonoita Creek meets the Santa Cruz at the Rio Rico Golf and Raquet Club) through to Palo Parado.

Tumacacori National Historical Park has expanded its boundary to include over one mile of river and its surrounding riparian area. The implications of protecting and monitoring the river are incredible and many studies and natural resource inventories are complete or in process. These efforts, along with other areas set aside by the many people and groups working for the river's betterment also contribute to the legacy we leave our youth - **but is it enough?**

Education about the river, its history, cultures and its wildlife are essential to insure a future citizenry that will support the river.



RIVER CARDS

Santa Cruz River Cards consist of a variety of pictures and descriptive information of all types of critters commonly found along the Santa Cruz River. Included are pictures and descriptions of mammals, birds, reptiles, arachnids, insects and amphibians.

The cards and pictures may be used in a variety of different ways to enhance student knowledge and appreciation of local wildlife. The activities suggest various ways in which you can use the cards, but please don't be limited by these. We encourage you to find your own games as well.

The pictures and information provided may be utilized as they are, but they are limited in size and description. Please make enlargements as appropriate.

Consider using the cards to:

- teach species identification, physical characteristics, feeding and activity habits and habitat.
- reinforce what the students have learned and evaluate the students' progress.
- identify and classify various animal species.
- compare and contrast the animals represented by finding similarities and differences in their physical characteristics, such as size, shape, coloring, skin and hair texture.
- learn about the types of food that various animals eat, and which animals eat the same types of food.
- encourage students to learn about and appreciate local wildlife and the areas that they inhabit.

Activity 1

*Animal Clue Game **

1. Refer to the clues for individual animals on Clue Cards - Master Pages 5.5-5.8. Consider photocopying and laminating cards to make a working copy.
2. Explain to your students that you will be reading clues about a certain type of animal, and they are to try to guess its name. They must listen to all clues before guessing.
3. Read one clue at a time.
4. When all the clues are read, have students say or write down their guess.



Activity 2

*What Animal Am I **

1. Review Information and cards on Species Cards - *Master Pages 5.9-5.16*. Consider photocopying and laminating cards to make a working copy. (Match pictures and information front to back.)
2. Explain that you have secretly selected an animal species and that they must ask a question to which you will only answer Yes, No, Maybe or Sometimes. For example: Are you as big as a breadbox? Are you a mammal? Do you eat meat?, etc. Model and discuss questions with students.
3. Choose one species from the attached cards, or another of your choice, without letting your students know your selection.

LESSON 5 - SANTA CRUZ RIVER CARDS

4. Encourage and coach students to ask appropriate questions about the species selected. The students have to ask at least five questions before they can begin guessing.

5. Repeat the activity with other animals allowing your students (once they know how to play) to take your place.

Activity 3

Santa Cruz River Bingo

1. Make photocopies of *Bingo - Master Pages 5.17 and 5.18*, one for yourself and each student.
2. Cut apart the species picture cards on *Master Page 5.17* and place in a hat or vessel from which to select.
3. Have students cut out the individual species squares on *Bingo - Master Page 5.17* and paste them at random onto *Bingo - Master Page 5.18*, making individualized bingo cards.
4. When ready to play, select a species card from your hat (see step 2) and either show them the picture or call out the animal name. Discuss the characteristics of the chosen species.
5. Instruct students to place a marker (bean) onto the corresponding square on their individual bingo board.
6. Continue playing until someone calls out "bingo."

Alternative Bingo Play

Give each student (or have them make) a blank bingo card with the appropriate number of squares. List the names on the blackboard at random and have each student copy the names of each species to be used on the squares. When ready, select pictures of each animal and, without verbally identifying the species, have the children match the name.

Activity 4

Card Games

A deck of cards can easily be made by photocopying and cutting out the picture squares of each species on *Species Cards - Master Pages 5.9-5.16*. You will find the size similar to that of a playing card. Get yourself a deck of old cards and glue the pictures onto the numbered sides, or else copy onto cardstock. Laminate the cards. Instruct your students to play different games such as matching, fish, rummy, or whatever other game you or they might dream up.

* Activities are used with permission from author, *Sharing Nature with Children* and *Sharing the Joy of Nature* by Joseph Cornell.

Enrichment

- Vary Activity 2 by having the class select an animal and the teacher or a student ask questions with the class answering Yes, No, Maybe, Sometimes.
- Assign each student to write a report on specific animals using the information on the Santa Cruz River Cards as a start.

MOUNTAIN LION

Felix concolor

1. I am grayish-brown in color with lighter areas under my belly.
2. I look for food only at night.
3. Deer is my favorite food but I eat any animal I can catch.
4. I can weigh from 100 to 200 pounds and am 5 feet long not including my tail.
5. I have short round ears and yellow-green cat's eyes.
6. I am the largest cat native to the USA.
7. My cousin, after whom I am named, is known as king of the jungle in Africa.

JAVELINA

Dicotyles tajacu

1. I am busy both day and night.
2. I have 4 legs, a small tail, and my hair is very coarse and oily.
3. I cannot see well, but I have a good sense of smell.
4. I eat plants, shrubs and roots.
5. I do not like anything that gets too close and will attack if they do.
6. Although most of my teeth are flat, I have two big ones like tusks on an elephant.
7. I am considered to be a sloppy eater.
8. I look like and am often called a pig.

WHITE-TAILED DEER

Odocoileus virginianus couesi

1. I have large ears with white on the inside and gray-brown on the outside.
2. My teeth are not sharp and pointed, but flat.
3. I'm small for my family & have a white tail.
4. I eat leaves, grass and twigs.
5. After my babies are born, they are left with only their color and spots to hide them.
6. I can run very fast and jump very high, even over fences.
7. Some of my kind have antlers.
8. Bambi is a relative of mine.

RACCOON

Procyon lotor mexicanus

1. I am warm blooded with four legs.
2. I eat about anything I can get my hands on.
3. I am very nimble and can pick up just about anything with my hands.
4. I hunt and look for food mostly at night. I am about the size of a small dog.
5. I am often found near water where I hunt for and clean my food.
6. I travel in small groups with two or more brothers and sisters.
7. I have a large bushy tail with rings. Some people mistake me for a bandit.

MEXICAN GREY WOLF

Canus lupis

1. I have four legs and I am big.
2. I weigh 60 to 100 pounds.
3. I hunt for my food at night.
4. I prefer meat of larger animals such as deer.
5. I am 5 feet long, have a long nose, and short ears.
6. I can talk with howls, growls and yips.
7. My relatives were once found all over the United States.
8. My species was recently returned to remote parts of Arizona.
9. I look like a dog and some call me Lobo.

COTTONTAIL RABBIT

Sylbilagus audubonii

1. I can run and jump very fast.
2. I do not have a stationary home, but sleep under bushes.
3. My paws are very furry.
4. I am about the size of a small cat.
5. I have flat teeth with two bigger ones in the front.
6. People hunt me for my soft warm fur.
7. People consider me to be cute and imitate me at Easter.
8. Part of my name comes from my tail that looks like a ball of cotton.

STRIPED SKUNK

Mephitis mephitis

1. My ears are small and rounded.
2. I eat mostly anything, but prefer insects.
3. I am about the size of a small cat and have a long bushy tail.
4. I am usually a gentle animal but lots of other animals and people are afraid of me.
5. My body color is black with two white stripes down my back.
6. I have a big tail that helps me if I am being attacked.
7. Some people say I smell bad.
8. When I get mad, I lift my tail and spray.

SPOTTED SKUNK

Spilogale gracilis

1. My ears are small and rounded.
2. I eat just about anything, but prefer insects.
3. I am about the size of a kitten and have a long bushy tail.
4. My body color is black with various white spots on my face and body.
5. I am usually a very gentle animal, but lots of other animals and people are afraid of me.
6. I have a big tail that helps me if I am being attacked.
7. Some people say I smell bad.
8. When I get mad, I lift my tail and spray.

BEAVER

Castor canadensis

1. I am about the size of a small dog.
2. I am known as a great swimmer.
3. My feet are webbed like those of a duck.
4. I have a large, paddle-like tail.
5. I have large front teeth to chew wood.
6. If I don't chew wood, my teeth will grow too big and I will die.
7. Many years ago, people blamed me for starting a disease called malaria and kicked us all out of the southwest rivers.
8. I was re-introduced to the San Pedro River.
9. I have a flat tail and like to build dams.

GRAY ROCK SQUIRREL

Spermophilus variegatus

1. I am about 20 inches long and grey in color.
2. I spend much of my time in the ground.
3. At the first sign of danger, I will slip quietly into my house and stay there until I am safe.
4. I have sharp teeth and strong claws.
5. I eat seeds, nuts, fruits, berries, grass seeds, cactus fruits, acorns and pine nuts.
6. I am in the same family as rats and mice.
7. I am considered to be cute but sometimes. I have diseases like rabies or plague.
8. I have a big bushy tail.

COYOTE

Canis latrans

1. I am a mammal found all over the USA.
2. I am a carnivore, but eat all sorts of things.
3. I like to run in groups.
4. I look pretty scroungy in the summer but have a beautiful coat in the winter.
5. I can talk with others of my kind by growls and yips.
6. I have a long dog-like nose.
7. I am often mistaken for my cousin who is the wolf, but he is much larger than I.
8. I am often seen howling at the moon.

BADGER

Taxidea taxus

1. I am short and very strong.
2. I have white markings on my face.
3. I eat mice, rats and squirrels, which I dig out of their homes in the ground.
4. I am a fighter and attack animals and people if cornered.
5. I am about 2 feet long and weigh 20 pounds.
6. I hunt for food only at night, and sleep in a different place every day.
7. I am mostly gray in color, and I have big claws about 1-1/2 inches long.

NORTHERN CARDINAL

Cardinalis cardinalis

1. If I am a male, my face and throat are black.
2. When I choose my mate, we are together forever.
3. I love to sing and whistle all year long.
4. My bill is very strong and shaped like a cone.
5. I have wings and can fly.
6. Seeds are my favorite food.
7. I have a pointed crest on the top of my head.
8. If I am a boy, I look like a Christmas ornament sitting in a tree.
9. My body is bright red!

BLACK-CHINNED HUMMINGBIRD

Archilochus alexandri

1. I am always busy and rarely rest.
2. My home is lined with soft cobwebs.
3. I drink nectar from flowers and eat bugs.
4. Some of my species are about the size of a human's thumb.
5. I can fly forwards and backwards.
6. Sometimes people put food out for me in a glass jar, from which I drink with my long tongue.
7. I am one of the smallest birds and make a humming sound with my wings when I fly.

GILA WOODPECKER

Melanerpes uropygialis

1. My mate and I raise our young together.
2. I am very noisy.
3. As a boy, I have a red spot on my head.
4. I have a zebra striped cape.
5. I live in holes that I make in big trees.
6. I eat insects, cacti, berries, and eggs of other birds.
7. I am very commonly seen along the Santa Cruz River and at Tumacácori.
8. I drum on trees or on your house.
9. Some people call me "Woody."

TURKEY VULTURE

Cathartes aura

1. I am very quiet and rarely talk.
2. I live on cliffs or in trees with my friends.
3. In the morning, I sit stretched out and sun bathe to dry off.
4. You often see me from the highway circling in the sky.
5. I soar with "V" shaped wings and I hardly ever flap them.
6. I eat only dead animals.
7. I have no feathers on my head, which is bright red like a turkey.
8. I am also known as a buzzard.

RED-TAILED HAWK

Buteo jamaicensis

1. I have two legs.
2. I hunt rabbits, snakes and small mammals.
3. I am very large for my family.
4. My claws are big and sharp for grabbing my food.
5. My call is a high pitched whistle or screech (one falling note).
6. You may see me soaring above the highways, treetops or cliffs or on telephone poles.
7. Some people mistake me for an eagle.
8. My tail has red feathers.

GREATER ROADRUNNER

Geococcyx californianus

1. I eat all kinds of things, including lizards.
2. I live in desert bushes and grasses.
3. Sometimes you can hear my call which sounds like the clanking sound of coo coo-ah coo-ah.
4. I have a long body and tail.
5. I have two legs.
6. My feathers are dark brown with a little bit of green.
7. Although I have feathers, I don't usually fly.
8. When I am near a road and bothered, I will run away.

GIANT DESERT HAIRY SCORPION

Hadrurus arizonensis

1. I am a southwestern desert arachnid.
2. My mother carries her young on her back.
3. I eat tiny insects.
4. I am found in desert washes, rocky areas, the open desert, and even in your house.
5. I am light brown with some yellow coloring.
6. I have two pincers with which I can hold and grab things.
7. I am poisonous, and you will be in pain if I sting you.
8. My tail curls and has a stinger at the end of it.

TARANTULA

Aphonopelma chalcodesa

1. I have black hair on my body and legs.
2. My coloring varies from different shades of brown to black.
3. I live under the ground.
4. The female in my species will live in the same tiny cave her entire life.
5. I am very large for my species.
6. Even though I don't usually bite, I scare people so I have been in some movies.
7. Although my venom is poisonous to animals, I rarely hurt humans.
8. I have eight legs.

WESTERN DIAMONDBACK RATTLESNAKE

Crotalus atrox

1. I can be found in the western part of the United States.
2. I come out to hunt usually at night.
3. I mostly eat rats, mice and gophers.
4. I produce poison and can be dangerous.
5. I am cold blooded.
6. I have two fangs and no other teeth.
7. When I am frightened, I will curl up like a garden hose, raise my tail and rattle it to warn you not to come close to me.
8. I have diamond shaped patterns on my back.

HORNED LIZARD

Phrynosoma solare

1. I am found only in the western United States and Mexico.
2. I like to eat insects and love ants.
3. I like to bury myself in the sand.
4. I am cold blooded.
5. When frightened I squirt blood from my eyes.
6. I have very rough skin that looks like scales.
7. Although I am only 3-1/2 to 6-1/2 inches long, some say I look like a small dinosaur.
8. Some call me a toad, but I am really a lizard.

SPADE-FOOTED TOAD

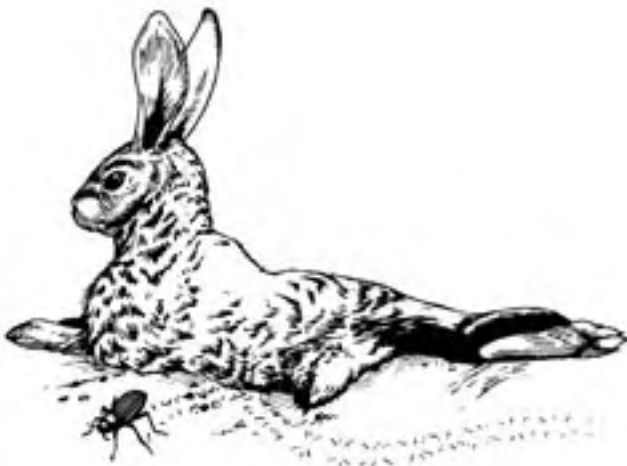
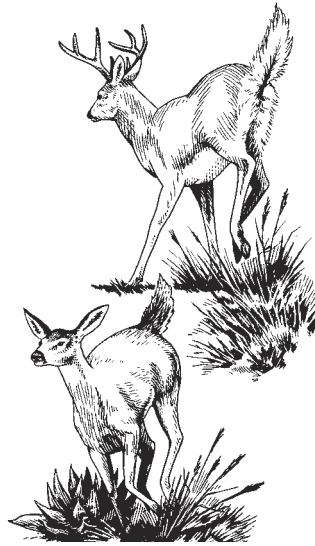
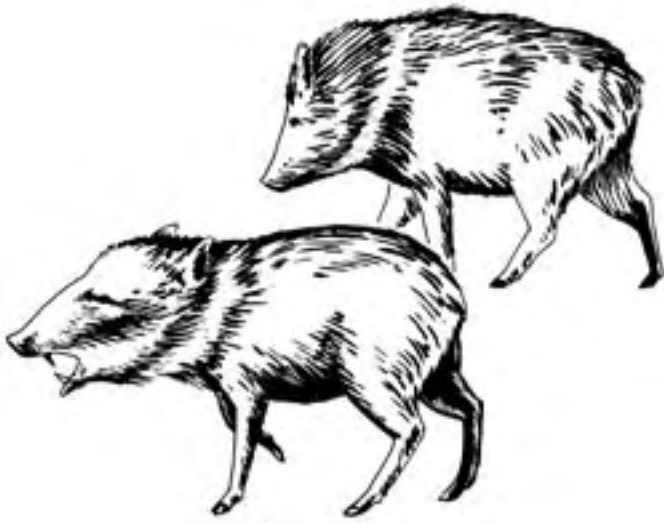
Scaphiopus couchi

1. I will spend most of my time underground.
2. I love to eat insects.
3. My rear feet resemble a spade.
4. I am cold blooded.
5. I will come out when it rains during the summer months.
6. I will lay my eggs in the water.
7. Kids like to catch me.
8. My skin is a dull brown, green and slippery.
9. I get around by hopping.
10. There is a story about me turning into a prince.

GIANT MESQUITE BEETLE

Thasus gigas

1. I am found in desert areas above the ground and in the mesquite trees.
2. I am very large for my type of creature.
3. I love sucking up plant juice.
4. I have two antennas and six legs.
5. I am red, white and black.
6. I can be found in bunches on mesquite branches.
7. I am a fussy eater and will only drink the juice of the mesquite tree.



MOUNTAIN LION

Felix concolor

Description: The largest cat in the United States - over five feet in length from the tip of his nose to the tip of his tail. It can weigh between 100 and 200 pounds. Lives mostly off deer and smaller prey.

Habitat: Lives mostly in the mountains but also can be seen in the desert. In AZ, prefers rugged, heavily vegetated areas like the Chiricahua Mountains.

Notes: Also known as Puma or Cougar, they are very shy and try very hard to stay hidden from humans. The lack of understanding of the mountain lion's habits, along with folklore, has made most people very afraid of this animal.

JAVELINA

Dicotyles tajacu

Description: Weighs 35-50 lbs; very coarse salt and pepper colored hair. Looks and acts like a pig but is not. It belongs to the old world Peccary family.

Habitat: Found in Arizona, Texas, and New Mexico (also in South America) living in deserts and lower elevation mountains. Preferred foods are cactus, grass, shrubs, roots and tubers. Any place you find these plants and cactus, you'll likely find javelina.

Notes: The javelina has very bad eyesight but a great sense of smell. Has a musk sack that lets out a very strong odor that other javelina can smell from great distances. This is how they can find their herd if they get lost.

WHITE-TAILED DEER

Odocoileus virginianus couesi

Description: Adult deer weigh 100 lbs or less. Their hair is tan-gray with white under parts. They are named for their white tail which can only be seen when it's up. The fawns are born with spots on their cinnamon-colored coats, which aid them in hiding from predators. They lose these spots in six months.

Habitat: High desert mountains, with rough wooded habitat. Food sources include grass, twigs, leaves, berries, and acorns.

Notes: Sometimes mule deer are mistaken for white-tailed deer. When the mule deer's tail is down it is white with a brown tip. On the white-tailed deer, you only see the white when the tail is up.

RACCOON

Procyon lotor mexicanus

Description: About the size of a small dog, it has gray fluffy hair with dark markings, a large bushy tail with rings and dark marks around the eyes making it look like a bandit. The raccoon has human-shaped paws that are used to grab objects and clean food.

Habitat: Found mostly in woods and forest environments. It is a very intelligent and curious animal and can be found going through trashcans and even inside houses looking for food.

Notes: The raccoon eats just about everything and is called an omnivore. Basically nocturnal but can also be seen in the day.

MEXICAN GREY WOLF

Canis lupis

Description: Often mistaken for a German Shepherd dog at first glance, but has longer legs, a shorter, straighter tail, bigger ears, and a longer snout. Has a light colored coat with a lot of gray, black, white and some tan.

Habitat: Wolves were hunted and trapped almost to extinction. The Mexican Grey Wolf lives in the high elevation desert or lower elevation mountains. Its main source of food is white-tailed deer.

Notes: The wolf is a very intelligent animal and learned very quickly to prey on domestic animals - a cause of their demise. Mexican Grey Wolves were re-introduced into the White Mountains in 1999.

COTTONTAIL RABBIT

Sylbilagus audubonii

Description: Gets its name from its fluffy white tail that looks like a cotton ball. Smaller than many rabbits, it has fur that is light grayish-tan with some white. It has clear brown eyes and moderately long ears and is the size of a medium cat.

Habitat: The cottontail lives in grassland, creosote brush, desert and mesquite forest. Although very common to the Arizona desert, they can be found in North Dakota, California, Montana, and Texas.

Notes: The cottontail defends itself from predators by running fast and darting in different directions. It will also lie very still and quiet so that predators and other threatening animals do not see it.



STRIPED SKUNK

Mephitis mephitis

Description: About the size of a cat. The striped skunk is distinguished by two white stripes down the back, a big bushy tail and a small head. Males are larger than females.

Habitat: The striped skunk can be found in most of the United States and Mexico in the desert, grassy plains and woodlands. The skunk moves slowly using ground cover as camouflage.

Notes: Although usually docile, when threatened, the skunk's defense is to spray a terrible odor up to 12 feet away. Four types of skunks are found in Arizona: striped, spotted, hooded and Hog-nosed. Skunks are primary carriers of rabies, dead or alive.

SPOTTED SKUNK

Spilogale gracilis

Description: This small nocturnal animal averages a total length of about 16 inches. The body is black with white spots on the face, 4 narrow white stripes along the front half of the back, a white blocked rump, and a tail that is half black and half white.

Habitat: They live in burrows or rock crevices in any location where there is lots of ground cover. Their diet consist of insects, lizards, rodents, birds' eggs and cactus fruits.

Notes: Their defense consists of stamping their front feet, turning around, hoisting their tail and emitting a repulsive odor. They can spray up to 12 feet away.

BEAVER

Castor Canadensis

Description: About the size of a medium sized dog with webbed rear feet, a tail shaped like a paddle and large front teeth. The fur is brown and thick.

Habitat: Found in mountains and waterways in the western United States. At one time, beavers were found throughout the United States but were depopulated by the fur trade. This species has been reintroduced to the San Pedro River.

Notes: In southwestern riparian areas, the beaver was removed or extirpated both for furs and because they were an assumed agent of malaria (mosquitos breed in still water). Beavers must chew wood, or their teeth may grow too big resulting in death.

GRAY ROCK SQUIRREL

Spermophilus variegatus

Description: These squirrels' coats are a mixture of dark grays and yellowish-browns with lighter gray on their front quarters, dirty white underneath, and bushy tails. They are large for ground squirrels, and can be up to 20 inches long.

Habitat: They get their name from their favorite habitat of rock with good cover of trees & bushes into which they blend well. They live in dens which can vary from rock slopes to human dwellings.

Notes: They always have a lookout point near their dens on which they perch to survey the surroundings. If there is any danger they will let out a loud shrill whistle as a warning.

COYOTE

Canis latrans

Description: About the size of a medium sized dog, with longer legs and bigger ears, weighing 20 to 50 lbs. The fur is tan and yellow with some black and white. The winter fur is full and thicker and the summer coat is often thin and sick looking.

Habitat: Common throughout the United States. Adapts to open plains, forest, desert and brush areas. Prefers small game but will eat about anything.

Notes: Often at night, either a lone coyote or a pack can be heard howling. Coyotes are very adaptable and have survived many difficult times. In many native cultures, the coyote is known as the trickster.

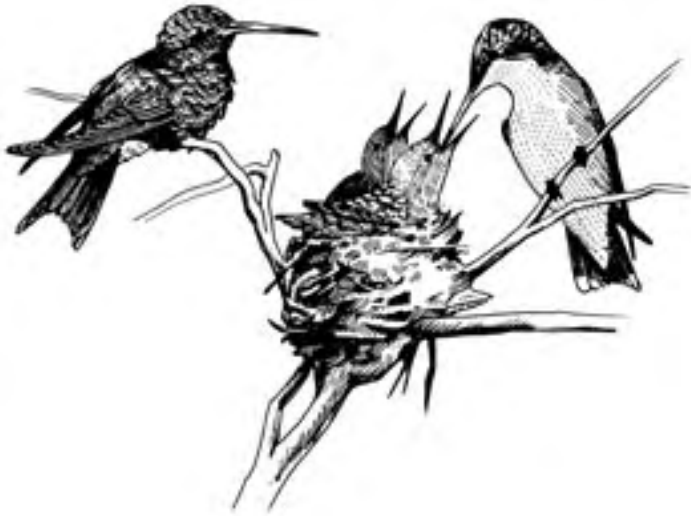
BADGER

Taxidea taxus

Description: A carnivore about two feet long, weighing 15 to 20 pounds. It is stocky shaped, with short legs, gray fur and distinct facial markings. Its legs are powerful, and it has long claws to dig and quickly unearth mice and squirrels.

Habitat: Found throughout the Sonoran Desert region. They live in underground burrows and move from den to den frequently, often every day.

Notes: Badgers are solitary and fierce, and most other animals avoid them because they are such good fighters. They eat only at night and roam over very large areas. Baby badgers stay with their mother for three months.



CARDINAL

Cardinali cardinalis

Description: Up to 7 1/2" long, the male is a bright Christmas red with a black face. Both male and female have distinct head crests and red beaks. The female is pinkish-peach colored.

Habitat: They are usually found in the mesquite-bosque and shrubs near the Santa Cruz River. They stay in southern Arizona year-round but are harder to spot in winter along the Santa Cruz.

Notes: They are ground feeders. The male is protective of his mate and surroundings and is known to attack his own reflection in windows because he thinks it is an intruder.

BLACK-CHINNED HUMMINGBIRD

Archilochus alexandri

Description: About 3" long, a small metallic-green bird with a black throat and white collar below it. With the sun shining just right, a purple patch will flash below his very long beak.

Habitat: These tiny birds winter in Mexico and then will travel as far north as Montana. Along the way they feed on nectar from brightly colored flowers.

Notes: The nest of the hummingbird is found in the fork of a branch and is only 1" high and 1-1/2" across. They can fly forward and backward, up and down. Their wings move so fast they make a humming sound, giving them their name.

GILA WOODPECKER

Melanerpes uropygialis

Description: This woodpecker has black and white zebra like stripes on the back and tail. Only the male has a bright red cap.

Habitat: They live year-round in the southwestern desert, woodland and cottonwood groves along the rivers. They eat insects, fruits of cactus, berries and the eggs of other birds.

Notes: The Gila Woodpecker is very common to the Santa Cruz River and can often be heard squawking.

TURKEY VULTURE

Cathartes aura

Description: Large black bird (25") with a bald, red head. When flying they have a wingspan of 6' and its wingtip feathers are spread apart, resembling fingers.

Habitat: They are found in open arid country, canyons and grasslands throughout the world. They are scavengers and feed on dead animals or carrion.

Notes: They soar high in the sky on thermal currents and can spot food from 2-1/2 miles away. Some Indian tribes thought the birds were messengers of the gods because of the way they soared higher and higher until they disappeared.

RED-TAILED HAWK

Buteo jamaicensis

Description: A large brown bird (18" long) with pale streaked breast, a dark belly band and a rusty red tail. They have a 4 foot wingspan, sharp claws or talons and a strong beak.

Habitat: Commonly found in open country, deserts and mountains. Often seen circling lazily in the air or perched on poles watching for their dinner which is usually mice, rabbits and other small animals.

Notes: They build a bulky platform nest of sticks that they defend by diving and screaming at intruders.

GREATER ROADRUNNER

Geococcyx californianus

Description: A large (22") ground bird with brown streaks, a shaggy crest, a very long tail, heavy beak and long blue legs.

Habitat: They live year-round in the Southwest deserts and mesquite shrub lands. Although they do fly, they prefer to run, hence, the name roadrunner. They are great hunters and eat the fruit of cactus, scorpions, tarantulas and snakes including rattlers.

Notes: We know them best from the Roadrunner cartoon with Wiley E. Coyote. Among Native Americans and Hispanics they were thought of as courageous and great hunters.



GIANT DESERT HAIRY SCORPION

Hadruvus arizonensis

Description: This arachnid is 5-1/2 inches long, with two pinchers and a stinger tipped “tail” that curves over its back when threatened. It is tan with a yellowish back and brown hair on its legs and body.

Habitat: Found in the desert along dry river washes, rocky areas and in more familiar places like in desert gardens and work sheds. This scorpion lives where it can prey on small, soft-bodied insects.

Notes: The female carries her young on her back for 10-15 days. The young will shed their skin several times before reaching maturity. Scorpions are venomous, and a person can get very sick if stung.

TARANTULA

Anphopelma chalcodesa

Description: These spiders are very hairy with long legs. Their color varies from dark brown to black with some grey. The female has hooks that look like large fangs and both male and female have a tight cluster of eight eyes.

Habitat: They are found in many parts of Arizona but mainly in the southwestern desert areas. They live in sandy washes and open desert areas in burrows. Their diet consists of insects and small rodents, such as mice, lizards and small snakes.

Notes: A tarantula’s bite, although painful, is not life threatening. It will only bite if provoked. Females live 20 years and males live 8-10 years.

WESTERN DIAMONDBACK RATTLESNAKE

Crotalus atrox

Description: Up to six feet long. Its name comes from the dark diamond shaped blotches on its back. Skin color is tan, yellow and very light pink. Like all rattlesnakes, the head is shaped like an arrow.

Habitat: Southeastern California to Arizona, New Mexico, to Arkansas and Northern Mexico. Lives in caves or under the ground. Lies on top of rocks, along trails, under bushes, and near open washes.

Notes: Although very dangerous, the snake is just as afraid of you as you are of it. The rattle is a warning. Be careful and leave it alone and it will leave you alone. Rattlesnake help keep rodent and rat population in balance by hunting them at night.

HORNED LIZARD

Phrynosoma solare

Description: This lizard has many scales and is crowned with sharp looking spines. Its color varies from tan to shades of dark brown and orange. The body is flat and close to the ground.

Habitat: These lizards can be found throughout Southern Arizona and into parts of Northern Mexico. They prefer rocky, sandy areas with shrub brush and succulents. They eat bugs and love ants and sometimes will eat very small snakes.

Notes: When threatened, they will squirt blood from their eyes. Their bodies will become very rigid when picked up.

GIANT MESQUITE BUG

Tassus gigas

Description: This bug is large and can be scary to look at. It has two long antennas and six legs. The color of this bug varies between black and red.

Habitat: The main area you find these bugs is any place where mesquite trees grow. Their diet consists mostly of the juice found in mesquite trees.

Notes: They can feed so much on the mesquite tree by sucking the juices that this beetle can actually kill part or sometimes the whole tree.

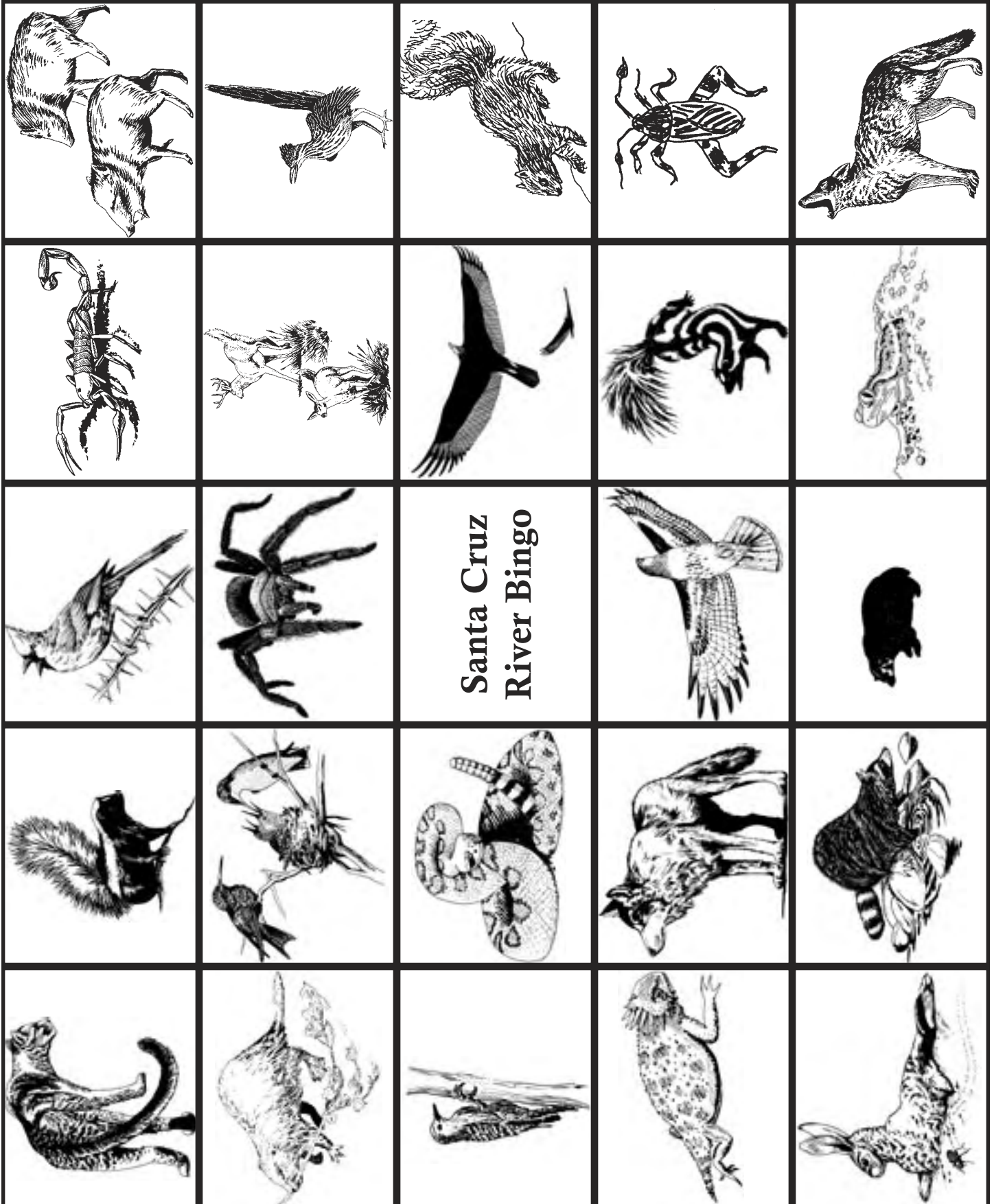
SPADE-FOOTED TOAD

Scaphiopus couchi

Description: Generally considered to be a small to medium sized toad with a white belly. The upper part of his body is yellowish green with different shades of marbling. The eardrum is clearly outside with no hump between the eyes. The body is plump and long.

Habitat: This toad can survive dry conditions so it is found in desert areas where mesquite and creosote grow. They live in other mammals’ burrows and loose soil or sand. Their diet consists of insects and the larvae of insects.

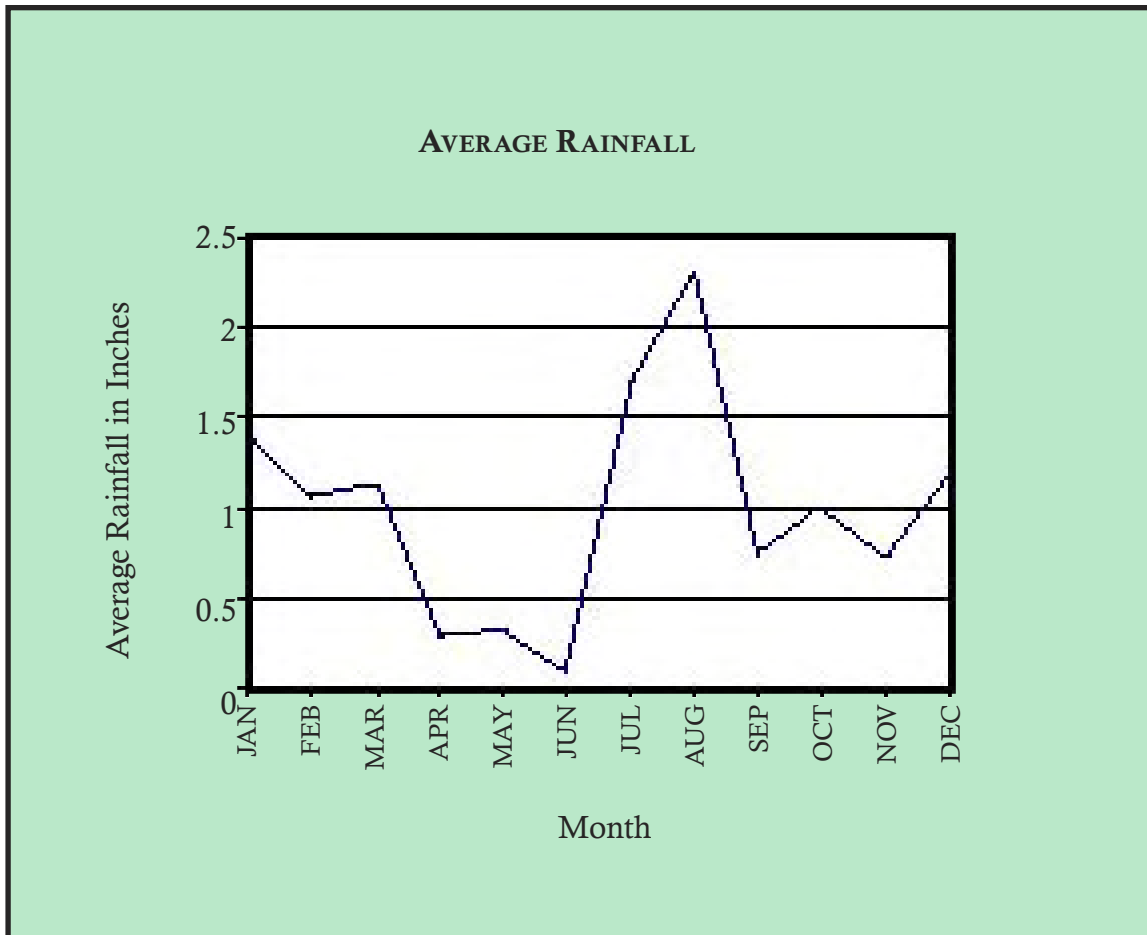
Notes: Their voice is very loud like a bleating lamb and can be heard from a long way.



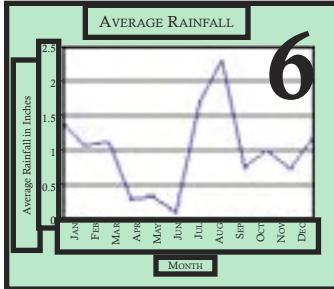
		Santa Cruz River Bingo		

LESSON 6

WHY THE SANTA CRUZ



By graphing rainfall and temperature patterns and comparing data in two specific sites, students will learn how environmental conditions affected human settlement along the Santa Cruz River.



LESSON OVERVIEW

By graphing rainfall and temperature patterns and comparing data in two specific sites, students will learn how environmental conditions affected human settlement along the Santa Cruz River.

Subjects

Math, Science, and Social Studies

Standards

Science as Inquiry
History and Nature of Science
Science in Personal and Social Perspectives
Earth Science

Objectives

Students will:

1. Graph and compare the rainfall and temperature patterns from two areas.
2. Discuss how cultures selected their home-sites based on environmental factors.

Preparation

Read the Background Information and review the graphs and charts on **Pages 6.2-6.6**; Copy **Master Page 6.5**, either for groups or individuals; have available pencils, graph paper and rulers.

Time

One or two 50-minute sessions.

Vocabulary

Pimeria Alta, acequia

WHY THE SANTA CRUZ?

TEACHER BACKGROUND INFORMATION

In the article, “Kino’s Unforeseen Legacy,” Dr. Sheridan speaks of environmental, economic and social/cultural conditions that were influential in determining the history of the Pimeria Alta, the historical designation for much of the Sonoran desert. For the O’odham people, and later the Spanish and Americans, environmental conditions influenced their lifestyle and choice of where to settle.



ARIDITY:

Since most of the Pimeria Alta only gets about five to fifteen inches of rainfall a year, water was a precious and relatively rare commodity. It is essentially the lifeblood of the area and almost all settlements were located close to or along the Santa Cruz River.

RAINFALL PATTERNS:

The two rainy seasons, winter and summer, have very different characteristics. In winter, rain falls more with greater frequency and tends to soak the ground in gentle, long-duration showers. Rain tends to fall over a wide area. Since the temperature is cooler, less rain evaporates back into the air before it can be absorbed by the ground or plant roots. Summer, in contrast, brings dramatic downpours that cause flooding. Summer rains are more sporadic than the winter rains and the rainfall patterns tend to be uneven. Some areas get drenched while others remain bone-dry. High summer temperatures can evaporate much of the rain that falls before it has a chance to get into the ground.

LESSON 6 - WHY THE SANTA CRUZ?

RIVER OASIS:

The Santa Cruz River provided a very different environment from that found in the “uplands,” (uphill and away from the floodplain). Rich soils and shallow groundwater levels allowed dense woodlands of mesquite and other trees to flourish in the lowlands, while nearer the river channel cottonwoods and willows created shady canopies with a lush understory of plants. The river itself flowed all year round in many places or else had a spring or cienega providing reliable water for both animals and humans. Villages such as Guevavi, Sonoita, Tumacácori, Tubac, and San Xavier were all located at places that offered year-round water supplies.

O’ODHAM ADAPTATION:

The O’odham were well-adapted to their environment but experienced major resource limitations. They farmed by utilizing floodplains near the river and collecting monsoon rainwater to water their crops of corn, beans, and squash. They may have brought water from the river to their fields via “acequias” or canals. Besides enduring drought periods, which caused crop failures, they suffered when summer rains were too heavy, washing out their floodplain crops. In addition, the O’odham lacked a winter crop and were forced to gather foods or hunt for survival. Because they could utilize wild foods so efficiently, the O’odham people survived such times, but had to move a great deal to gather enough wild foods to survive, sometimes ranging over great distances just to feed their families.

PART 1

1. Discuss present day weather patterns in the Santa Cruz Valley:

When is the hot season?

How hot does it get?

Is it as hot in the Santa Cruz Valley as it is in Tucson? Phoenix?

Why is there a difference?

How cold does it get in winter?

When is the rainy season?

Does it ever flood?

2. Working in teams, hand out copies of “Rainfall in the Santa Cruz Valley” chart on **Master Page 6.5**. Using the chart as a reference, ask students to try to answer the following questions.

When does the most rainfall occur? The least?

Which rainy season has more consistent rainfall?

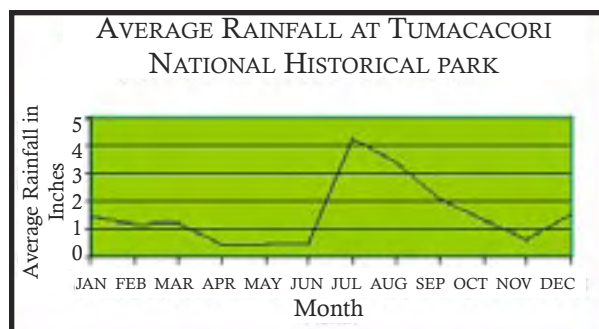
If you were farmers, which season would be best for growing crops?

3. Model and ask students to plot and graph rainfall over time at Tumacácori.

a. Add the monthly rainfall data for each of the ten years.

b. Find the average by dividing the total monthly rainfall by ten.

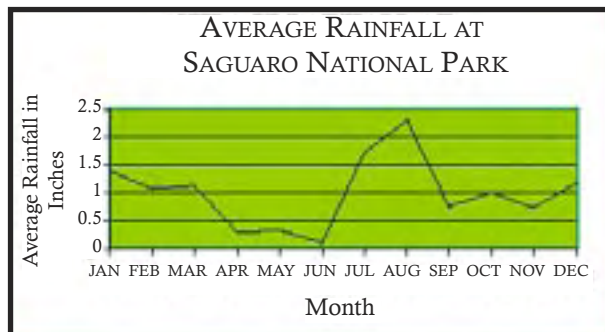
c. Plot the averages over time.



This graph is for teacher use only.

LESSON 6 - WHY THE SANTA CRUZ?

4. Repeat the graphing exercise for Saguaro National Park.



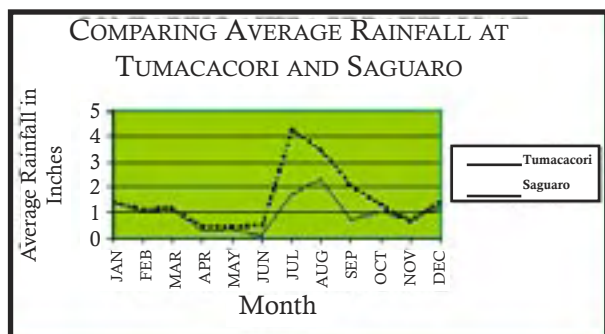
This graph is for teacher use only.

5. Discuss the following

Are there any differences between the rainy seasons?

Do you think you could grow corn in the desert? Why or why not?

6. Make a graph that includes both areas.



This graph is for teacher use only.

7. Discuss and compare similarities and differences between the two sites.

Which area received more rain? Why?

Based on rainfall, which area would be better to live in if you were a farmer?

What year might be a particularly good year for farming? Why?

What was the worst year?

Which years would a farmer be likely to lose his corn crop if he planted in June or July? Why?

(Rainfall of five inches or more in a month would create a flood in summer months; six or more inches for winter months. In years #2, #4, #6, #7 and #8 there occurred corn losses from flooding and in #1 from too little rain.)

What do you think happened to the Pima Indians in year #1?

(They would have to rely on wild foods only, as their crops would have failed.)

PART 2 - Optional

1. Repeat the assignment using temperature data on *Master Page 6.6*.

2. Compare and discuss the two sites combining temperature and rainfall.

Would they answer the questions in the same way?

Enrichment

- As an evaluation, have students do Part 2 and on paper answer the same questions as in Part 1.
- Use the Project WET groundwater model to examine the underlying groundwater resources in our area and activities related to the river.
- Do the Activity: "Water Wonders," Project Learning Tree (PLT) # 44.

NOTES

RAINFALL IN THE SANTA CRUZ VALLEY

TOTAL MONTHLY RAINFALL (INCHES) FOR TUMACÁCORI NHP

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
#1	2.0	2.1	1.5	0	0.2	0.1	3.3	3.2	0.9	3.4	2.8	3.6
#2	2.8	0.8	1.4	0	0.5	0.9	3.4	1.9	0.2	0.1	0.3	0.4
#3	0.4	2.0	0.8	0	0.1	0.1	0.6	2.5	0.8	0	0	0.1
#4	1.5	0.7	1.9	0.1	1.0	0	6.9	4.1	2.0	1.1	0.7	0
#5	1.1	0.1	0.7	0	0	0.3	2.2	3.1	1.9	0	0.4	3.8
#6	1.9	1.2	3.3	0.1	0	0	3.2	4.8	6.4	6.7	0.8	0.7
#7	2.0	0	0	0.4	0.1	1.5	10.6	3.8	1.5	1.1	0.7	4.1
#8	2.1	1.3	0.1	0.7	0	0	5.2	2.6	2.9	1.5	0.8	0.4
#9	0	1.6	1.3	0	0.4	0.4	5.3	3.9	0.5	0.2	0.4	1.6
#10	0.6	1.9	0.4	1.3	0.6	0	3.3	5.3	2.6	0.8	0.2	1.7

RAINFALL IN THE DESERT

TOTAL MONTHLY RAINFALL (INCHES) FOR SAGUARO NATIONAL PARK

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
#1	2.0	0.9	0.3	0.3	Trace	Trace	1.9	1.0	1.2	1.1	1.3	0.3
#2	0.1	1.8	1.4	Trace	0.2	0	1.7	0.6	0	0.6	0.6	1.3
#3	0.7	1.4	0.8	Trace	0.7	0.7	0.6	1.0	1.3	0.4	0.3	1.4
#4	0.4	0.6	0.2	1.8	0	0.1	1.2	4.2	0.1	2.8	0.5	0.3
#5	0.8	0.1	0.9	0	0.1	0.1	2.2	2.2	0	1.1	0.4	0.3
#6	1.4	0.7	1.5	0.5	0.1	Trace	4.8	1.7	1.2	0.8	0.5	3.2
#7	1.3	0.7	1.7	0	0	0	0.4	0.2	0.9	1.0	1.2	1.2
#8	2.0	2.2	2.1	0.2	1.1	0.1	3.8	4.8	1.7	0.6	0	0
#9	5.2	1.0	0.7	0	0.3	0	0	5.6	0.2	--	1.3	0.5
#10	0	1.3	1.7	0.1	0.8	Trace	0.4	1.7	0.8	0.6	1.1	3.2

TEMPERATURES IN THE SANTA CRUZ VALLEY
MONTHLY MAXIMUM/MINIMUM TEMPERATURES FOR TUMACÁCORI

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	66 --	66 23	74 31	81 30	90 37	102 48	100 57	95 57	92 47	87 42	70 29	62 5
1979	59 18	69 25	70 28	82 31	87 34	99 45	102 56	96 53	99 56	91 32	73 16	72 24
1980	68 26	72 29	71 30	82 31	87 35	104 43	102 62	97 57	96 51	86 32	78 24	76 24
1981	69 28	74 21	71 31	85 32	88 42	103 53	97 64	96 58	93 50	84 31	81 28	75 19
1982	67 22	71 22	75 23	84 --	89 40	98 46	98 56	96 59	94 44	87 33	72 26	63 21
1983	67 22	67 28	69 29	75 26	90 36	97 43	99 54	93 53	91 56	80 45	72 24	69 26
1984	66 23	70 22	78 28	80 29	96 38	96 53	92 61	91 59	92 51	78 40	73 21	65 25
1985	62 26	68 17	74 25	85 32	91 37	102 44	98 58	95 53	89 47	82 42	72 24	70 22
1986	74 22	72 26	77 31	84 32	92 35	99 50	93 58	94 62	91 42	83 35	73 28	66 21
1987	67 17	67 24	71 26	82 37	84 38	98 53	97 52	91 54	87 46	85 43	71 23	62 14

TEMPERATURES AT SAGUARO NATIONAL PARK
MONTHLY MAXIMUM/MINIMUM TEMPERATURES FOR SAGUARO

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	77 32	80 34	90 40	96 38	106 46	111 60	110 67	104 67	102 55	100 50	86 38	78 21
1979	74 30	85 31	85 37	92 39	100 44	114 57	113 68	106 60	108 61	101 46	85 32	82 36
1980	75 35	86 38	79 40	98 40	100 46	114 57	112 63	110 67	108 65	106 46	93 39	87 35
1981	83 37	89 34	86 38	98 39	97 54	113 70	109 67	109 68	103 64	93 46	90 39	85 32
1982	81 31	86 35	82 36	93 43	101 49	109 61	109 65	108 65	106 57	94 45	85 35	80 31
1983	77 33	81 36	85 43	91 37	109 49	107 59	116 71	105 64	107 61	87 55	82 33	79 33
1984	77 31	77 34	87 39	96 39	108 49	105 62	107 65	107 63	103 61	89 47	89 30	73 31
1985	71 29	81 23	81 33	94 45	99 50	112 54	109 66	108 66	99 54	96 47	87 32	77 28
1986	83 39	87 29	89 37	93 41	103 47	107 64	109 64	105 65	102 50	90 46	80 40	78 33
1987	83 22	81 31	83 35	96 41	96 49	109 63	109 67	104 63	101 60	101 56	81 34	81 24

LESSON 7

PEOPLE AND THEIR ENVIRONMENT



Students will hear accounts of the river environment during different time periods; visualize and depict, through drawing, each time period and record and discuss the potential impact people had on the environment of the Santa Cruz Valley.



LESSON OVERVIEW

Students will hear accounts of the river environment during different time periods; visualize and depict, through drawing, each time period and record and discuss the potential impact people had on the environment of the Santa Cruz Valley.

Subjects

Social Studies, Art, Science

Standards

Science as Inquiry
History and Nature of Science
Science in Personal and Social Perspectives
Life Science

Objectives

Students will:

1. Read essays from three different time periods.
2. Use critical thinking skills to answer questions related to assigned readings.
3. Write or depict, through drawing, a hypothesis for future events.

Preparation

Copy *Master Page 7.10* for each student; Have available *Master Pages 7.4 - 7.9* (or optionally make copies for students to work in groups.)

Vocabulary

aquifer, *cienea*, culture, depleted, endangered, extinct, meandering, monsoon, *presidio*, population

PEOPLE AND THEIR ENVIRONMENT

TEACHER BACKGROUND INFORMATION

The environment of the Santa Cruz River Valley has changed significantly over time. Evolving from a prehistoric Hohokam site, it was home to the O'odham at the time of historical contact.

As no written record exists before Father Kino's arrival we can only attempt to imagine what the area looked like.

The Santa Cruz was subject to drought and flooding with

weather dictating how much surface water flowed. Primary tree species like cottonwood,

willow, mesquite and Mexican elder were probably much the same as we see today. Smaller shrubs and plants may have been displaced, however, by introduced or exotic species. The impact the Native Americans had on the environment was probably

minimal due to their small populations, but it did exist. Living off the land meant utilization of natural resources needed for food, construction materials and heat.

With Father Kino's arrival in 1691, environmental impact increased minimally, given the fact that for the first forty years the priests only occasionally visited most sites. As more European settlers arrived, the

advent of townships meant higher population and more impact. Introduced foods and

species began to change the lifestyle and environment of the native people. Introduced livestock helped to spread some native plants like mesquite while native grasses were displaced by introduced or "exotic" species like Johnson Grass.



LESSON 7 - PEOPLE AND THEIR ENVIRONMENT

Impacts around settlements like Tubac were great as a result of large herds of livestock and other human activity while the surrounding rural areas were relatively unchanged. Environmental impact was greatest with the Americans in the 1880s. With the advent of the train, coupled with increased human population, mass-scale agriculture and ranching, the land and its resources were compromised. Exotic species were introduced, fields were cleared, forestry resources removed and animals extirpated. Water, too, was affected, and, by 1971, surface flow in the Santa Cruz essentially stopped except during the rainy seasons.



Today we are again able to enjoy the environment of the Santa Cruz River and get a feel for the area where the O'odham once lived. The river now flows year-round between Rio Rico and Tubac thanks to treated water from the Nogales International Wastewater Treatment Plant. Many groups like Friends of the Santa Cruz River, the Anza Trail Coalition, Arizona State Parks, US Fish and Wildlife and the National Park Service work together to maintain a healthy environment and insure a future for the river.

What does our future look like?

What do our youth think?

Hopefully, participating in the following activity will encourage students to think, formulating ideas - a small step towards conserving our heritage.

Part 1

1. Read aloud the description and quote *The River Valley Before 1752* on **Master Page 7.4**. Have the students try to imagine, painting a picture in their minds of who lived there and what it might have looked like.
2. Show students the artist's depiction of Tubac on **Master Page 7.5** and discuss whether or not it matched their vision of what they thought it looked like. Emphasize that this is one artist's depiction and is not meant to be a "photo" of what it actually looked like.
3. Based on their impressions of "The River Valley before 1752," have students answer the questions on **Master Page 7.10** as best they can, either individually, in small groups, or together as a class.
4. Repeat steps 1 through 3 for each of the following periods, completing **Master Page 7.10** for each time period:

The River Valley Before 1752:

The O'odham people hunt, gather and farm the Santa Cruz River valley.

Master Pages 7.4-7.5

The River Valley After 1752:

The Spanish settlers brought new ideas, technologies and lifestyle to Tubac.

Master Pages 7.6-7.7

The River Valley in the 1900s

Many changes occur with the coming of the Americans, railroad, industry and technology.

Master Pages 7.8-7.9

Part 2

1. Discuss the following questions and compare with your students' answers written on *Master Page 7.10* for each time period.

Who lived in Tubac?

Was there more than one culture?

What effect, if any, did these people or their culture have on the environment?

Did the number of people (population) have any effect on the environment?

Was anything threatened, drastically changed, endangered, or made extinct?

If you could live in Tubac during any one of the three time periods, which one would you pick? Why?

Which time period would you least like to live in? Why?

2. Hypothesize possible outcomes should Tubac become the size of Green Valley, Nogales, or even Tucson. What are the pros and cons?

3. Ask students to complete the fourth column, "After 2025," on *Master Page 7.10*.

4. Assign students to make a sketch or written description about what they think the river valley might look like in the future, say in the year 2025.



Enrichment

- Instead of reading aloud to the class, make copies of selected readings and have students read in groups.
- Ask students to redraw a picture of Tubac in 2025 that reflects the following question: "If you were in charge of developing the town, what would you do to make it a great place to live?"
- Invite a local developer or real estate agent to talk with them about present or potential development projects in the area.
- Take a field trip to the river or the cienega at Meadow Hills Housing area in Nogales to get a feel for what the river looks like today.

The River Valley Before 1752

Before 1752, the overall Santa Cruz Valley looked different than it does today. The river was *meandering* and surrounded by *ciénegas* (swamps or wetlands). Rainfall was probably not much different from today. However, when it did rain, the *ciénegas* temporarily held the water until it had time to soak into the ground, in drought years returning it to its natural underground storage, or *aquifer*.

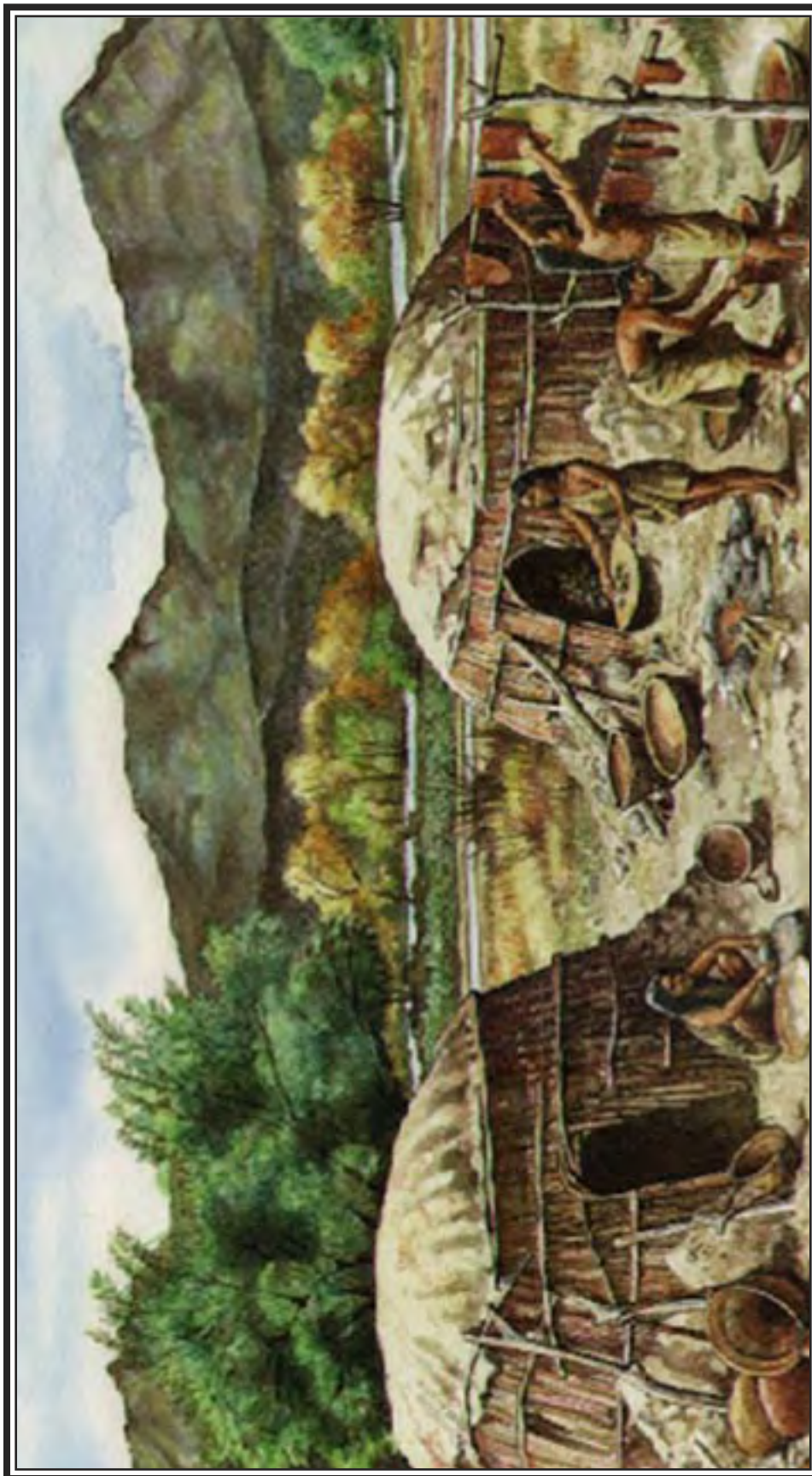
The *ciénegas* or wetlands also offered water, food and homes for wildlife such as jaguar, beaver, otter, wild turkey, grey wolf and bighorn sheep. None of these are found in the Santa Cruz Valley today.

The river (*riparian*) and forest (*mesquite-bosque*) environments were possibly dense with similar trees, but different plants and grasses. The main human inhabitants were the O'odham who lived in simple mud and stick homes, and did small-scale farming and hunting along the river.

During the twenty years following Kino, what he accomplished appeared to be in danger of being lost entirely, principally because Indian enemies constantly attacked the frontier settlement. The O'odham gathered in pueblos were without adequate means of protection. Enemy Indians began their raids upon the Spanish frontier before Kino's time. As early as 1703 Kino made the following entry in his memoirs:

The early explorers found several thousand people whom they called Sobaipuris (a branch of the northern Pimans) residing in more than a dozen small villages scattered along the perennial reaches of the river, often near 'ciénegas' (marshes). The populations of these kin-based 'rancherías' (encampments) varied from 80 to 900 persons. Their houses were constructed of poles and woven mats. Vaulted roofs covered by several layers of matting could withstand precipitation. Supplied by vast networks of irrigation canals, extensive fields produced a surplus of corn, beans, squash, melons, cotton, and tobacco. On seasonal gathering trips to the surrounding desert, the river-dwelling villagers supplemented their diet with agave, cactus fruits, desert "greens," and saguaro fruit for making wine ... The villagers kept wild fowl, including 'guacamayas' (Macaws or possibly Thick-billed Parrots), whose feathers they valued for decoration. Wearing garments of 'gamuza' (expertly tanned antelope or deer skin) or woven cotton cloth, they greeted the missionaries with dancing, shouting, and banquets, and showered them with so many gifts of food, including fish from the river ... Early descriptions of Sobaipuri villages on the Santa Cruz depict a people living in a balanced relationship with their environment.

From Diana Hadley, Arizona State Museum



From *Las Capas*, by Michael Hamshire

The River Valley After 1752

Because of the Pima Revolt of 1751, the settlers in the Santa Cruz Valley asked Spain for a presidio (a garrison for soldiers and their families) to be built at Tubac. It was completed about 1752. The nearby Jesuit, black-robed missionaries decided that a church was needed close enough to the presidio for protection, but far enough away for independence. They chose the spot where Tumacácori is now located. The first church, now only an adobe foundation, was built sometime between 1752 and 1757. The introduction of the presidio at Tubac and the church at Tumacácori established the first permanent non-native settlement in present-day Arizona.

The Tubac Presidio housed fifty soldiers, their wives and children. With them came new farming techniques, guns to make hunting easier, and imported cattle and other livestock. Within two years 300 people were living in Tubac and the population grew to 500 by 1767. Areas were cleared for the Presidio and for farming.

During the next hundred years changes to the environment were greater compared to that of the Native Americans, but remained minimal. Apache attacks kept the population small and no significant development occurred. The human population varied, but remained low.

A few adventurous pioneers grew crops, raised stock, or operated small gold and silver mines in the outlying areas such as Arivaca and the San Pedro Valley, but most Spaniards continued to live along the Santa Cruz. The rest of Arizona remained in Native American hands.

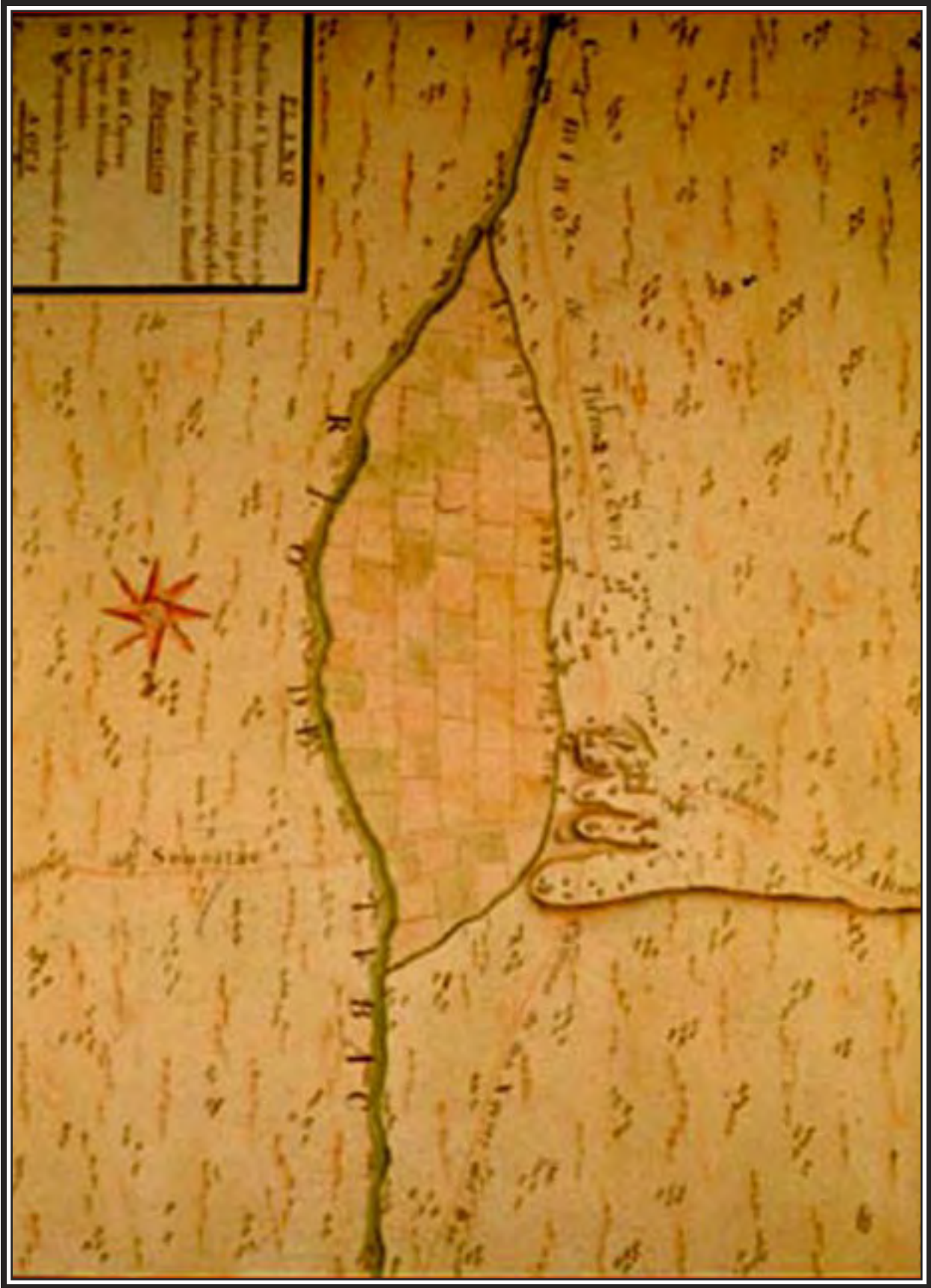
Despite their small size, communities like Tucson and Tubac were . . . not impressive: flat-roofed adobe buildings clustered beside a ragged patchwork of fields. As Tucson's Captain José de Zúñiga noted in 1804, "We have no gold, silver, lead, tin, quicksilver, copper mines or marble quarries." He went on to say, "The only public work here that is truly worthy of this report is the church at San Xavier del Bac."

Spanish frontiersmen were as tough as any pioneers on the North American continent. They knew the desert and they knew the Indians—fighting, sleeping, and dying with Tohono O'odham from the western deserts, Pimas from the San Pedro Valley, Apaches from the eastern mountain ranges, and even Yaquis from southern Sonora and Yumans from the Colorado River.

The most important crop was wheat, followed by corn, beans and squash. The most important animals were cattle and horses, although a herd of 5,000 sheep at Tubac produced enough wool for 600 blankets in 1804. During times of relative peace, farming and ranching expanded along the Santa Cruz and spilled over into watersheds. But whenever Apache raiding intensified, herds dwindled, fields were abandoned, and families took refuge behind presidio walls.

It was a harsh way of life. One that swung like a pendulum between flood and drought, peace and war. Nonetheless, it endured. The people of Hispanic Arizona may not have been able to extend the empire, but they held on to their little piece of it in the face of great odds. Like rawhide, the sinews of their culture bound them together and bound them to the land.

1767 - From Thomas E. Sheridan, Arizona



The River Valley in the 1900s

Between the 1880s and the 1970s the results of the Industrial Revolution took its toll on the environment along the Santa Cruz River. After Geronimo surrendered in 1886, Tubac resettled and was never again abandoned. The population steadily increased and started to have an impact on the environment and its resources. New technology also brought changes to the area never seen before, mainly the railroad and big cattle operations. The railroad allowed products and crops to be easily transported. This resulted in an increase in large-scale agriculture and cattle ranching. *Cienegas* and *mesquite-bosques* were made into cotton fields. Thousands of cattle grazed and trampled the native plants while other imported species were introduced. Hunting and the killing off of “desirable” (beaver and otter for furs) and “undesirable” (wolf and bear) wildlife increased. Introduced plant species replaced many native species.

The invention of new, more efficient water pumps and well-drilling equipment allowed people to remove water from the underground aquifer easily. The disappearance of many *cienegas* also caused the river to swell and flood during the monsoon rains, threatening land owners.

By 1970 the water in the Santa Cruz River did not flow as it had before, a result of drought and agriculture. Things then changed for the better in 1972. With a combination of increased rainfall, large farm operations closing down and the added water from the new Nogales International Wastewater Treatment Plant, the river between Rio Rico and Tubac flows above historical levels whereas the area between Kino Springs and Rio Rico is still subject to drought and human use. Sometimes it flows and sometimes it doesn't.

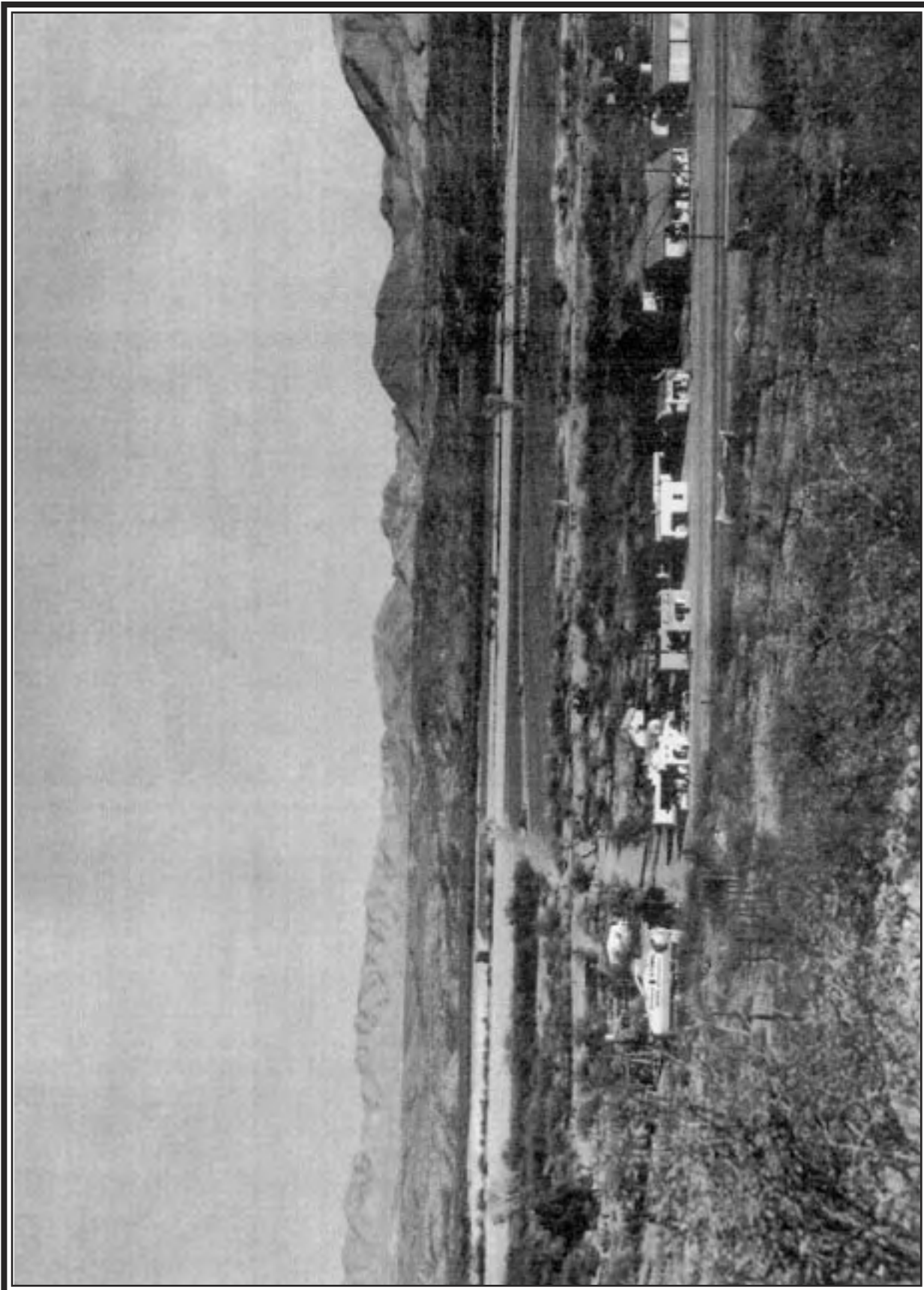
“The [biggest] changes have to do with buildings and cultivated land. Carmen . . . and its cotton fields are new . . . The mesquite bosque across the valley is no [larger] today than before, and the many large trees present there today attest to its great age. Any changes that may have occurred on the hills across the valley, [thickly] covered with white thorn today, aren't easily seen, but the small area on the hillside shows an increase in shrubs. . . No cottonwoods appear along the present channel.

From James Hastings and Raymond Turner, *The Changing Mile*

The land lying along the Santa Cruz River, between Tucson and the [Mexican border] contains . . . valley land, all of which is [good] for alfalfa, sugar, beets, grains, fruits and vegetables of all kinds.

These lands, located on both sides of the river, can be reclaimed by different systems of irrigation . . . to be filled by the waters of the Santa Cruz River during the flood season from July to October, or by the construction of a dam at Guevavi . . . where the bed rock comes near the surface.

From J. George Hilzinger, *Treasure Land: A Story*



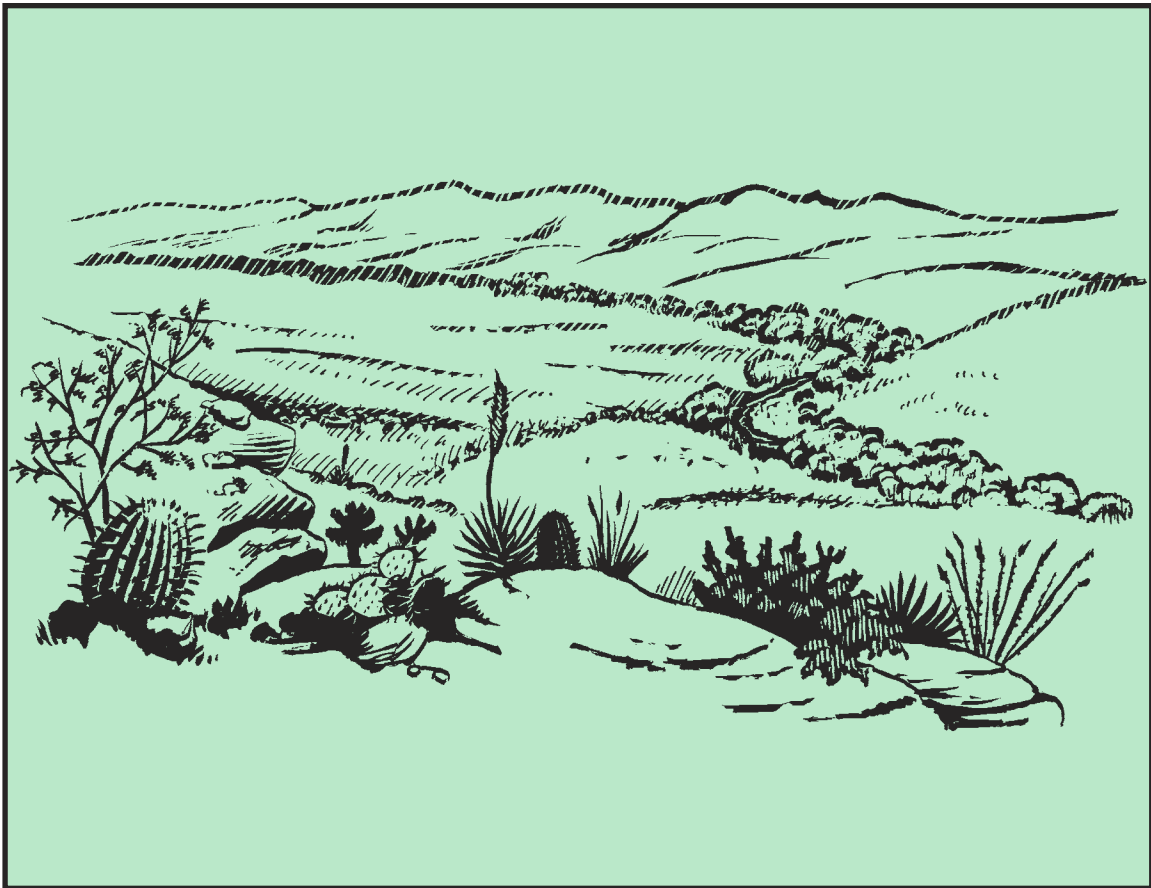
Do People Affect Their Environment?

Answer the questions below for each time period:

	Before 1725	After 1725	1900s	2025
What cultures lived in Tubac?				
What animals were found around Tubac? Were any endangered or extirpated?				
What did the river look like? Where did people get their water? Was there enough?				
How many people lived in Tubac? Did the number of people affect the environment? Why?				

LESSON 8

RIVER ISSUES AND YOU



Students will learn about specific issues relating to the Santa Cruz River, assert their opinion about each and participate in a debate using knowledge gained.



LESSON OVERVIEW

Students will learn about specific issues relating to the Santa Cruz River, assert their opinion about each and participate in a debate using knowledge gained.

Subjects

Reading, Science,
Social Studies

Standards

Science in Personal and
Social Perspectives
Life Science
Earth Science

Objectives

Students will:

1. Read about issues currently affecting the Santa Cruz River.
2. Summarize and present the contents of a reading assignment.
3. Discuss and evaluate current issues.
4. Present and defend their position on a current issue.

Preparation

Make copies:

- 1) *Master Pages 8.3-8.4*, either one per two students, or else cut them out to make cards,
- 2) *Master Page 8.5*, one for each student,
- 3) five of *Master Page 8.6*.

Time

One to two 50-minute sessions.

Vocabulary

ATV, interpretation, littering, pollution, riparian

RIVER ISSUES AND YOU

TEACHER BACKGROUND INFORMATION

1. Review the information on *Master Pages 8.3- 8.6* as teacher background before proceeding with the lesson.
2. Review and discuss each of the following four issues affecting the river: As much as possible, try to present each issue without biasing or influencing the students.

Water

ATVs

Littering

Pollution

3. Divide students into groups of two or three and hand out a copy of the Jigsaw readings on *Master Pages 8.3-8.4* (see preparation) to each group. Consider reading abilities when selecting groups.
4. Assign a reading to each group and explain that they will need to summarize the content and present it to the rest of the class.
5. Have each reading group present their summary to the class.

What Do You Think

1. Hand out a copy of **What Do You Think?** on *Master Page 8.5* to each student and ask students to complete the worksheet, based on what they learned from the reading.
2. Upon completion of the worksheet, discuss each of the four issues allowing students to interject their personal opinions. Use the following questions as guidelines:

WATER

What will happen if the Santa Cruz River Valley gets as big as Tucson? Is there enough water for housing, recreation, agriculture, and the river?

ATVs

Should ATVs (All Terrain Vehicles) be allowed along the Santa Cruz River? If not, is there somewhere else they

LESSON 8 - RIVER ISSUES AND YOU

LITTERING

Is trash bad or dangerous? Why? How can trash be controlled?

POLLUTION

In what ways does pollution affect us individually or as a community?

Part 3 - Preparing for the Debate

1. Introduce the groups listed below and discuss how each group might want to use the Santa Cruz River:

Off-road vehicle users

Developers

Picnickers

Hikers

Birders

2. Divide the class into five working groups. Assign each group to represent one of the user groups on *Master Page 8.6*. Give students a copy.

3. Explain that students are to pretend that they are members of their assigned club or special interest group. The goal of the meeting is to prepare for a public hearing about the future of the Santa Cruz River.

4. In their own group, ask students to write answers to the following questions:

5. Have students prepare for the upcoming debate by creating a small presentation (a speech or an advertisement) to convince others that your group's activities at the river are important. Speak out for the cause!

What kind of people are in the group?

Do they share any common interests?

Does the culture of the members have anything to do with the group?

How do they use the river?

How often do they go there?

Do they help the river or its environment in any way?

Do they hurt it?

6. Discuss the following with the class

What are the other groups' views about the river?

How do they use the river?

From your group's point of view, are they helping or hurting?

Is your group on good terms with them?

Will they support you in a debate?

How can you work together so that everyone is happy?

Part 4 - The Debate

1. Once each group is ready, call the whole class together for a public hearing. Have each group present their position to the other groups. Allow some time for questions after each presentation. Upon completion of all group presentations, open the floor to debate.

Enrichment

- Plan a field trip to the Santa Cruz River, the Nogales Wash, or Nogales Wastewater Treatment Plant.
- Bring in a representative from the Friends of the Santa Cruz River, Anza Trail Coalition or other groups associated with the river to speak with your class.

<p>1) Water is the most important thing in the Santa Cruz River Valley. Without it, animals couldn't survive, plants wouldn't grow and people couldn't live here. People settled in the areas of the valley that had a permanent water supply.</p>	<p>2) In the 1880s things changed during a drought (a time of little rain). Big cattle drives, larger farms and the railroad (that allowed them to transport the cows to other parts of the country) also came. All this affected the water.</p>	<p>3) The invention of a new water pump in the 1940s allowed farmers to easily take the water out of the aquifer (a lake under the ground) in different areas along the river. The biggest aquifer is under Tucson with smaller ones between Green Valley and Mexico.</p>
<p>4) In Tucson, more and more people came and built houses, and the water supply dropped. To control flooding, river banks were cemented or changed. The water that normally goes back into the water table was moved out of the area.</p>	<p>5) By 1970 the river was pretty much dry on the surface and we were using up more water than was returning into the ground. Many large farms left and then in 1972, they opened the International Wastewater Treatment Plant in Rio Rico.</p>	<p>6) Today, thanks to the recycled water from the treatment plant and better management, the water is put back in the river and it flows year-round between Rio Rico and Amado. Both animals and people use and enjoy the flowing river.</p>
<p>7) But what happens as more and more people move to the Santa Cruz River Valley? Large developments in Nogales, Rio Rico and Green Valley are adding new houses every day. Stores and warehouses are built to support goods from Mexico.</p>	<p>8) What will happen if the area becomes as populated as Tucson? Is there enough water? How can we ensure that there will be? How will the increase in population effect issues such as trash and pollution?</p>	<p>9) One of the main problems along the river is trash. Picnickers, hikers and other people drop litter. Tons of litter is left when trash from Nogales and Rio Rico is carried downstream and deposited along the river after a heavy rain.</p>

<p>10) Trash that ends up in the river includes trash from Ambos Nogales (both sides of the border). An estimated 300,000 people live in Nogales, Sonora! Can we work together to educate people in both Mexico and the United States?</p>	<p>11) Pollution is a problem that involves all of the other issues (water, littering and ATVs). The most serious thing is health. Do you know that Nogales, Arizona, has one of the highest rates of lupus disease in the country?</p>	<p>12) Experts believe that groundwater or air pollution are the causes of lupus and other health problems. Poor management in Nogales, Mexico allows factories to dump their waste and toxic chemicals, which cause many problems.</p>
<p>13) With 25,000 people in Nogales, Arizona, and an estimated 300,000 people in Nogales, Mexico, more air pollution is made from uncontrolled automobile and factory exhaust, smoke from fireplaces, and dust from unpaved roads.</p>	<p>14) Disposable diapers, chemical cleaners, soap, batteries and other household, factory and medical products are thrown in the Nogales Wash daily, from both sides of the border, and end up downstream. The chemicals also leak into the ground.</p>	<p>15) ATVs (All Terrain Vehicles) include motorcycles, three-wheelers, dune buggies, etc. Many people love to drive them along and through the river. It's a lot of fun to race an ATV through the river with water splashing everywhere.</p>
<p>16) Not everyone likes ATVs though. Hikers and bird watchers are upset by the loud noise. ATV tracks make parts of the river look like a highway. ATVs disturb animals, fish and birds and can destroy their homes or habitat.</p>	<p>17) As much fun as they are, ATVs can hurt the environment. What do you think about ATVs? Is there a place for them along the river? Are there other areas that could be used for ATVs? Is there a way to control or limit their use?</p>	<p>18) Soon parts of the Santa Cruz River are to be managed by State and National Parks. Over time, cattle and ATVs will not be allowed and pollution and trash problems will improve. What will this mean for the river? What will the river look like in 10 years?</p>

WHAT DO YOU THINK?

What do you think about the following issues that affect the Santa Cruz River? Study each of the issues below. In the blank space write down your opinions. Is it a good thing? Should it be managed? How?

WHAT DO YOU THINK?

ISSUES

WATER

Water is the most important resource in the Santa Cruz River Valley. Without it, animals couldn't survive, plants wouldn't grow and people couldn't live. People must manage the water very carefully. Do you think that there is enough water in the Santa Cruz River Valley? Would there be enough if the area had as many people as Tucson?

ALL TERRAIN VEHICLES (ATVs)

ATVs are a lot of fun to race through the water, water splashing everywhere, but they hurt the natural environment. Animals and birds are disturbed. Often their homes and habitat are destroyed. As much fun as ATVs are, should they be allowed in and along the river? If not, where should they go? Should they be controlled? How?

POLLUTION

All living things require clean water and air, but what happens when people's septic tanks leak into the water? Factories and individual people sometimes dump harmful chemicals into the ground and the river and pollute the air. Is this right? Can the pollution be controlled?

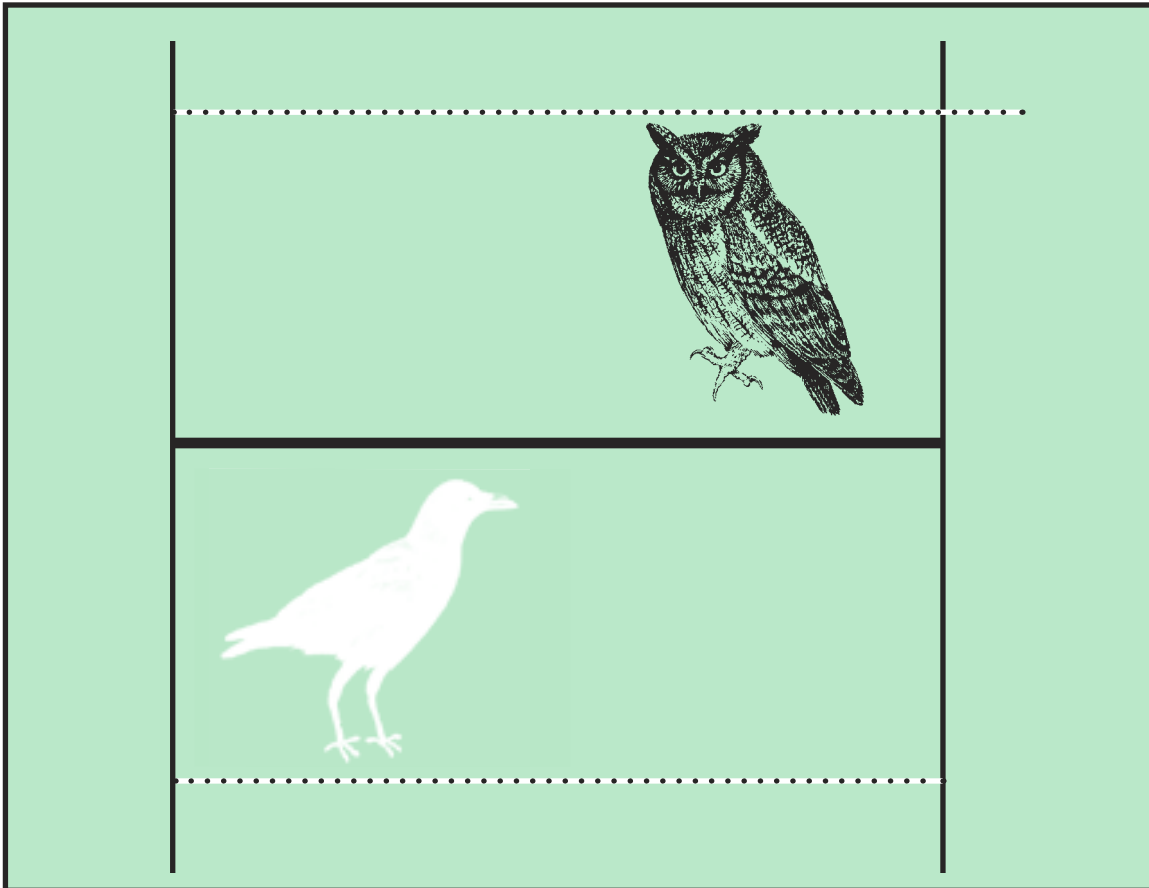
LITTERING

One of the main problems along the river is trash. Picnickers, hikers and others drop litter. Even more litter is left when trash from Nogales is carried downstream and deposited along the river after a heavy rain. An estimated 300,000 people inhabit Nogales, Sonora, alone! Is trash bad or dangerous? Why? What can you do to help control litter?

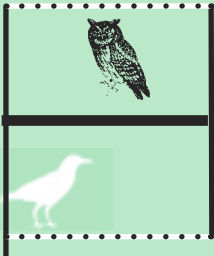
SPECIAL INTEREST GROUPS USING THE RIVER				
OFF ROAD VEHICLE USERS	DEVELOPERS	PICKNICKERS	HIKERS	BIRDERS
Use motorcycles and ATVs with unrestricted use. All other users are welcome.	Primary goal is to make a housing development. Areas of the river will be preserved as part of the scheme. Others are welcome if they respect homeowners rights and rules.	Local families like to enjoy the river. Kids enjoy wading and playing while adults like to picnic or party. All others are welcome at the river.	The Anza Trail allows hikers to walk between Tubac and Tumacácori. They enjoy the trail while learning about the natural area. Everyone who respects the natural area is welcome.	The river provides some of the best bird-watching in Arizona. Because birders need quiet, they prefer the area to have limited or no access for other user groups except for quiet observers and researchers.
<u>Problem</u> Destroys habitat and natural beauty causes noise and air pollution; disturbs others trying to enjoy the solitude of the river.	<u>Problem</u> Destroys habitat and natural beauty; access for others could become limited; may affect the water supply and its course.	<u>Problem</u> Litter; possible water pollution; possible health and safety hazards.	<u>Problem</u> Any group or activity that damages or disturbs the habitat and its natural beauty is not welcome.	<u>Problem</u> Because birders prefer a quiet environment, other "noisier" activities might be in conflict.

LESSON 9

OWLS AND CROWS



Through playing a physically active quiz game, students will demonstrate their knowledge gained of the river, the environment and local, present-day cultures.



9

LESSON OVERVIEW

Through playing a physically active quiz game, students will demonstrate their knowledge gained of the river, the environment and local, present-day cultures.

Subjects

Science, Social Studies, Physical Education

Standards

Life Science

Objectives

Students will:

1. Evaluate and answer questions related to the environment and cultures the Santa Cruz River.

Preparation

Delineate a playing area that has three parallel lines 20-30 feet apart (see the diagram this page); Make one copy of *Page 9.3* to use in the activity.

Time

15 to 30 minutes.

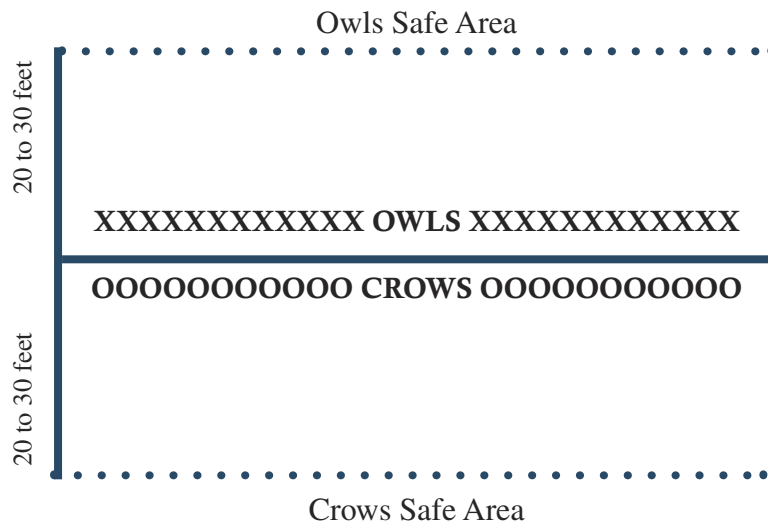
OWLS AND CROWS

TEACHER BACKGROUND INFORMATION

Owls and Crows is a fun way to enforce concepts and evaluate students' knowledge. The questions listed on *Page 9.3* are examples that pertain to the river. However, any question may be substituted, whether pertaining to this unit or to any other subject you might wish to use such as math, science, etc.

Owls and Crows is adapted with permission from *Sharing Nature with Children* by Joseph Cornell.

1. Designate and delineate a playing area with three parallel lines approximately 20-30 feet apart where students can run. (See diagram below)
2. Review themes, content and concepts learned.
3. Split the class into two teams (owls and crows) with teams facing each other on either side of the center line. Each player must have one foot within 12 inches of the center line.



LESSON 9 - OWLS AND CROWS

Explain that the owls are the wise team that always tells the truth whereas the crows can be deceptive and may lie.

4. Tell students that you will read various statements that they will have to determine to be either true or false. They will be given time to think about the answer and may not start until you say “**GO.**” If the statement is true, the owls (the wise ones) will chase the crows towards the owl “Safe Area.” If an owl touches a crow before getting to the safe zone then that crow must join the owl team for the next statement. If the statement is false, then the crows chase the owls towards the owl “Safe area,” again dragging any caught owls back to the crows team.

5. Start by demonstrating instructions with an easy statement such as “Today is Christmas” or “We live in the United States of America.” The first example is false, today is not Christmas! After giving students time to think about the question, say “Go.” (They may not run until you say so.) The crows then chase the owls towards the owl safe area, dragging any caught owls back to the crow team.

6. Using the statements listed on Master Page 9.3, read one statement (**BOLD AND CAPITALIZED**) per round, each time regrouping and discussing the correct answer. (*The answer is written below each question in italics.*) Make each statement progressively harder. Make up your own statements!



Enrichment

- Study individual species to determine why some animals survive better than others.
- Activity: “How many trees in a forest,” Project Learning Tree.
- Take a field trip to the Santa Cruz River. (Call Tumacácori National Historical Park or Friends of the Santa Cruz River for more information)

THE SANTA CRUZ RIVER FLOWS BOTH SOUTH AND NORTH (True)

The river flows from the San Rafael Valley south into Mexico, then hangs a U-turn heading north back into Arizona. Historically it flowed into the Gila River but today is dry at about Amado, with the exception of when there are heavy rains.

GROUNDWATER IS THE WATER THAT WE SEE ON THE GROUND (False)

What we see is surface water. Ground water is underground, below the surface.

POLLUTION AFFECTS WILDLIFE THAT DRINKS FROM THE RIVER (True)

Various diseases and parasites are found in polluted water that affect wildlife and humans. In 1999, for example, high ammonia content was found to kill some of the fish.

**THE SPANISH WERE THE FIRST PEOPLE TO LIVE ALONG
THE SANTA CRUZ RIVER (False)**

First came the Mammoth hunters, then the Hohokam who disappeared in the 1400s. The O'odham showed up shortly after. Archeologists claim that they don't know where the Hohokam went. The O'odham believe that the Hohokam are their ancestors.

**THE SANTA CRUZ RIVER ONCE WAS SO LARGE THAT STEAM POWERED
PADDLE BOATS WERE USED FOR TRANSPORTATION (False)**

The Santa Cruz River never has been and probably never will be big enough to carry large boats, especially not a paddle boat! This false belief comes from a real estate promotion that fooled people by publishing a picture of a paddle boat on the Santa Cruz.

**A RIPARIAN AREA IS A PLACE WHERE FRUIT IS STORED
AND LEFT UNTIL IT IS RIPE (False)**

Riparian refers to the area along a body of water. Along the Santa Cruz it is referred to as the Southwest Cottonwood-Willow Riparian Area.

**TODAY THE SANTA CRUZ RIVER FLOWS YEAR-ROUND FROM RIO RICO TO
TUMACÁCORI BECAUSE TREATED WATER IS RELEASED INTO THE RIVER
FROM THE NOGALES WASTEWATER TREATMENT PLANT (True)**

Because of large scale agriculture, the river was pretty much dry on the surface by 1970. The Nogales International Wastewater Treatment Plant in Rio Rico processes more than forty million gallons of sewage daily from both sides of the border.

**IN THE EARLY 1900s, MANY OF THE NATIVE TREES AND PLANTS WERE
CUT DOWN TO GROW COTTON AN OTHER CROPS (True)**

Better water pumps in the 1940s, allowed large-scale farms to operate. Much of the area along the river was heavily cultivated up to the 1970s.

**UNTIL RECENTLY, THE SANTA CRUZ RIVER WAS A
GREAT PLACE TO GO FISHING (False)**

Although it is true that there are three types of native fish in the Santa Cruz (Long-finned Dace, Desert Sucker and the endangered Gila Topminnow), all are very small, about the size of a minnow. There never were trout or bass.

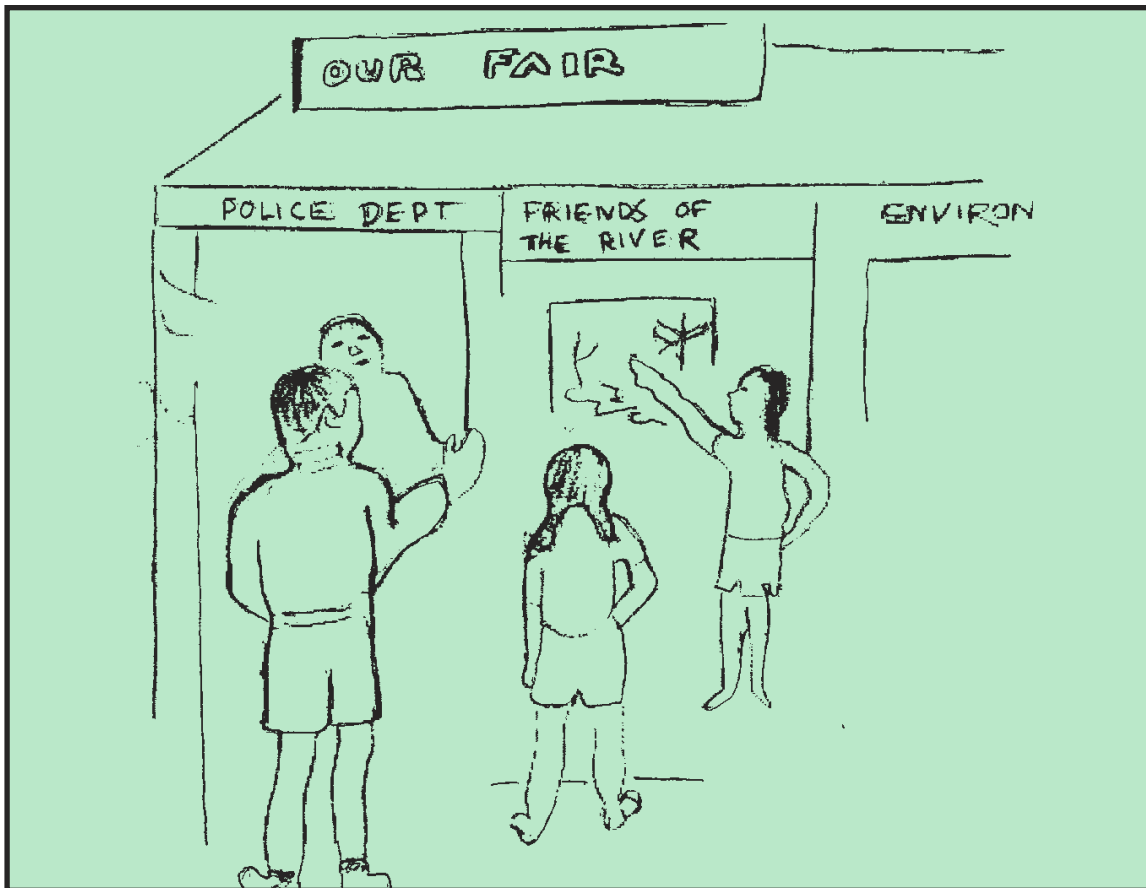
**UNCONTROLLED DEVELOPMENT ALONG THE SANTA CRUZ RIVER
CAN BE A POTENTIAL THREAT AND PROBLEM (True)**

Uncontrolled development, ATVs (All Terrain Vehicles), over-pumping of groundwater and over-population pose a potential threat to the river. If left unchecked, the Santa Cruz River Valley could become a city between Nogales and Tucson.

LESSON 9 - OWLS AND CROWS

LESSON 10

SANTA CRUZ COUNTY 2050



Students will become members of a hypothetical local agency in the year 2050. Based on knowledge gained, they will design and construct an informative display regarding their agency's concerns and the future for the area.



LESSON OVERVIEW

Students will become members of a hypothetical local agency in the year 2050. Based on knowledge gained, they will design and construct an informative display regarding their agency's concerns and the future for the area.

Subject

Reading, Science,
Social Studies

Standards

Science as Inquiry
History and Nature of
Science
Science in Personal and
Social Perspectives

Objectives

Students will:

1. Evaluate current and historical issues affecting the river and its environment.
2. Hypothesize the future.
3. Design and create an educational display.

Preparation

Make cards or copies of *Master Page 10.3*; Have a supply of cardboard (for displays), research materials (such as magazines) and miscellaneous art supplies (such as construction paper, string, tape and marking pens).

Time

One or more 50-minute sessions.

Vocabulary

agency, annually, bureau, immigrants, monitor

SANTA CRUZ COUNTY 2050

TEACHER BACKGROUND INFORMATION

Currently Santa Cruz County claims to have a population of over 39,150 (1999). With retirees immigrating to Green Valley, Tucson expanding to the south and people moving to Nogales to work with NAFTA (North American Free Trade Agreement)-related projects and business, the area is rapidly growing. Increased development and population means more employment, education and recreational opportunities. At the same time, those who have chosen rural living away from the city may not be able to keep the slow-paced lifestyle they currently enjoy. This then, poses a dilemma for our youth.

Will Santa Cruz County grow to be as large as Pima County with 803,618 people (1999)?

*What will their future be like?
How much say will they have in that future?*

What role will agencies working in the area like the National Park Service (Tumacácori National Historical Park) or Arizona State Parks (Tubac Presidio State Historic Park and Sonoita Creek Natural Area) play in the future?

These are just a few questions we must ask before planning for our future. Encourage students to think about these as well as explore creative ways they can impact the river's future.

Use this information, the descriptions on *Master Page 10.3* and other research material to help your students complete this assignment.



LESSON 10 - SANTA CRUZ COUNTY 2050

1. Divide the class into six groups. Give each group a different Agency Information Card from *Master Page 10.3*.
2. Explain that each student is to become a member of a hypothetical agency in the year 2050. The goal for their agency or bureau is to create a display depicting life in the Santa Cruz River Valley in the Year 2050. Each display will then be presented as part of a symposium or fair.
3. Using the Teacher Background Information, the descriptions on Master Page 10.3 and the questions below as references, review and discuss with your class the current situation in the Santa Cruz River Valley:

What kind of crops are grown? What kind of problems do local farmers face?

What public services does Santa Cruz County currently offer?

Would you say that people are well educated in the Santa Cruz valley?

If a friend or relative were to visit, where would you take them?

What would you do or see?

*Do you think that the health services in the Santa Cruz valley are sufficient?
How could we improve them?*

*Is the area a safe place?
How could we make it safer?*

*Is there pollution in the valley? What kinds?
What could you do to help?*

Is there a big problem with illegal immigration in the valley? Should we try to stop illegal immigrants from moving through or to the area? How?

Why is the river important? Do you think it is something worth preserving?

4. Working in small groups, assign a specific agency and give each the respective information card from Master Page 10.3. Have them use this and other research material (check the Encounters Box, library, agency contacts, etc.) in order to complete the following assignment:

Assignment

If you were to live in the Santa Cruz River Valley in the year 2050, what would it be like? Use the information on your card as well as other materials from books, magazines, talking with people and your imagination to help you predict the future.

Create a display for your agency. Make posters, activities and things to touch so that others can learn about your agency in the year 2050.

5. Hold a fair in which each group can set up its display. With the whole class listening, go from display to display giving each group time to explain its work to the class.

Enrichment

- Use all of the different displays and information to create a master plan for the future of the Santa Cruz River.
- Contact individual agencies for information and research. Invite a guest speaker from one or more agencies.

<p align="center"><u>Border Patrol</u></p> <ol style="list-style-type: none"> 1. Many immigrants come to U.S. for a better way of life. 2. Illegal immigration is a major problem, causing lost jobs, lack of service, and trash. 3. Border Patrol arrest an average of 500 illegal immigrants daily. 4. 24-hour temporary and alternative checkpoints are located on I-19 at either Peck Canyon or Agua Linda Rd. and on the road to Patagonia. There is a proposed permanent checkpoint station at Agua Linda Road. 	<p align="center"><u>Tumacácori National Historical Park</u></p> <ol style="list-style-type: none"> 1. In 1918 the National Park Service took the responsibility of maintaining and preserving this historical place. The ancient ruins of Guevavi and Calabasas were added in 1991 and part of the river was added in 2004. 2. The Mission has an average of 60,000 visitors annually. There are 4,000 students who enjoy, participate, and learn from the programs that are offered each year. 3. The park offers educational programs about the mission, its people and the river.
<p align="center"><u>Friends of the Santa Cruz River</u></p> <ol style="list-style-type: none"> 1. The Santa Cruz River is an endangered desert riparian community providing water. 95% of the local wildlife rely on the river. 2. All people living in Nogales, Santa Cruz County and Tucson use the groundwater from the Santa Cruz River. 3. As more people move to the Santa Cruz Valley there may not be enough water. 4. Friends of the Santa Cruz River monitors, educates and advocates for a healthy river. 	<p align="center"><u>Developer</u></p> <ol style="list-style-type: none"> 1. They provide new housing and shopping centers for many new residents. 2. Housing in Green Valley increases by 400 homes annually. 3. There are many golf courses in the Santa Cruz valley. Water is needed for lawns and golf courses. 4. Some developers work with local groups to help preserve the river. 5. Flooding sometimes requires developers to control the river by cementing its sides.
<p align="center"><u>City Of Nogales</u></p> <ol style="list-style-type: none"> 1. The population of Nogales, AZ, is 25,000. Nogales, Sonora, is unofficially about 400,000. 2. NAFTA has caused major growth in business. Many new Mexican-run factories were built along with the construction of transportation warehouses in Rio Rico. 3. Trash and pollution thrown into the Nogales Wash runs into the Santa Cruz River. 4. New roads are built every year to help the new businesses transport merchandise. 	<p align="center"><u>Department of Education (School)</u></p> <ol style="list-style-type: none"> 1. There are twelve elementary schools, three middle schools, four high schools, one community college, and three private schools in the county. (Nogales has more than 6,000 students.) 2. One out of ten people have a college degree: Six out of ten people have a high school degree. 3. Many agencies, such as Arizona State Parks, Friends of the Santa Cruz River, the Anza Trail Coalition and the National Park Service, offer educational programs.



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